Geotechnical Instrumentation
Geosense is one of Europe’s leading manufacturers and suppliers of instrumentation to the geotechnical, civil engineering, mining and environmental industries.

Geosense specialises in the manufacture of vibrating wire sensors which are used to measure strain, load, force, pressure and temperature and are universally recognised for their long-term stability within the harsh environment often found in civil engineering construction sites.

The company also supplies a full range of other instrumentation including inclinometers, tilt sensors, piezometers, data loggers and readouts, settlement systems, convergence monitors and extensometers.

Products are used in the following applications:
- Dam instrumentation
- Tunnel instrumentation
- Bridge instrumentation
- Deep excavation & pile testing
- Diaphragm & retaining walls
- Slope stability
- Pile testing

The company head office is located on a 1 hectare site in Suffolk, England, where there are more than 3,000 square metres of manufacturing and warehousing facilities, ensuring large stocks of products are available for immediate delivery.

Geosense is the European and MENA (Middle East and North Africa) distributor for RST Instruments of Vancouver, Canada.

Our engineers have been involved with major geotechnical and civil engineering projects throughout the world for more than 30 years.

Geosense is committed to developing new products to meet customers’ needs and has the capability to provide custom engineered solutions to site-specific problems. Many products have been designed in conjunction with clients’ input following field testing or are based on project requirements. When requested, in-depth technical support is provided and relevant staff members are available to work with clients until a solution is found.

Established in 1992, Geosense is a division of Marton Geotechnical Services Ltd.

Geosense is officially certified to ISO 9001:2000 – the internationally-recognised quality management system which covers responsibility, design control, inspection and testing, delivery, internal quality audit procedures, training and servicing. With ISO 9001:2000 certification, Geosense guarantees to customers that a quality control management system is in place and strictly adhered to.
<table>
<thead>
<tr>
<th>Category</th>
<th>Pages</th>
</tr>
</thead>
<tbody>
<tr>
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<tr>
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<td>9-11</td>
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<tr>
<td>Piezometers</td>
<td>12-13</td>
</tr>
<tr>
<td>Settlement Systems</td>
<td>14-16</td>
</tr>
<tr>
<td>Convergence Monitors &amp; Extensometers</td>
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<tr>
<td>Load, Stress &amp; Pressure</td>
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<td>Readouts &amp; Dataloggers</td>
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<tr>
<td>Environmental Products</td>
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<td>Software</td>
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<tr>
<td>Borehole Packers</td>
<td>35</td>
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<tr>
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<tr>
<td>Diver® Data Loggers</td>
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<td>42</td>
</tr>
<tr>
<td>Miscellaneous</td>
<td>43-45</td>
</tr>
</tbody>
</table>
Cutting edge MEMS (Micro-Electro-Mechanical Systems) technology for the measurement of lateral displacement.

**VERTICAL MEMS INCLINOMETER SYSTEM**

- Lateral displacement of dams & embankments
- Deflection of bridge piers and abutments
- Deflection of dam membranes, abutments and retaining walls
- Stability of tunnels, shafts, underground workings and piled foundations

**KEY FEATURES & SPECIFICATIONS**

- Probe-based microcontroller with digital calibration
- 24-bit A/D converter for digital data output
- Bluetooth™ wireless communication with Pocket PC data collector
- High strength, lightweight digital cable with Kevlar® strain relief
- Slimline 25mm diameter probe for all casing sizes

**Applications:**
- Embankments
- Dams
- Roadways
- Storage Tanks
- Landfills

**See Table for Technical Specifications**

**INCLINED MEMS INCLINOMETER**

- Cutting edge MEMS (Micro-Electro-Mechanical Systems) technology for the measurement of lateral displacement.
- Used for monitoring:
  - Direction of movement and shear-plane identification in natural and cut slopes

**KEY FEATURES & SPECIFICATIONS**

- Probe-based microcontroller with digital calibration
- 24-bit A/D converter for digital data output
- Bluetooth™ wireless communication with Pocket PC data collector
- High strength, lightweight digital cable with Kevlar® strain relief
- Slimline 25mm diameter probe for all casing sizes

**HORIZONTAL MEMS INCLINOMETER**

- For monitoring settlement or heave under structures and observation of ground movement caused by construction excavation or fill placement. A local microcontroller in the probe manages the data collection, applies precision digital calibration and transmits the data in digital format for best of class accuracy.

**Applications:**
- Embankments
- Dams
- Roadways
- Storage Tanks
- Landfills

**KEY FEATURES & SPECIFICATIONS**

- Digital precision and efficient data collection with a high-level user interface that has instant USB synchronisation with office computers
- Probe may be used with RST’s Vertical in-place MEMS inclinometer system
- Probe may be purchased with or without a system

**See Table for Technical Specifications**

---

**IMPERIAL SYSTEM ALSO AVAILABLE**
In-place MEMS inclinometers (IPI) are designed for continuous automatic monitoring where early warning of movement is essential for protecting life and equipment. A series of inclinometers are connected together and suspended inside the casing which can provide a continuous profile of the inclinometer casing which can be data logged in real time.

**Used for monitoring:** Stability adjacent to excavations; Deflection of piles & retaining walls; Dams and embankments; Landslides and slope stability

### Optional single cable BUS system
Lower cost than servo-accelerometer systems
On board electronics
Removable
High precision wheeled probe
Tilt & temperature calibration
Easily adaptable to datalogging

### KEY FEATURES & SPECIFICATIONS
- **Range:** ±15°
- **Resolution:** ±5 arc sec (±0.025mm/m (10HzBW) or better, readout technique dependent)
- **Non-linearity:** ±0.05%FS (±0.025%FS digital)
- **Sensor:** MEMS (Micro-electro-Mechanical Systems) inclinometer
- **Operating Temp:** -40 to 85°C
- **Gauge Length:** 0.5-3 m

---

### INCLINED IN-PLACE INCLINOMETER
In-place MEMS inclinometers (IPI) are designed for continuous automatic monitoring where early warning of movement is essential for protecting life and equipment. A series of inclinometers are connected together and suspended inside the casing which provides a continuous profile of the inclinometer casing which can be easily data logged in real time.

**Used for monitoring:** Deflection of dam up-stream face

Optional single cable BUS system
Lower cost than servo-accelerometer systems
On board electronics
Removable
High precision wheeled probe
Tilt & temperature calibration
Easily adaptable to datalogging

### KEY FEATURES & SPECIFICATIONS
- **Range:** ±15° from 45°
- **Resolution:** ±5 arc sec (±0.025mm/m (10HzBW) or better, readout technique dependent)
- **Non-linearity:** ±0.1%FS
- **Sensor:** MEMS (Micro-electro-Mechanical Systems) inclinometer
- **Operating Temp:** -40 to 85°C
- **Gauge Length:** 0.5-3 m

---

### HORIZONTAL IN-PLACE INCLINOMETER
In-place MEMS inclinometers (IPI) are designed for continuous automatic monitoring where early warning of movement is essential for protecting life and equipment. A series of inclinometers are connected together inside the casing which can provide a continuous profile of the inclinometer casing which can be easily data logged in real time.

**Used for monitoring settlement or heave in:** Tank foundations; Embankments and dams; Landfills

Optional single cable BUS system
Lower cost than servo-accelerometer systems
On board electronics
Removable
High precision wheeled probe
Tilt & temperature calibration
Easily adaptable to datalogging

### KEY FEATURES & SPECIFICATIONS
- **Resolution:** ±5 arc sec (±0.025mm/m (10HzBW) or better, readout technique dependent)
- **Non-linearity:** ±0.1%FS
- **Sensor:** MEMS (Micro-electro-Mechanical Systems) inclinometer
- **Operating Temp:** -40 to 85°C
- **Gauge Length:** 0.5-3 m
The RST Digital MEMS Inclinometer Spiral Sensor is used to determine down-hole helical deformation of installed inclinometer casing. Spiralling is typically of concern only in deep installations, however, should poor installation be suspected or installed spiral of interest, measurement of the installed groove azimuth can be carried out with this instrument. Operation is similar to an inclinometer, using the same cable and readout instruments, however it is necessary to read only one groove set, and not take a 180 degree second reading set.

Compatible with RST’s Digital Inclinometer System. Simply connect the probe to the reel's connector and get spiral readings on the spot. No additional software required; The Inclinalysis™ software used for the digital inclinometer system is also used to process the spiral data. Compact and lightweight design.

### Key Features & Specifications

<table>
<thead>
<tr>
<th>Material</th>
<th>Stainless steel</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weight</td>
<td>1kg</td>
</tr>
<tr>
<td>Overall length</td>
<td>570mm</td>
</tr>
<tr>
<td>Gauge length</td>
<td>400mm</td>
</tr>
<tr>
<td>Accuracy</td>
<td>± 0.25% F.S.</td>
</tr>
<tr>
<td>Resolution</td>
<td>0.01°</td>
</tr>
</tbody>
</table>

**Inclinometer Casing SS - Snap Seal**

Snap Seal (SS) inclinometer casing is manufactured from virgin ABS material and flush coupled and offers the ultimate in quality and accuracy. This is obtained through the shape and the machining process of the keyways to provide minimum spiral deviation. Telescopic sections are available where vertical heave or settlement is anticipated to exceed 1-2%. Available in 85mm heavy duty version for rock fills.

Applications include: Slopes & landslides; Diaphragm walls; Sheet pile walls; Retaining walls; Dams; Tunnels; Subsidence & heave.

Flush coupled with Quick Connect joints and O-ring seal provides rapid and easy installation especially in deeper holes through the elimination of glue, rivets and tape. Telescopic sections are available where vertical heave or settlement is anticipated to exceed 1-2%.

Colour: Orange/Red

### Key Features & Specifications

<table>
<thead>
<tr>
<th>Diameter</th>
<th>70mm OD x 59mm ID</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overall length</td>
<td>85mm OD x 73mm ID</td>
</tr>
<tr>
<td>Casing Length</td>
<td>1.5 or 3m</td>
</tr>
<tr>
<td>Casing Weight</td>
<td>1.27kg/m</td>
</tr>
<tr>
<td>Material</td>
<td>ABS Plastic</td>
</tr>
<tr>
<td>Groove spiral</td>
<td>&lt;0.3 deg/3m</td>
</tr>
</tbody>
</table>

**Inclinometer Casing EC - External Coupler**

EC inclinometer casing is manufactured using high tolerance extrusion and provides a cost effective alternative to Snap Seal. It is joined using an external coupler in combination with glue, rivets and tape to seal against water or grout ingress and is suitable for all types of inclinometer systems.

Applications include: Slopes & landslides; Diaphragm walls; Sheet pile walls; Retaining walls; Dams; Tunnels; Subsidence & heave.

EC inclinometer casing has internally extruded keyways offering high accuracy together with the flexibility of being able to cut lengths on site and join using the external coupler. Telescopic sections are available where vertical heave or settlement is anticipated to exceed 1-2%.

Colour: Green

### Key Features & Specifications

| Casing Diameter  | 70mm OD x 60mm ID |
| Coupler Diameter | 80mm OD x 70mm ID |
| Coupler Length   | 140mm             |
| Casing Length    | 1.5 or 3m         |
| Casing Weight    | 1kg/1m            |
| Material         | ABS Plastic       |
| Groove spiral    | <0.5 deg/3m       |

Aluminium casing also available: Pipes - Length 3m, Nominal OD 58mm; Coupling - Length 30cm, OD 62.5mm.
INCLINOMETER CASING ANCHORS & ACCESSORIES

Inclinometer Casing Anchors are fixed to the bottom of the casing prior to installation to prevent uplift, usually due to buoyancy forces of water or grout. As soon as the anchor exits the bottom opening of the drill rod/borehole, the spring-loaded arms of the anchor are automatically extended to grip the borehole wall.

Anchors available for 70 and 85mm casing in both snap seal and glue and socket coupling styles
Grouting version of the anchor available
Magnetic targets can also be integrated

GENERAL CASING ACCESSORIES:
- Repair couplings
- Caps
- Grout Caps
- Suspension Caps
- Alignment Tool
- Anti-Flotation Tool

SLIP INDICATOR SYSTEM

An economical method of determining within a soil mass the location of a zone where movement is occurring.

A flexible slip indicator pipe with base plate is inserted into the base of a borehole and surrounded with sand. When lateral movement of the soil occurs, the flexible tube becomes deformed in the zone of movement.

Indicator probes attached to a length of support rope are used to determine the zone of movement.

Can be installed in 70mm boreholes or larger
Cost-effective way to measure movement in soils
Simple to install
No readout required
Probes can be made to suit individual requirements

KEY FEATURES & SPECIFICATIONS

- Magnetic targets can also be integrated
- Anchors available for 70 and 85mm casing in both snap seal and glue and socket coupling styles
- Grouting version of the anchor available
The Portable MEMS tiltmeter uses a MEMS sensor to measure tilt in either one or two axial planes perpendicular to the surface of the base plate. It has a demountable sensor and is designed for applications where a large number of measuring points are to be observed.

### Applications:
- Monitor tilt of retaining and building walls
- Tilt of concrete dams
- Landslide monitoring & ground subsidence
- Bridge Piers

### Key Features & Specifications
- Uniaxial or biaxial sensors available for horizontal or vertical applications
- Lightweight & easy to use
- Datalogger compatible; High accuracy & repeatability
- Operational range & temperature coefficients exceed that of bubble sensor devices

---

The RST Submersible Tiltmeter provides precision real-time remote monitoring of tilt of submerged structures.

It consists of a MEMS sensor and electronics mounted inside a rugged waterproof enclosure machined from solid stainless steel bar, providing extreme endurance for long-term, high-pressure underwater service. The cable entry is a submarine grade connector, which can be connected underwater and provides watertight performance at depths to 2,000m, making it an excellent choice for monitoring dams & off-shore structures.

### Key Features & Specifications
- Uniaxial or biaxial sensors available
- Horizontal or vertical applications
- Analog, digital & frequency outputs available
- Datalogger &/or manual readout compatible
- NEMA 4X (IP-65) weatherproof enclosure
- Signal outputs: Voltage, 6-20mA, Digital, Digital BUS, Frequency

---

The IN-PLACE MEMS Tiltmeter is used to measure tilt in either one or two axial planes perpendicular to the surface of the base plate. Designed to be permanently installed to provide long-term observation with maximum resolution and sensitivity and for manual or remote data acquisition.

### Applications include:
- Monitoring tilt of retaining & building walls
- Tilt of concrete dams; Structural load testing; Landslide monitoring; Building safety along adjacent excavations; Observation of benches & berms in open pit mines; Bridge pier monitoring; Ground subsidence

### Key Features & Specifications
- Uniaxial or biaxial sensors available
- Horizontal or vertical applications
- Analog, digital & frequency outputs available
- Datalogger &/or manual readout compatible
- NEMA 4X (IP-65) weatherproof enclosure
- Signal outputs: Voltage, 6-20mA, Digital, Digital BUS, Frequency

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The Submersible MEMS Tiltmeter provides precision real-time remote monitoring of tilt of submerged structures.

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### Key Features & Specifications
- Uniaxial or biaxial sensors available
- Horizontal or vertical applications
- Analog, digital & frequency outputs available
- Datalogger &/or manual readout compatible
- NEMA 4X (IP-65) weatherproof enclosure
- Signal outputs: Voltage, 6-20mA, Digital, Digital BUS, Frequency

---
**MEMS TILT BEAM**

For the measurement of differential movements in structures in the following applications:

- Monitoring the effect of excavation and diaphragm walling adjacent to buildings and other structures.
- The movement of tunnels and their effect on adjacent structures.
- Structures being underpinned & compensation grouted
- The deflection of bridges and beams under load
- Railway track monitoring

**KEY FEATURES & SPECIFICATIONS**

- Simple construction with no moving parts to damage
- Simple to install on any structure & easy to use
- Beams can be linked together to monitor movement over long distances
- Signal outputs: Voltage, 6-20mA, Digital, Digital BUS, Frequency
- Easily adaptable to datalogging

**RXTX TELEPENDULUM SYSTEM**

For monitoring and measuring lateral movements in structures including:

- Relative displacement between the base and top of a dam or between the dam and its foundation
- Structural and foundation movements of tall buildings
- Horizontal displacement of bridges, rock and building foundations

**KEY FEATURES & SPECIFICATIONS**

- Precise optoelectronic detection system for monitoring x, y and z axes
- Available as both direct & inverted systems
- Local microprocessor for real-time recording
- Weatherproof housing
- On-board data protection system
- Ability to connect to several types of dataloggers

**PENDULUM**

Simple and reliable systems used to monitor internal lateral deformations of concrete dams, dam foundations and abutments, tall industrial buildings and bridge piers.

- The direct pendulum (plumbline) consists of a stainless steel wire attached to a fixed point at the top of a structure, a weight and a tank of damping fluid to damp movements. Displacements relative to the wire are measured by optical reading stations and telependulum.
- The inverted pendulum uses the same readout units but the wire is anchored in the foundation.

**KEY FEATURES & SPECIFICATIONS**

- Simple, reliable and accurate for long-term use
- Available as both direct & inverted systems
- Inverted pendulum measures absolute deformation of structure and can be used to monitor movement during construction; also as reference for geodetic surveying
- Telependulum for remote monitoring and datalogging

**AVAILABLE ITEMS**

- Direct pendulum c/w tensioning weight & tank
- Inverted pendulum
- Stainless steel wire for pendulums
- Portable co-ordinator
- RxTx telependulum
Metallic Time Domain Reflectometry is a simple and economical way of detecting and interpreting rock and soil mass response to underground and surface mining. It can be used effectively to locate rock and soil mass movements. Used for monitoring rock and soil movement, monitoring subsidence above abandoned underground mines and high wall slope monitoring in open pit mines.

**KEY FEATURES & SPECIFICATIONS**

- **Range**
  - ±3.0 degrees
  - ±10 degrees
- **Resolution**
  - 1 arc sec
  - 2 arc sec
- **Repeatability**
  - ±0.001°
  - ±0.006°
- **Beam Length**
  - 1, 2 or 3 meters
- **Material**
  - Fibreglass, aluminium or carbon fibre

Simple construction with no moving parts to damage. Simple to install on any structure & easy to use. Good long term stability. Can be linked together to monitor movement over long distances. Manual readout or easily adapted to datalogging.

**TIME DOMAIN REFLECTOMETRY**

Economical installation and data acquisition costs. Ability to monitor deformation along the entire length of the borehole.
Vibrating Wire Piezometers are used for accurate measurement of pore water pressure in fully or partially saturated soil and rock.

**Applications:** Pore pressure measurements in foundations, embankments retaining walls and dams

**Fluid pressures in hydro-fracture & pump tests**

**Stability monitoring of tunnels, pipelines, mines and other underground engineering works**

**Draw down and recovery testing in pumping and observation wells**

**KEY FEATURES & SPECIFICATIONS**

<table>
<thead>
<tr>
<th>Standard Ranges kPa</th>
<th>70, 173, 345, 518, 690, 1034, 2068, 3447, 5171, 6895 kPa</th>
</tr>
</thead>
<tbody>
<tr>
<td>Over-range</td>
<td>Min twice rated pressure</td>
</tr>
<tr>
<td>Resolution</td>
<td>0.025% F.S. (min)</td>
</tr>
<tr>
<td>Accuracy</td>
<td>±0.1% F.S.</td>
</tr>
<tr>
<td>Non-linearity</td>
<td>&lt;0.5% F.S.</td>
</tr>
<tr>
<td>Temp range</td>
<td>-20°C to +80°C</td>
</tr>
</tbody>
</table>

**VIBRATING WIRE TECHNOLOGY**

**STRAIN GAUGE PIEZOMETER**

The strain gauge piezometer series of transducers/transmitters is specifically designed to meet the rigorous environments encountered in level measurement applications. These transmitters provide repeatable, precision depth measurements under the most adverse conditions.

**Applications:**

- Ground water and surface water monitoring;
- Well monitoring; Percolation tests; Hydrostatic pressure; Site remediation; Deep aquifer measurement; Sea water depth; Drawdown;
- Dewatering; Dams; Slug tests

**HIGH STATIC ACCURACY AND REPEATABILITY GUARANTEES REPRODUCIBLE MEASUREMENTS**

Welded 316 SS construction for demanding environments

(Optional titanium construction for corrosive environments)

Full temperature compensation provides accurate data over extreme excursions

Output: Voltage, 4-20mA

**KEY FEATURES & SPECIFICATIONS**

<table>
<thead>
<tr>
<th>Pressure Range</th>
<th>345 to 6895kPa</th>
</tr>
</thead>
<tbody>
<tr>
<td>excitation</td>
<td>9-30 VDC</td>
</tr>
<tr>
<td>Static Accuracy (%FS)</td>
<td>±0.1% - ±1% (depending on model)</td>
</tr>
<tr>
<td>Thermal Error (%FS)</td>
<td>0.05 - 0.1 (depending on model)</td>
</tr>
<tr>
<td>Comp Temp Range</td>
<td>10-50°C (depending on model)</td>
</tr>
<tr>
<td>Temp range</td>
<td>-10°C to 60°C</td>
</tr>
</tbody>
</table>

**GROUTABLE MULTI-POINT PIEZOMETER STRING**

Allows multiple vw piezometers to be simply and reliably installed in a single borehole and be connected to a tough urethane jacketed Kevlar® reinforced single cable which prevents vertical void channels. Used primarily where multi-zone monitoring is needed at single locations. No conductors are shared ensuring the independent reliability of each sensor reading.

**Applications:**

- Earth fill dams & embankments;
- Slope stability; Pressures behind retaining & diaphragm walls; Pore pressures during fill or excavation.

**KEY FEATURES & SPECIFICATIONS**

<table>
<thead>
<tr>
<th>Standard Ranges kPa</th>
<th>70, 173, 345, 518, 690, 1034, 2068, 3447, 5171, 6895 kPa</th>
</tr>
</thead>
<tbody>
<tr>
<td>Over-range</td>
<td>Min twice rated pressure</td>
</tr>
<tr>
<td>Resolution</td>
<td>0.025% F.S. (min)</td>
</tr>
<tr>
<td>Accuracy</td>
<td>±0.1% F.S.</td>
</tr>
<tr>
<td>Non-linearity</td>
<td>&lt;0.5% F.S.</td>
</tr>
<tr>
<td>Temp range</td>
<td>-20°C to +80°C</td>
</tr>
</tbody>
</table>
CASAGRANDE PIEZOMETER

Simple and economic measurement of groundwater pressures in soil and rock.

Applications:
- Dams, reservoirs & embankments
- Slope stability

Groundwater levels for dewatering & drainage
- Groundwater sampling
- Permeability testing
- Contaminated soil monitoring

Water level measurements are normally taken using a water level meter (dipmeter) or in the case of artesian pressure a Bourdon pressure gauge is attached to the top.

KEY FEATURES & SPECIFICATIONS

<table>
<thead>
<tr>
<th>POROUS PLASTIC ELEMENT</th>
<th>CERAMIC ELEMENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Material</td>
<td>Material</td>
</tr>
<tr>
<td>HDPE</td>
<td>Alumo Silicate</td>
</tr>
<tr>
<td>Mean Pore Size</td>
<td>60 microns</td>
</tr>
<tr>
<td>Permeability</td>
<td>3x 10^-4 m/s</td>
</tr>
<tr>
<td>Porosity</td>
<td>35%</td>
</tr>
<tr>
<td>Permeability</td>
<td>3x 10^-4 m/s</td>
</tr>
<tr>
<td>Porosity</td>
<td>45%</td>
</tr>
</tbody>
</table>

PNEUMATIC PIEZOMETER

RST pneumatic piezometers utilise a direct reading pneumatically-operated diaphragm, making operation simple while ensuring long-term stability and high accuracy at low cost.

Applications:
- Measurement of water pressures in soil and rock
- Stability monitoring of foundations, earth fill dams & embankments
- Slope stability investigations
- Monitoring water levels in wells & standpipes
- Monitoring pressures behind retaining & diaphragm walls

More than 25 years proven, long-term reliability & accuracy & more than 50,000 installations worldwide

Lowest displacement available pneumatic piezometer available

Available in standard & mini versions

No internal metal parts – components are corrosion-resistant nylon

Flow or non-flow methods supported

Compatible with most brands of readout

KEY FEATURES & SPECIFICATIONS

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Sensitivity</td>
<td>0.1%F.S.</td>
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<tr>
<td>Displacement</td>
<td>0.002cc</td>
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<tr>
<td>Materials</td>
<td>Nylon 12 with EP diaphragm</td>
</tr>
<tr>
<td>Accuracy</td>
<td>±0.25% F.S.</td>
</tr>
<tr>
<td>Range</td>
<td>0-200kPa/ 0-200psi</td>
</tr>
<tr>
<td>Repeatability</td>
<td>±0.35kPa/ ±0.05psi</td>
</tr>
</tbody>
</table>

WATER LEVEL METER

For the measurement of water level within soil and rock.

Applications: Ground investigation
- Hydrogeological studies
- Groundwater lowering and control
- Temporary & permanent drainage systems

Stability investigations for slopes & embankments
- In-situ permeability tests
- Pumping tests
- Environmental studies

Simple and easy to use with audible and visual signals

Slimline 14mm probe (minimum displacement)

High accuracy

Easy to clean

Robust

Available with temperature readout option

KEY FEATURES & SPECIFICATIONS

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
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</thead>
<tbody>
<tr>
<td>Probe Diameter</td>
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</tr>
<tr>
<td>Probe Length</td>
<td>150mm</td>
</tr>
<tr>
<td>Tape Type</td>
<td>Steel mm markings</td>
</tr>
<tr>
<td>Tape Lengths</td>
<td>30, 50,100,150, 200, 250, 300 metres</td>
</tr>
<tr>
<td>Special lengths on request</td>
<td></td>
</tr>
<tr>
<td>Audible Indicator</td>
<td>88 dB (A) buzzer</td>
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</tbody>
</table>
The GEO-XM™ settlement system is used typically to monitor settlement and heave in foundations, excavations, embankments and dams as well as behind retaining structures such as diaphragm walls and sheet piles. It can also be used in tunnels and shafts. Settlement is identified by the depth/position at which settlement has occurred as well as measurement of the total amount of settlement.

The GEO-XM™ system comprises a reed switch probe and a series of magnetic targets positioned on the outside of the flush jointed access or inclinometer tube. For soils where settlement is expected, telescopic joints or an outer corrugated pipe can be installed to de-bond the inner pipe from the surrounding grout/soil which is subject to settlement. For other ground types the magnetic target rings can just be attached directly to telescopic joint couplings.

Applications: Foundations; Excavations; Dams; Embankments; Sheet piles; Retaining walls; Slurry walls; Tunnels & shafts

**KEY FEATURES & SPECIFICATIONS**

### INCLINOMETER CASING
- **Casing OD**
  - 70mm
  - 85mm
- **Casing ID**
  - 59mm
  - 73mm
- **Casing Length**
  - 1.5 or 3m
  - 1.5 or 3m
- **Material**
  - ABS
  - ABS
- **Groove Spiral**
  - <0.005 rad/3m
  - <0.005 rad/3m

### ACCESS TUBING
- **Casing OD**
  - 33mm
- **Casing ID**
  - 25mm
- **Casing Length**
  - 1.5 or 3m
- **Material**
  - PVC

### ACCESSORIES
- **Coupling**
  - 42, 80, 100mm
- **Material**
  - PP, PVC
- **Length**
  - 3 or 50m coil
- **Magnetic targets**
  - 90, 117mm
- **Reed switch probe**
  - 30, 50, 100, 150, 200m

### CORRUGATED PIPE
- **Pipe OD**
  - 42, 80, 100mm
- **Pipe ID**
  - 35, 71, 91mm
- **Length**
  - 3 or 50m coil
- **Material**
  - PP, PVC

### ACCESS TUBING TELESCOPIC SECTION
- **Telescopic section OD**
  - 42mm
- **Telescopic section ID**
  - 35mm
- **Length**
  - 500mm
- **Range**
  - 200mm
- **Material**
  - PVC

### INCLINOMETER TELESCOPIC SECTION
- **Telescopic Section**
  - 70mm
  - 85mm
- **Compressed Length**
  - 508mm
  - 508mm
- **Extended Length**
  - 660mm
  - 660mm
- **Range**
  - 152mm
  - 152mm
- **Material**
  - ABS
  - ABS
- **Groove Spiral**
  - <0.005 rad/3m
  - <0.005 rad/3m

### REED SWITCH PROBE
The reed switch probe is used to determine the location of magnetic sensors in magnetic settlement systems. When the reed switch passes through a magnetic field it closes, completing a circuit, and a buzzer is activated. The elevation of the magnet target is read directly from the tape.

**KEY FEATURES & SPECIFICATIONS**

- Slimline probe
- High accuracy
- Simple to use
- Easy to clean
- Robust construction

### PROBE SPECIFICATIONS
- **Probe Diameter**
  - 14mm
- **Probe Length**
  - 150mm
- **Probe Material**
  - Austenitic Stainless Steel
- **Tape Type**
  - Steel mm markings
- **Tape Width**
  - 9.5mm
- **Tape Coating**
  - Polyethylene
- **Tape Lengths**
  - 30, 50, 100, 150, 200m
  - Special lengths on request

**GEO-XM™ MAGNETIC SETTLEMENT SYSTEMS**
ROD SETTLEMENT SYSTEM

Single point devices used to monitor sub-surface settlement or heave of ground. The system comprises a series of inner and outer rods together with plates when positioned on ground before fill or Borros type anchors when used in boreholes.

Applications: A datum for standard surface settlement plates, negating the need for costly survey; Settlement monitoring under fills, preloads and embankments; Bottom heave in excavations; Settlement and rebound associated with tunneling; Heave as a result of grouting

Simplicity of operation
Uses locally-sourced common steel riser pipe
Low cost

LIQUID SETTLEMENT SYSTEM

The vibrating wire liquid settlement system is designed for remote measurement of settlement or heave in soils and manmade structures. A vibrating wire pressure sensor is attached to a settlement plate located at the point of settlement. The sensor is connected via two liquid-filled tubes, extending laterally, to a reservoir located on stable ground. The sensor measures the hydraulic head of liquid between the sensor and reservoir locations. A vented cable runs from the sensor to a remote readout location.

Standard configuration includes one reservoir for each cell. Where settlements of two or more points long the same monitoring profile are of interest multi-position reservoirs are available
Also available as a Pneumatic Liquid Settlement Monitoring System. Similar to the VW system, but it uses a pneumatic pressure sensor. A reservoir is mounted at a higher elevation than the sensor in an area not subject to settlement

<table>
<thead>
<tr>
<th>Settlement Cell Width</th>
<th>150mm</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cell Height</td>
<td>550mm</td>
</tr>
<tr>
<td>Accuracy</td>
<td>±0.3mm</td>
</tr>
<tr>
<td>Ranges</td>
<td>50mm, 100mm</td>
</tr>
<tr>
<td>Water height</td>
<td>&lt;100mm</td>
</tr>
<tr>
<td>Reference Cell Size</td>
<td>162mmx550mm</td>
</tr>
</tbody>
</table>

PRECISION LIQUID SETTLEMENT SYSTEM

The liquid settlement system is an automated multi-cell settlement monitoring system used to monitor heave and/or settlement where a high degree of accuracy is required. The system configuration is very versatile, limited only by local conditions and site specifications.

Applications:
Monitoring structures that may be exposed to settlement as a result of nearby construction, tunneling or natural phenomena
Monitoring compensation grouting

Reference cell ensures a common liquid level, removes cell inter-dependency and allows cell isolation
De-aired fluid keeps the continuity of fluid consistent
Surfactant reduces the adverse effects of surface tension
Temperature compensation stabilises temperature effects on fluid density

<table>
<thead>
<tr>
<th>Settlement Cell Width</th>
<th>150mm</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cell Height</td>
<td>550mm</td>
</tr>
<tr>
<td>Accuracy</td>
<td>±0.3mm</td>
</tr>
<tr>
<td>Ranges</td>
<td>50mm, 100mm</td>
</tr>
<tr>
<td>Water height</td>
<td>&lt;100mm</td>
</tr>
<tr>
<td>Reference Cell Size</td>
<td>162mmx550mm</td>
</tr>
</tbody>
</table>
HYDROSTATIC PROFILER

A portable device designed to measure profiles of heave and settlement beneath structures. A sensitive vibrating wire pressure sensor is located in a cylindrical metal housing which is pulled through a buried pipe. The sensor is connected, via a liquid-filled tube, to a reservoir located on stable ground. The sensor measures the hydraulic head between the reservoir and its location.

Applications: Beneath fills, embankments, roadways, storage tanks, structures etc

Independent measurements of settlement can be made at closely spaced intervals providing a detailed profile of differential settlements over a wide area.

The sensor is vented so that barometric pressure fluctuations have no effect on readings.

KEY FEATURES & SPECIFICATIONS

<table>
<thead>
<tr>
<th>Feature</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Range*</td>
<td>7m</td>
</tr>
<tr>
<td>Resolution</td>
<td>0.025%FS</td>
</tr>
<tr>
<td>Sensor Accuracy*</td>
<td>0.1%FS</td>
</tr>
<tr>
<td>Temp Range</td>
<td>-20°C to +80°C</td>
</tr>
<tr>
<td>Length x Diameter</td>
<td>203 x 35mm (probe)</td>
</tr>
<tr>
<td></td>
<td>178 x 610mm (reel)</td>
</tr>
</tbody>
</table>

*Other ranges available on request; Total system accuracy subject to site specific variables.
The GEO-XB™ rod type extensometer range is used to measure and locate settlement, displacement and deformation in soil and rock. It consists of a reference head and one or more in-hole anchors each of which is placed at a known depth and connected to the reference head by either a rigid or flexible rods running inside sleeves which keep the rods de-bonded from the grout.

As the soil or rock deforms the anchors’ positions change and the relative movement can be measured in the reference head. The magnitude, distribution, rate and acceleration of deformation can be accurately measured at the reference head.

**APPLICATIONS**

- Deformation of dam abutments & foundations
- Ground movement around tunnels & mines
- Ground movement behind retaining walls & sheet piles
- Fracturing in roofs of underground caverns
- Deformation of concrete piles
- Settlement & heave in soft soil excavations

**REFERENCE HEAD TYPES**

- Flanged
- Flangeless

**MEASUREMENT OPTIONS**

- Mechanical
  - Reading is carried out using a dial indicator or depth micrometer
- Electrical
  - Reading is carried out using an electrical sensor
- Combination
  - Reading can be carried out both mechanically and electrically

**SENSORS**

- Vibrating wire displacement gauge
- Linear Potentiometer
- Linear Variable Displacement Transducer (LVDT)

All of the above can be used in combination with a mechanical system.

**RODS**

- Rigid type - 6mm stainless steel M6 threaded flush coupled joints available in 1,2,3m lengths
- Flexible type - 5mm GRP in lengths up to 400m

**SLEEVES**

Available in rigid PVC with flush threaded joints or flexible nylon with external couplers.

**ANKORS**

- Borros
- Snap Ring
- Groutable
- Hydraulic

**KEY FEATURES & SPECIFICATIONS**

- Quick & easy to install in uphole applications
- Easy access & adjustment to sensors
- Mechanical & electrical combination possible
- Integral grout holes in head make grouting easy
- Accurate & reliable

<table>
<thead>
<tr>
<th>Description</th>
<th>Ranges</th>
</tr>
</thead>
<tbody>
<tr>
<td>Manual</td>
<td>0-150mm</td>
</tr>
<tr>
<td>Vibrating Wire</td>
<td>25, 50, 75, 100, 150, 200mm</td>
</tr>
<tr>
<td>Linear Potentiometer</td>
<td>10, 20, 30, 50, 100, 125, 150mm</td>
</tr>
<tr>
<td>LVDT</td>
<td>25, 50, 75, 100, 150mm</td>
</tr>
</tbody>
</table>

**VW Specification**

<table>
<thead>
<tr>
<th>Excitation</th>
<th>Pfuck or swept frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Thermistor</td>
<td>3k Ohms at 25°C</td>
</tr>
<tr>
<td>Over-range</td>
<td>Range +/-20%</td>
</tr>
<tr>
<td>Resolution</td>
<td>0.025%/FSO min</td>
</tr>
<tr>
<td>Accuracy</td>
<td>&lt;0.5%/FSO</td>
</tr>
<tr>
<td>Operating Range</td>
<td>-20°C to +50°C</td>
</tr>
<tr>
<td>Typical Range</td>
<td>3000-1600Hz</td>
</tr>
</tbody>
</table>
RST FLEXIBLE MPBX

Used to measure and locate settlement, displacement and deformation in soil and rock. Applications same as the extensometers featured previously.
Flexible extensometers comprise pre-set lengths of fibreglass which are coiled at the factory and shipped ready for installation. It is lightweight making it easier to handle and install and less costly to ship. On-site assembly time is minimal and installation simplified.

KEY FEATURES & SPECIFICATIONS

- Accuracy at low cost
- Unit supplied completely assembled and sealed, ready for installation
- Light and easily handled for quick and simple installation
- Compact design for installation in boreholes of minimum size (up to 6 rods can be accommodated in a 75mm borehole)
- Limited transverse shear accommodated without jamming of rods

<table>
<thead>
<tr>
<th>Measurement Points</th>
<th>1 to 6</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rod Length</td>
<td>2 to 100 metres</td>
</tr>
<tr>
<td>Adjustment Range</td>
<td>±60mm</td>
</tr>
<tr>
<td>Rod Material</td>
<td>GRP, Carbon Fibre, Steel</td>
</tr>
<tr>
<td>Sleeve Material</td>
<td>Polyethylene/ Nylon</td>
</tr>
<tr>
<td>Rod Diameter</td>
<td>5mm</td>
</tr>
<tr>
<td>Borehole Diameter</td>
<td>25-75mm</td>
</tr>
</tbody>
</table>

MEASURING ANCHORS

Measuring anchors combine a rock bolt and an extensometer and are used to determine load exerted on rock bolts.
Within an anchor body, four mini extensometer rods have anchor points at different locations. Changes of length or compression between each anchor point can be measured using a mechanical dial gauge, VW, transducer or potentiometer.

Applications: Tunnels, inc NATM; Mines; Dams; Bridge abutments; Retaining walls; Rock formations; Foundations

KEY FEATURES & SPECIFICATIONS

- Simple & robust construction
- Replaces system anchor
- No extra borehole required
- Automatic data acquisition possible

<table>
<thead>
<tr>
<th>Lengths</th>
<th>2,3,4,6 metres</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anchor points</td>
<td>4</td>
</tr>
<tr>
<td>Capacity</td>
<td>250 kN</td>
</tr>
<tr>
<td>Maximum diameter</td>
<td>38mm</td>
</tr>
<tr>
<td>Min borehole diameter</td>
<td>50mm</td>
</tr>
<tr>
<td>Range</td>
<td>±10mm</td>
</tr>
<tr>
<td>Resolution</td>
<td>0.01mm</td>
</tr>
<tr>
<td>Accuracy (VW)</td>
<td>&lt;0.5%FS</td>
</tr>
</tbody>
</table>

INSTRUMENTED ROCK BOLTS

For long or short-term monitoring of strata loads. A vibrating wire strain gauge is inserted into a short length of standard threaded rockbolt or rebar which can be connected to a longer length of the same material for installation in the normal manner, ensuring the strain gauge remains within the loaded part of the rockbolt. The gauge is read by a portable probe, connected to a strain gauge.

Used to measure loads in: Ungrouted rockbolts; Tiebacks used to stabilise ground around excavations & supporting retaining walls

KEY FEATURES & SPECIFICATIONS

- Robust – requires no special handling
- Recessed VW gauge can be left unattended for long-term monitoring
- The strain gauge is located along the axis of the rockbolt and so is not affected by bending of the bolt
- Long-term stability and accuracy

<table>
<thead>
<tr>
<th>Standard Range</th>
<th>2500µε</th>
</tr>
</thead>
<tbody>
<tr>
<td>Resolution</td>
<td>0.5µε</td>
</tr>
<tr>
<td>Accuracy</td>
<td>±0.25% F.S.</td>
</tr>
<tr>
<td>Linearity</td>
<td>±0.5% F.S.</td>
</tr>
<tr>
<td>Temp Range</td>
<td>-20 to +80°C</td>
</tr>
<tr>
<td>Bolt Sizes</td>
<td>25mm, 8 gauge rebar &amp; larger</td>
</tr>
<tr>
<td>Length</td>
<td>300mm (standard)</td>
</tr>
</tbody>
</table>
convergence monitors & extensometers

**JOINTMETER**

Developed to monitor joints of mass concrete structures.

The instrument consists of two parts - a socket and the main body with a waterproof vibrating wire sensing gauge.

- Used to monitor:
  - Joints of concrete arch, gravity and buttress dams
  - Joints of concrete-faced rockfill dams
  - Joints of concrete retaining and training walls and slabs

**KEY FEATURES & SPECIFICATIONS**

- Long-term stability in difficult environments
- Suitable for datalogging and remote monitoring
- Integral lighting protection
- High accuracy and resolution
- Accommodates shear movement
- Not affected by cable length

**CRACK METERS**

Designed to measure movement across surface cracks and joints in a number of civil engineering and mining projects.

Available in two versions:
- 1-D & 3-D, with options of VW, manual & electrical output

**APPLICATIONS**

- Concrete structures
- Rock and soil structures
- Tunnel and shaft linings
- Bridge construction

**KEY FEATURES & SPECIFICATIONS**

- Rugged and reliable
- Alarm triggered when preset critical rate or value reached
- Suitable for remote reading and datalogging
- Strong, flexible or screened cable available

**TAPE EXTENSOMETER**

For the measurement of surface movement. A portable device designed to measure the relative distance between reference anchors fixed to an excavation or structure.

- Deformation of excavations
- Measurement of radial movements and convergence of tunnels, shafts, linings and caverns
- Displacement of retaining walls, cuttings, bridge piers arches and abutments
- Surface measurement of slope stability

**KEY FEATURES & SPECIFICATIONS**

- Rapid one-man operation
- Applicable in any orientation
- Rugged, simple design
- High accuracy and reliability
- Supplied with robust carrying case
- Digital and manual versions

- Range: 15, 20, 30m
- Dial Indicator resolution: -0.01mm
- Repeatability: +/- 0.25mm
- Weight with 20m tape: 2.2kg

**VIBRATING WIRE TECHNOLOGY**

- Sensor Specifications
  - Range: 5-200mm
  - Non-linearity: <0.05%FS
  - Accuracy: <0.1%FS

**RANGE**

- 15, 25, 50mm (others available)
- Over-range: 1.25X range
- Resolution: 0.02% range
- Accuracy: 0.1% range
- Operating temp: -20 to +80°C
- Diameter: 51mm
- Lengths: 15 & 25mm range: 340mm 50mm range: 430mm

**APPLICATIONS**

- Concrete arches, gravity and buttress dams
- Joints of concrete-faced rockfill dams
- Joints of concrete retaining and training walls and slabs
**CONVERGENCE MONITOR**

An economical, robust instrument for the continuous or random monitoring of ground closure in mining and civil engineering projects.

**Applications:**
- Mine development in squeezing ground
- Tunnelling

- **Remnant mining**
- **Road intersections**
- **Subsidence and closure surveys**

**Digital indicator with standard range of 150mm**

**Adjustable upper leg**

**Option for remote reading by datalogger - useful where continuous monitoring is essential**

<table>
<thead>
<tr>
<th>Key Features &amp; Specifications</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Standard Range</strong></td>
</tr>
<tr>
<td><strong>Resolution</strong></td>
</tr>
<tr>
<td><strong>Span</strong></td>
</tr>
</tbody>
</table>

**TUNNEL PROFILE MONITORING SYSTEM**

The system involves a series of linked rods, fixed to a tunnel wall to monitor deformation. A datalogging system and related software is available to provide near real time displacement and generate a graphical representation of tunnel performance.

**Applications:**
- Underground openings during construction for control and safety
- Tunnel deformation due to nearby construction
- Long-term deformation and performance of existing tunnels

**Low profile design with multiple arms to fit close to tunnel wall**

**Does not interfere with tunnel traffic**

**High system accuracy of up to 0.02mm of deformation**

**Custom engineered to suit each individual application**

**Immune to air density problems inherent in optical systems**

**Direct measurement of displacement rather than calculation from tilt measurement**

<table>
<thead>
<tr>
<th>Key Features &amp; Specifications</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>SYSTEM COMPONENTS</strong></td>
</tr>
<tr>
<td>Tilt/displacement sensor assembly</td>
</tr>
<tr>
<td>Extension tube</td>
</tr>
<tr>
<td>Electrical sensor to logger</td>
</tr>
<tr>
<td>Reference pin c/w tape extensometer connector</td>
</tr>
<tr>
<td>Datalogger system</td>
</tr>
<tr>
<td>GeoViewer software &amp; manual</td>
</tr>
</tbody>
</table>

**TELL-TALE CRACK MONITOR**

Tell-Tales consist of two plates which overlap for part of their length. One plate is calibrated in millimetres and the overlapping plate is transparent and marked with a hairline cursor. As the crack width opens or closes, one plate moves relative to the other and the relationship of the cursor to the scale represents the amount of movement occurring.

**Available as:**
- **Standard:** For movements across cracks on flat surfaces
- **Corner:** For monitoring movement across internal and external corners
- **Displacement:** For monitoring cracks when one surface moves out of plane with the other
- **Tell-Tale Plus:** Weather resistant, measures to an accuracy of 1.0mm

**Key Features & Specifications**
The VW Soil Extensometer monitors lateral and longitudinal deformation of soil and different types of embankments and embankment dams. It consists of a vibrating wire displacement sensor encased in a sealed body. The body contains a telescopic outer PVC pipe fitted with two flanges and an inner stainless steel rod. One end of the rod is attached to the flange while the other is connected to a displacement sensor attached to the other flange. As deformation occurs, the telescopic pipe moves with the soil causing the rod to operate the displacement sensor.

**KEY FEATURES & SPECIFICATIONS**

- **Gauge Length**: 1m, with 0.5, 1, 2 & 3m extension kits
- **Sensor Range**: 25, 50, 75, 100 & 150mm
- **Accuracy**: ±0.5% FSR
- **Resolution**: 0.02% FSR
- **Non-Linearity**: 0.5% FSR

Easy installation and maintenance
Suitable for remote reading and datalogging
VW displacement sensor assures long-term stability
Robust and accurate
Wide measuring range
**VW LOAD CELL**

For the measurement and control of compressive or tensile load. Available in both solid and annular styles.

**Applications:**
- Ground anchors & tendons
- Rock bolts
- Structural beams
- Piles
- Tunnel lining segments
- Proof loading & pull-out testing of trial anchors

**Key Features & Specifications**

- Proven long-term stability and accuracy
- High sensitivity & accuracy; datalogger compatible
- Will accommodate eccentric loading
- Frequency output of vibrating wire resistant to external electrical noise
- Able to tolerate wet wiring without signal degradation
- Signal capable of being transmitted several kilometres

**Specifications**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Capacity</td>
<td>225 to 10675kN</td>
</tr>
<tr>
<td>Over-range Capacity</td>
<td>150% F.S.</td>
</tr>
<tr>
<td>Sensitivity</td>
<td>0.01% F.S.</td>
</tr>
<tr>
<td>Accuracy</td>
<td>0.5% F.S.</td>
</tr>
<tr>
<td>Material</td>
<td>High tensile steel</td>
</tr>
<tr>
<td>Hole Size</td>
<td>16 to 280mm</td>
</tr>
</tbody>
</table>

**HYDRAULIC LOAD CELL**

Hydraulic Load Cells provide measurement of compressive loads between structural members. The load is distributed equally over the loading area of the cell by a thick, machined steel distribution plate. The load, when applied to the cell, causes a pressure increase in the hydraulic fluid and this change can be measured.

Two designs available: An annular cell and a solid cell.

Used for rock and soil anchors, concrete pre and post-tensioning and for the measurement of compressive loads between structural members.

**Key Features & Specifications**

- Simple, reliable hydraulic operation
- Automated data acquisition systems available.
- Readout methods: A Bourdon Tube Gauge, the simplest method, or various types of electrical transducers
- Low profile
- Remote readout capability
- Can be converted to VW & strain gauge output

**Specifications**

- Range: 300 to 25005kN
- Over-range Capacity: 150% F.S.
- Sensitivity: 0.005% F.S./°C
- Accuracy: 0.01% F.S.
- Temp range: -10°C to +55°C
- Excitation: 10 V DC
- Output: mV/V

**STRAIN GAUGE ANCHOR LOAD CELL (7000 series)**

SGLC-7000 series consists of a hollow cylinder of high strength steel and a series of electrical resistance strain gauges connected around the periphery of the spool as a Wheatstone Bridge and provides a single mV/V signal output.

**Applications**

To measure tensile loads in tie-back anchors and rock bolts or compressive loads in structures.

**Key Features & Specifications**

- Manufactured from high tensile, heat treated, stress relieved steel and with precision bearing surfaces
- Multi sensor configuration makes it possible to obtain more accurate readings under mildly eccentric loading conditions
- Connection to the load cell is via a heavy duty multi-core sheathed cable which can be connected to a direct portable readout, switched terminal units or a data logging system

**Specifications**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Range</td>
<td>300 to 25005kN</td>
</tr>
<tr>
<td>Over-range Capacity</td>
<td>150% F.S.</td>
</tr>
<tr>
<td>Sensitivity</td>
<td>0.005% F.S./°C</td>
</tr>
<tr>
<td>Accuracy</td>
<td>0.01% F.S.</td>
</tr>
<tr>
<td>Temp range</td>
<td>-10°C to +55°C</td>
</tr>
<tr>
<td>Excitation</td>
<td>10 V DC</td>
</tr>
<tr>
<td>Output</td>
<td>mV/V</td>
</tr>
</tbody>
</table>
**VW TOTAL PRESSURE CELL**

Used to monitor total pressure in earth fill dams and embankments or placed at the interface between structures and the excavation wall. Available in three transducer outputs: VW, pneumatic and strain gauge.

**Applications:**
- Embankments & dams
- Retaining walls, piers and abutments
- Foundations
- Underground excavations, rock walls of caverns and tunnels

**KEY FEATURES & SPECIFICATIONS**

<table>
<thead>
<tr>
<th>Feature</th>
<th>Pneumatic</th>
<th>Strain Gauge</th>
<th>Vibrating Wire</th>
</tr>
</thead>
<tbody>
<tr>
<td>Range</td>
<td>Up to 13,800kPa</td>
<td>Up to 34,500kPa</td>
<td>Up to 34,500kPa</td>
</tr>
<tr>
<td>Accuracy</td>
<td>.25 or .15%FS</td>
<td>16 ± 0.1%FS</td>
<td>0.1%FS</td>
</tr>
<tr>
<td>Over-range</td>
<td>2000psi max</td>
<td>200-500%FS</td>
<td>200%FS</td>
</tr>
<tr>
<td>Resolution</td>
<td>Equal to readout instrument</td>
<td>Equal to readout instrument</td>
<td>0.1%FS</td>
</tr>
<tr>
<td>Operating Temp</td>
<td>-20° to +80°C</td>
<td>-20° to +80°C</td>
<td>-20° to +80°C</td>
</tr>
<tr>
<td>Excitation</td>
<td>n/a</td>
<td>Dependent on sensor</td>
<td>5V sq Wave</td>
</tr>
</tbody>
</table>


**VW NATM STRESS CELL**

NATM stress cells are designed to measure total stress in concrete (shotcrete) linings in tunnels and other underground workings. The instrument is associated with monitoring & control of construction by the New Austrian Tunnelling Method (NATM), also known as Sprayed Concrete Lining and sequential Excavation Method. It is used for the monitoring of radial and tangential stresses within and on shotcrete lining, along with measurement of tunnel convergence and deformation.

**KEY FEATURES & SPECIFICATIONS**

<table>
<thead>
<tr>
<th>Feature</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Over-range</td>
<td>200% F.S.</td>
</tr>
<tr>
<td>Accuracy</td>
<td>to 0.1% F.S.</td>
</tr>
<tr>
<td>Resolution</td>
<td>0.025% F.S.</td>
</tr>
<tr>
<td>Signal output</td>
<td>2000-3000Hz</td>
</tr>
</tbody>
</table>


**BOREHOLE PRESSURE CELL**

For strain measurement in both elastic and viscoelastic rock. Cells are available in two basic configurations: a miniature flatjack version and a cylindrical pressure cell.

Both involve stainless or copper plates welded together at the edges. The space between is filled with fluid. Once the cell is grouted in the borehole, the fluid is pressurised. Stress changes can then be determined by the corresponding change in hydraulic pressure.

**KEY FEATURES & SPECIFICATIONS**

<table>
<thead>
<tr>
<th>Feature</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Range</td>
<td>0-10,000 PSI</td>
</tr>
<tr>
<td>Sensitivity with</td>
<td>40 PSI</td>
</tr>
<tr>
<td>gauge readout</td>
<td></td>
</tr>
<tr>
<td>Accuracy with</td>
<td>1%</td>
</tr>
<tr>
<td>gauge readout</td>
<td></td>
</tr>
</tbody>
</table>
PUSH-IN PRESSURE CELL

A Push-in Pressure Cell is designed to be pushed into the ground where it can measure total earth pressure and pore water pressure within the soil. It can be used as a site investigation tool to determine the in-situ stress state, both vertical and horizontal, depending on the direction of installation.

**KEY FEATURES & SPECIFICATIONS**

- Integrated pore pressure measurement
- Long-term stability
- High accuracy & sensitivity
- Constant monitoring capability
- Ease of data logging
- Range of transducers

<table>
<thead>
<tr>
<th>Range</th>
<th>70, 170, 350, 700 kPa</th>
</tr>
</thead>
<tbody>
<tr>
<td>Over Range</td>
<td>150% FS</td>
</tr>
<tr>
<td>Accuracy</td>
<td>±0.1% FS</td>
</tr>
<tr>
<td>Temperature</td>
<td>-20°C to +80°C</td>
</tr>
<tr>
<td>Filter</td>
<td>50 micron sintered</td>
</tr>
<tr>
<td>Length</td>
<td>524mm</td>
</tr>
</tbody>
</table>

JACKOUT EARTH PRESSURE CELL

Used to measure active and passive pressures on diaphragm walls.

**Applications:**

- Measurement and control of contact pressures on diaphragm walls

**KEY FEATURES & SPECIFICATIONS**

- Choice of pneumatic, strain gauge or vibrating wire pressure transducers
- High accuracy and sensitivity
- Suitable for remote monitoring or datalogging
- Cell designed to have stiffness similar to that of typical soils
- Rugged, easy to install and operate
- Fluid pressure calibrated

(Vibrating wire version)

<table>
<thead>
<tr>
<th>Range</th>
<th>up to 5000psi</th>
</tr>
</thead>
<tbody>
<tr>
<td>Accuracy</td>
<td>to 0.1% F.S.</td>
</tr>
<tr>
<td>Resolution</td>
<td>0.1% F.S. (min)</td>
</tr>
<tr>
<td>Operating temp</td>
<td>-29°C to +65°C</td>
</tr>
</tbody>
</table>

PILE TIP LOAD CELL

Custom-manufactured to suit site specific requirements. Cells can be any shape to suit different pile types. They operate on principles similar to total earth pressure cells.

The cell is typically divided into between 1 and 4 independent sections, each connected to a pressure transducer. Each of these reacts to the change in fluid pressure in each section and the sum of these gives the total load on the pile tip.

**Used for measurement of load at the tips of driven piles, cast-in-place piles and drilled shafts**

**KEY FEATURES & SPECIFICATIONS**

- Water resistant
- Can be datalogged
- Signal output options: VW; Pneumatic & strain gauge options

**ANCILLARY EQUIPMENT**

- Readout units
- Datalogger
- Pile tell-tales
- Load cells
- Strain gauges for measuring stress distribution
- Sister bars
**VW-2100 EMBEDMENT STRAIN GAUGE**

Particularly suitable for the long-term monitoring of concrete structures. Consists of two end flanges with a tensioned steel wire between them. As concrete undergoes strain, the end blocks will move and the tension in the wire changes. A vibrating wire readout generates voltage pulses in the magnet/coil at the centre of the gauge and measures the resonant frequency of vibration.

Monitors stress and/or strain determination in: Driven and bored piles; Tunnels and deep excavations; Concrete Dams; Mass concrete pours; Building foundations; Retaining Walls

**Key Features & Specifications**

- Reliable long-term performance and accuracy
- Rugged, suitable for demanding environments
- Not affected by long cable lengths
- Suitable for direct embedment in concrete
- Output resistant to electrical noise
- Thermally aged to minimise long term drift & calibration changes

- **Resolution**: 1με
- **Strain Range**: 3000με
- **Accuracy**: ±1% to ±0.5% FS
- **Non Linearity**: <0.5%
- **Temperature Range**: -20°C to +80°C
- **Lengths**: 50 to 260mm

**VWS-2000 SURFACE MOUNT STRAIN GAUGE**

Used for the long-term monitoring of steel or concrete structures. Gauges may be attached to steel structures by arc welding or by using alternative end blocks bonded or grouted into concrete. The arc weldable surface mounting blocks are designed so the complete strain gauge can be mounted in them after welding.

Monitors stress and/or strain determination in or on: Steel struts; Excavation support systems; Tunnel linings; Driven and bored piles; Bridges; Arches

**Key Features & Specifications**

- Reliable long-term performance and accuracy
- Rugged, suitable for demanding environments
- Not affected by long cable lengths
- Coils permanently attached to strain gauge
- Output resistant to electrical noise
- Thermally aged to minimise long term drift & calibration changes

- **Resolution**: 1με
- **Strain Range**: 300με
- **Accuracy**: ±0.1% to ±0.5% FS
- **Non Linearity**: <0.05%FS
- **Temperature Range**: -20 to +80°C

**VWS-2020 SPOT WELD STRAIN GAUGE**

Designed primarily to measure strains on the surface of steel structures. Consists of two end blocks with a tensioned steel wire between. As the surface undergoes strain the blocks move changing tension in the wire. A VW readout generates voltage pulses and measures the resonant frequency of vibration.

Available in two versions: Gauge with integral coil housing; Gauge only with separate coil housing

Monitors stress and/or strain determination in or on: Struts and support systems; Pipelines; Bridges & Dams; Buildings; Tunnel linings; Piles & Mass Concrete

**Key Features & Specifications**

- Small - can be used in confined spaces
- Easily tensioned on site
- Reliable long-term performance
- Rugged, suitable for demanding environments
- Insensitive to long cable lengths
- Suitable for remote reading and data logging
- Attached by spot welding

- **Gauge Length**: 49mm
- **Overall Length**: 65mm
- **Strain Range**: 3000με
- **Resolution**: 0.4με
- **Accuracy**: ±0.1% to ±0.5% FS
- **Non Linearity**: <0.5%FS
- **Temp range**: -20°C to +80°C
TENSMEG TENSION MEASURING GAUGE

The TENSMEG (Tension Measuring Gauge) for monitoring strand tendons is a spiral strain gauge comprising a Teflon® coated resistance wire extending between two hard rubber end anchors. It is a highly effective, simple to use means to examine load and strain in rock and soil anchors and also in cable bolts used for rock support.

Exceptional linear response and accuracy in a low-cost system
Simple to use and implement on site
Sturdy design provides ultimate reliability and durability
Performance not compromised when embedded in concrete or surrounded by grout
Water resistant

<table>
<thead>
<tr>
<th>Feature</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Full Scale Tension</td>
<td>Exceeds 50,000με</td>
</tr>
<tr>
<td>Full Scale Compression</td>
<td>3000μ*</td>
</tr>
<tr>
<td>Resolution</td>
<td>1με</td>
</tr>
<tr>
<td>Accuracy</td>
<td>2% F.S.</td>
</tr>
</tbody>
</table>

* Dependent on level of pre-tension applied during installation

REBAR STRAIN METER & SISTER BARS

Designed to be embedded in concrete for measuring strains due to imposed loads. It is welded into and becomes an integral part of the existing rebar cage. (Sister bars are tied-in, not welded.) Particularly applicable for pours where placing of concrete is remote and uncontrolled, typically in diaphragm walls and deep piles.

Rebar strain meters are usually installed in pairs on either side of the neutral axis. The extensions are long enough to ensure perfect contact with the surrounding concrete so that measured strains inside the steel are equal to the strains in the surrounding concrete.

Exceptional linear response and accuracy in a low-cost system
Simple to use and implement on site
Sturdy design provides ultimate reliability and durability
Performance not compromised when embedded in concrete or surrounded by grout
Water resistant

Key Features & Specifications

<table>
<thead>
<tr>
<th>Feature</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Excitation</td>
<td>Pluck or swept frequency</td>
</tr>
<tr>
<td>Thermistor</td>
<td>3k Ohms at 25°C</td>
</tr>
<tr>
<td>Over-range</td>
<td>Range +20%</td>
</tr>
<tr>
<td>Resolution</td>
<td>0.025% FSO (min)</td>
</tr>
<tr>
<td>Accuracy</td>
<td>&lt;0.8% FSO</td>
</tr>
<tr>
<td>Operating range</td>
<td>2500 micro strain</td>
</tr>
<tr>
<td>Typical range</td>
<td>3200-1600Hz</td>
</tr>
</tbody>
</table>

VIBRATING WIRE TECHNOLOGY
GEOLOGGER SERIES

A multi-channel datalogger designed for reliable remote monitoring under demanding geotechnical conditions. It is capable of monitoring all types of sensors with the following outputs: voltage, 4-20mA, digital, digital BUS, frequency.

Applications:
Remote datalogging of various types of geotechnical instrumentation used in dams, tunnels, bridges, mines and natural slopes
Real time datalogging and analysis

Key Features & Specifications
- Data retrieval by several methods:
  - RS232 Cable/USB
  - Storage Modules
  - Radio Frequency
  - Wireless Short Haul Modems
  - Phone Modems
  - Satellite

- Ability to read virtually any geotechnical sensor
- Large range of data retrieval options
- Alarm triggered when movement reaches a preset critical rate or levels reach a present value

DT2055 DATALOGGER

The DT2055 Vibrating Wire Data Logger is a low cost, battery-powered data logger, designed for reliable, unattended monitoring of up to 10 sensors which may be any mix of vibrating wire sensors and thermistors, typically 5 vibrating wire sensors with their associated thermistors.

It is a purpose-built logger ideal for remote locations or instruments that require frequent reliable data recording.

Key Features & Specifications
- Robust construction & Weather resistant
- 4MB memory
- NEMA 4X (IP65) enclosure
- Battery powered for remote sites.
- 100 year memory backup
- Compatible with all VW sensors (excluding those with auto resonant circuitry)

SINGLE CHANNEL VW DATALOGGER

A single channel, low cost battery-powered datalogger designed for reliable unattended monitoring of a single vibrating wire sensor and thermistor.

Ideal for remote locations or instruments that require frequent reliable data recording.

It connects to all geotechnical vibrating wire sensors including piezometers, crack meters and strain gauges via a IP68 bayonet connector.

Key Features & Specifications
- Frequency output immune to external electrical noise
- Tolerates wet wiring without signal degradation
- Transmits over several kilometres without loss

- Accuracy: 0.1% F.S.
- Resolution: 1 part in 65,000
- Memory: Over 30,000 readings
- Temperature range: -40°C to 60°C
- Power Source: 2 AA batteries
- Data stores in CSV format and opens in Microsoft Excel.
dataloggers & readouts

**SURTAGE ARRESTER**
Wiring, particularly long horizontal wiring, can convert transient electrical fields to destructive voltages at sensors and data logger terminals. The Surge 4D (4-Wire & Shield Transient Protector) can be used to divert these transients to ground, increasing installed system reliability.

**KEY FEATURES & SPECIFICATIONS**
- Protects against high-speed transients of up to 20,000 amps
- Low resistance in dormant state
- Self re-setting for uninterrupted operation after transient completed
- Compatible with most devices, including VW sensors, data loggers, 4-20 mA transmitters and other DC-powered sensors*
- Compact user-friendly devices

* For continuously powered DC devices, a fuse in series with the DC supply is recommended

**VW0420 VW ISOLATED ANALOG INTERFACE**
The VW0420 provides an interface between vibrating wire instruments and factory automation systems which support 4-20 mA sensors. The VW section measures the natural frequency and temperature of the sensor. The measurements are then converted into engineering units etc., as required, and scaled to the 4-20 mA outputs.

**KEY FEATURES & SPECIFICATIONS**
- Straightforward setup using Windows host program via USB cable
- Four dialectically isolated ground subsystems (for power, sensor and one each for outputs) means maximum flexibility in connecting the system

**FLEXI-MUX MULTIPLEXER**
The Flexi-Mux allows a single channel of dataloggers to be sequentially connected to numerous sensors. Each Flexi-Mux can sequentially multiplex 5 groups of 4 lines for a total of 20 lines. Internal DIP switch settings permit the multiplexing of 10 groups of 2 lines.

**KEY FEATURES & SPECIFICATIONS**
- Unlimited connections to datalogger using cascading method
- Slim and compact design utilises box space efficiently
- Quick access and detachable screw terminals simplify the wiring process
- Built-in transient protection on every line

**VIBRATING WIRE TECHNOLOGY**

**FLEXI-MUX MULTIPLEXER**
The Flexi-Mux is used to monitor numerous types of sensors in conjunction with a datalogger. It is compatible with most sensors including load cells, pressure transducers, vibrating wire sensors, thermistors, potentiometers and numerous other specialty sensors.

**KEY FEATURES & SPECIFICATIONS**
- Power: 12Vdc (under load)
- Current drain: 10µA quiescent; 8mA active
- Operating temp: -40°C to 70°C
- Reset Active Levels: 2.0V (max)
- Clock Active Levels: 2.0V (max)
- Clock Pulse Width: 1ms (min)
- Actuation Relay: 20ms (max)
GEOWAVE

A wireless datalogger, fully featured and providing a complete cable-free datalogging and remote data monitoring solution which can be connected to any vibrating wire instrumentation. Built-in vibrating wire technology provides an all-in-one data acquisition and monitoring solution. It collects readings directly from radio sensors, storing them in a non-volatile memory. Data retrieval is via purpose-designed software.

Applications: Geotechnical Instrumentation Structural Monitoring

Cable-free monitoring
Range up to 600m
Long Battery life
Remote data acquisition
Remote interval adjustment
Alarm triggering

KEY FEATURES & SPECIFICATIONS

<table>
<thead>
<tr>
<th>TRANSMITTER</th>
<th>No of sensors</th>
<th>Power</th>
<th>Battery life</th>
<th>Range</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>9V standard 6-24 optional</td>
<td>Up to 127</td>
<td>3 years (5 min intervals)</td>
<td>600m (in line of sight)</td>
<td>2.4GHz</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>DATALOGGER</th>
<th>No of transceivers</th>
<th>No of sensors</th>
<th>Power</th>
<th>Memory</th>
</tr>
</thead>
<tbody>
<tr>
<td>30</td>
<td>Up to 1,200</td>
<td>12-24V</td>
<td>1mb non volatile</td>
<td></td>
</tr>
</tbody>
</table>

RUGGED FIELD PC

The Ultra-Rugged Field PC functions as a data collector for a wide range of instruments, including inclinometers, tilt meters and tilt beams, and can download information from other data loggers using Field Book 5 software. It allows ‘on site’ data analysis and comparison to previous data sets and instant USB synchronization with office computers. Wireless communication is available with the RST MEMS Inclinometer and via a USB-RS485 cable for a wide range of other MEMS sensors and data loggers.

KEY FEATURES & SPECIFICATIONS

<table>
<thead>
<tr>
<th>Operating system</th>
<th>Software</th>
<th>Memory (RAM)</th>
<th>Data Storage</th>
<th>Temperature Range</th>
<th>Size</th>
<th>Weight</th>
<th>Enclosure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Windows® Mobile</td>
<td>Field Book 5</td>
<td>128MB</td>
<td>256/512mb Flash disc</td>
<td>-30°C to 50°C</td>
<td>165Lx43Wx89H mm</td>
<td>482g</td>
<td>IP67</td>
</tr>
</tbody>
</table>

SINGLE CHANNEL VW2106 READOUT

The VW2106 Vibrating Wire Readout is a weatherproof, portable device which reads, displays and logs both vibrating wire sensors and thermistors. The user-friendly format allows the user to programme the calibration factors for up to six different types of gauges. The maximum download time is just 15 seconds. Operating it is simple - connect the gauge, select the correct gauge type and press ‘Enter’ to log the data. A large backlit display and sealed control permits operation under demanding site conditions.

KEY FEATURES & SPECIFICATIONS

<table>
<thead>
<tr>
<th>VW Excitation Range</th>
<th>Resolution</th>
<th>Timebase Accuracy</th>
<th>Temperature Accuracy</th>
<th>Temperature Range</th>
<th>Memory Capacity</th>
</tr>
</thead>
<tbody>
<tr>
<td>400Hz to 6000Hz, 5V Square Wave</td>
<td>0.01µs</td>
<td>±50ppm</td>
<td>±0.1°C</td>
<td>-50°C to 80°C</td>
<td>11,400 labelled points</td>
</tr>
</tbody>
</table>
dataloggers & readouts

**VW200 VW READOUT**

The VW200 vibrating wire readout is an easy-to-use portable direct readout for use with all vibrating wire sensors. Fitted with a highly audible plucking tone, it provides a simple and easy-to-use readout.

**KEY FEATURES & SPECIFICATIONS**

<table>
<thead>
<tr>
<th>Feature</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overall size</td>
<td>10 x 180 x 44mm deep</td>
</tr>
<tr>
<td>Weight (approx)</td>
<td>500 grams</td>
</tr>
<tr>
<td>Case material</td>
<td>Black ABS plastic</td>
</tr>
<tr>
<td>Pluck voltages</td>
<td>14 or 21Vdc, switchable</td>
</tr>
<tr>
<td>Display</td>
<td>Large 6 digit LCD</td>
</tr>
<tr>
<td>Temperature range</td>
<td>-10°C to 70°C</td>
</tr>
<tr>
<td>Battery life</td>
<td>40 hrs (speaker off), 5 hrs (on)</td>
</tr>
</tbody>
</table>

**Durable compact design**

**Large easy to read display**

**Audible pluck for easy operator check**

**Readings in micro-seconds**

---

**MEMS TILTMETER READOUTS**

Used to monitor tiltmeters or in-place inclinometer sensors utilising MEMS technology. The readout is simple to connect and two versions are available with output displays in mV or Sine Angle. It is extremely useful for checking tiltmeter/beams or in-place inclinometers prior to connection to a data acquisition system.

**KEY FEATURES & SPECIFICATIONS**

<table>
<thead>
<tr>
<th>Feature</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Power supply</td>
<td>±12 VDC, 250 mA</td>
</tr>
<tr>
<td>Continuous Work Time</td>
<td>28 hours</td>
</tr>
<tr>
<td>Operation Temp</td>
<td>-10°C to +60°C</td>
</tr>
<tr>
<td>Relative Humidity</td>
<td>&lt;95% at +40°C</td>
</tr>
<tr>
<td>Range</td>
<td>300mV</td>
</tr>
<tr>
<td>Angle</td>
<td>±4.2° in-place inclins, ±1.2° tilt sensors</td>
</tr>
</tbody>
</table>

**Lightweight**

**Rugged construction**

**Easy to use**

**Large LCD display**

**Colour-coded inputs**

---

**INTELLIGENT TRANSDUCER READOUT**

A portable battery-powered field instrument designed to monitor strain gauge type transducers with readout directly in engineering units, or as a Voltage. Compatible with a wide range of gauges.

Microprocessor intelligence provides a wide range of features and the simplicity of design allows the non-technical user to operate the readout with a minimum amount of instruction. All set-up data is stored in a non-volatile memory.

**KEY FEATURES & SPECIFICATIONS**

<table>
<thead>
<tr>
<th>Feature</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Monitors:</td>
<td>ANY wheatstone full bridge based transducer</td>
</tr>
<tr>
<td></td>
<td>Strain gauge piezometers &amp; load cells</td>
</tr>
<tr>
<td></td>
<td>Pressure transducers</td>
</tr>
<tr>
<td></td>
<td>CSIRO hollow inclusion stress cells</td>
</tr>
<tr>
<td></td>
<td>CSIRO yoke gauges</td>
</tr>
<tr>
<td></td>
<td>ANZSI stress cells</td>
</tr>
</tbody>
</table>

**Readout in ANY preferred engineering unit**

**Rugged and Reliable**

**rechargeable battery-powered operation**

**Monitors both unterminated and connector equipped gauges**

**Automatic internal calibration function**
DEPTH GAUGES

Used to gain extensometer measurements. The depth micrometer is suitable when there is easy access to the reference head. When access to the reference head is difficult or where real-time or continuous monitoring is required, a sensor is the better option. Available with digital or dial display.

**KEY FEATURES & SPECIFICATIONS**
- Large, easy to read display
- Tolerance, relative and absolute modes
- Complete with 6 flat end depth rods
- In fitted case (digital only)

PNEUMATIC READOUT C108

Pneumatic readout instruments provide the most accurate and reliable monitoring of pneumatic piezometers, pressure cells and settlement systems with a simple one switch operation. Pneumatics are especially suited to projects where manual readings are required and are excellent for projects where lightning-immune backup to electrical sensors is needed.

Applications include monitoring of all pneumatic transducers, including Total Earth Pressure Cells and ‘Bubbler’ readout for monitoring standpipe piezometers.

**KEY FEATURES & SPECIFICATIONS**
- Sealed weatherproof case and electronics & automatic shut-off
- The standard FC-100 automatic flow controller ensures accurate repeatable readings. Operator error in adjusting flow rate valve and reading of flow meter is eliminated
- Pressure ranges to 2000psi (14,000kPa)
- Economical low operating rate of 35cc/min
- File format compatible with Microsoft Excel® and other spreadsheets

THERMISTOR READOUT

The portable TH2016 Thermistor Readout reads, displays and logs up to 16 thermistor string points at the push of a button. Unprecedented accuracy, flexible memory options and ease of use make the TH2016 invaluable for projects requiring temperature monitoring involving thermistor strings. Maximum download time is only 15 seconds.

The TH2016 combines maximum accuracy with efficiency. Housed in a compact and rugged case, the complete readout operates with only 3 AA batteries and has a large graphics display.

**KEY FEATURES & SPECIFICATIONS**
- Durable, compact design for excellent portability and field use.
- Readings in raw or engineering units
- Stores up to 254 thermistor string locations per route, each with a text label, date stamp, previous data, and up to 3,000 arrays of 16 points
- Data transfer to a host computer via USB in a compatible file format for Microsoft Excel® and other spreadsheets. User-friendly host software for Microsoft Windows® included

DEPTH GAUGES

Used with Rod Extensometers in applications including: Tunnels, Roof and wall stability; Subsidence; Dams; Bridge abutments; Retaining walls

**KEY FEATURES & SPECIFICATIONS**
- Range | 0-150mm
- Diameter of rods | 4.5mm
- Base width | 100mm
- Resolution | 0.001mm
- Display | Digital, Dial
**INTERFACE PROBE**

The OWP oil/water interface probe is used to determine the thickness of hydrocarbons, in light non-aqueous phase (LNAPL) and dense non-aqueous phase (DNAPL) in groundwater. It consists of a stainless steel shroud with a specially designed float and conductive probe to minimise surface tension errors thus providing unparalleled accuracy.

As the probe is lowered into the LNAPL, a single audible buzz is heard and a green light shows. Once the probe reaches the water at the oil/water interface, a two-tone buzzer is heard and both the green and red lamps show.

**KEY FEATURES & SPECIFICATIONS**

- **Slimline 20mm probe**
- High accuracy
- Simple to use
- Easy to clean
- Robust construction
- Compact design

<table>
<thead>
<tr>
<th>Shroud Diameter &amp; length</th>
<th>20mm x 225mm</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shroud Material</td>
<td>Austenitic st. steel</td>
</tr>
<tr>
<td>Tape Type</td>
<td>Steel, mm markings</td>
</tr>
<tr>
<td>Tape Lengths</td>
<td>30, 50 &amp; 100 metres</td>
</tr>
<tr>
<td>Float Diameter</td>
<td>10mm</td>
</tr>
<tr>
<td>Reel Diameter</td>
<td>230mm</td>
</tr>
<tr>
<td>Power</td>
<td>9 Volt PP3 battery</td>
</tr>
</tbody>
</table>

**ANTIFOAM DIP METER**

The Anti-Foam Dipmeter has been designed to measure the leachate level within gas/leachate wells or sumps. Its special shroud is unaffected by the presence of leachate foam found within wells, particularly where leachate is being pumped and/or positive gas extraction occurs, thus eliminating false readings. Once the float comes in contact with liquid (NOT FOAM) an audible buzz is heard, together with a visible red light.

**KEY FEATURES & SPECIFICATIONS**

- Simple and easy to use with audible and visual signals
- Slimline 21mm probe (minimum displacement)
- High accuracy
- Easy to clean
- Robust
- Available with temperature readout option

<table>
<thead>
<tr>
<th>Probe Diameter</th>
<th>21mm</th>
</tr>
</thead>
<tbody>
<tr>
<td>Probe Length</td>
<td>200mm</td>
</tr>
<tr>
<td>Tape Type</td>
<td>Steel, mm markings</td>
</tr>
<tr>
<td>Tape Lengths</td>
<td>30, 50, 100, 150, 200, 250, 300 metres</td>
</tr>
<tr>
<td>Audible indicator</td>
<td>88dB (A) buzzer</td>
</tr>
</tbody>
</table>
GEOSENSE VIEWER WEB-BASED SOFTWARE

An Internet browser-based package which allows the viewing of remote data from geotechnical instrumentation anywhere and at any time, removing the need for a dedicated PC on site. All the data and analysis power from field instruments is made immediately available.

To access it, users simply log on to their dedicated secure DataSense site through their web browser using a unique access code and password. They can then check for readings, alarms, graphs and reports - all in real time.

KEY FEATURES & SPECIFICATIONS

- Secure UK-managed server
- Loads directly from dataloggers or by manual upload
- Fully interactive graphing
- User or project graph saving
- Data export
- Real time display
- Data filtering
- Simple data upload
- No software needed
- From single to multi-instrument readings

GEOVIEWER SOFTWARE

Designed to simplify data interpretation, GeoViewer software allows the user to retrieve data from loggers in near-real time and graphically process the information.

APPLICATIONS:
- Assess settlement effects on various civil structures
- Correlating data obtained from various monitoring instrumentation used on the same project

KEY FEATURES & SPECIFICATIONS

- Software in both English and customised to the user’s specified language
- Superimposition of original images over post deformation data
- Automated collection and processing of data updating in near-real time
- Multiple alarm functions with user programmable rate/magnitude thresholds provisions
- Cross platform data export abilities to Windows™95, 98, 2000, NT™ and XP™ operating systems
- Export on-screen data representation as JPEG image for internet or email use

INCLINALYSIS SOFTWARE

RST Inclinalysis™ Software is a powerful companion to the RST Digital Inclinometer System.

It allows the user quickly and efficiently to reduce large volumes of inclinometer data in a variety of formats suitable for analysis and presentation.

Compatible with other manufacturers’ data files.

KEY FEATURES & SPECIFICATIONS

- Create custom graph, text views, vector or time plots
- Single click views for mean deviation, incremental displacement, absolute position, cumulative displacement, checksum, time plot and vector plot
- User defined settings for X and Y-axis properties such as scale, units, labels, ticks and gridlines
- Trial software is available at http://www.rstinstruments.com/software.html
PM LOGGER
Software for use with the Geowave wireless datalogger (see Page 28).

KEY FEATURES & SPECIFICATIONS
System Requirements: PC operating systems Windows 95 and XP
Set Clock: Synchronise with PC or set different time
Data Retrieval: CSA via modem. Stored in Hz & engineering units. Temperature reading in °C
BOREHOLE PACKERS

Pneumatically or hydraulically inflatable packers that incorporate one fixed and one sliding head attached to a centre shaft. The sliding head allows the packer gland to retract about the centre shaft as it inflates.

Applications:
- Permeability testing
- Hydro-fracturing of formations
- Monitoring well sampling
- Sealing artesian flows in boreholes
- Packer piezometers
- Pressure grouting

Steel reinforced, or fabric reinforced, abrasion resistant glands are easily replaced in the field

Hollow centre shaft for placement of sampling and monitoring equipment or for passing water through the packer during permeability testing or hydrofracturing

Suitable for a wide variety of applications in open or cased holes

KEY FEATURES & SPECIFICATIONS

Ancillary Equipment
- Sampling Pumps
- Dataloggers
- Flow Meters
- Inflation Regulator

Air-driven

Inflation Pumps

Perforated Spacer Pipe

BOREHOLE PACKER ACCESSORIES

A large number of Borehole Packer Accessories are available for use with borehole applications. Items include: inflation regulators, lifting bails, stuffing boxes, seating cones, feed-through adapters, flow systems, water inflation systems, portable inflation line reel, packer inflation systems and other numerous spare parts.

KEY FEATURES & SPECIFICATIONS

Inflation Regulators - control inflation of the borehole packers

Lifting Bails - raise and lower the packer assembly by utilising the wireline

Stuffing Boxes - provide a seal on the drill rods and against the wireline and inflation line

Seating Cones - used to set the packer assembly in place at the drill bit

Feed-through Adapters - allow instrument leads to be passed through the packers to pumps and other equipment in the zone below the packer

Flow System - to monitor and control water during down-hole testing

Water Inflation System - to inflate borehole packers hydraulically, useful in high pressure applications

The Portable Inflation Line Reel - a convenient and easy way of controlling inflation line during testing and storage

Packer Inflation System - all the features of an inflation regulator with the added convenience of all items being enclosed in a weatherproof case
CARLSON instruments are elastic wire strain meters containing two coils of highly elastic steel wire, one of which increases in length and electrical resistance when a strain occurs, while the other decreases. The ratio of the two resistances is independent of temperature (except for thermal expansion) and therefore the change in resistance ratio is a measure of strain. The total resistance is independent of strain since one coil increases the same amount as the other decreases due to a change in length of the meter. Therefore, the total resistance is a measure of temperature.

The cable most commonly used is heavy duty, neoprene rubber-covered, with either three or four conductors. Alternate cable types are available to suit site specific conditions. The CARLSON model MA-6B and later series readout instruments, while compatible with both three and four wire systems, require only three conductors to monitor both temperature and resistance. Earlier versions require four conductors to monitor both parameters. We recommend the total design length of cable be attached at the factory to ensure system integrity. Should the final design length not be known at the time of order, specify the total length of cable to be supplied in bulk, and that a 1m length of either three or four conductor be attached. As conductor diameter is determined by lead length, please specify the approximate total length. While field splicing is possible, the instructions in the CARLSON field manual must be followed.

Joint meters and foundation meters are similar to strain meters except they have greater range. This is accomplished by having a coil spring in series with each of two loops of elastic wire. The foundation meter is the same as the joint meter except that it has its range mainly in contraction. The joint meter is used mainly to measure the opening to joints and therefore it has most of its range in expansion. Range is allowed by spring-loading the elastic wire. Both measure temperature as well as expansion or contraction in the same way that strain meters do.

CARLSON Stress Cells are 178mm diameter plates with a strain-meter sensing element mounted on one face. The plate has a mercury film at its thickest and a flexible rim, with the result that any stress through the plate is applied to the mercury film. Extraneous deformation such as drying shrinkage has very little effect on stress through the plate (and the mercury) so the calibration is in terms of compressive stress per 0.01 per cent reduction in the resistance ratio of the sensing element. Available for both soil and concrete.

### CARLSON INSTRUMENTS - PRINCIPLE OF OPERATION

The cable most commonly used is heavy duty, neoprene rubber-covered, with either three or four conductors. Alternate cable types are available to suit site specific conditions.

The CARLSON model MA-6B and later series readout instruments, while compatible with both three and four wire systems, require only three conductors to monitor both temperature and resistance. Earlier versions require four conductors to monitor both parameters. We recommend the total design length of cable be attached at the factory to ensure system integrity. Should the final design length not be known at the time of order, specify the total length of cable to be supplied in bulk, and that a 1m length of either three or four conductor be attached. As conductor diameter is determined by lead length, please specify the approximate total length. While field splicing is possible, the instructions in the CARLSON field manual must be followed.

### CARLSON JOINT & FOUNDATION METERS

### KEY FEATURES & SPECIFICATIONS

<table>
<thead>
<tr>
<th>JOINT METERS</th>
<th>FOUNDATION METERS</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Carlson Model No</strong></td>
<td><strong>Range Contraction</strong></td>
</tr>
<tr>
<td>J0.1</td>
<td>0.51mm</td>
</tr>
<tr>
<td>J0.25</td>
<td>0.25mm</td>
</tr>
<tr>
<td>J0.5</td>
<td>0.25mm</td>
</tr>
</tbody>
</table>

### CARLSON STRESS CELLS

CARLSON Stress Cells are 178mm diameter plates with a strain-meter sensing element mounted on one face. The plate has a mercury film at its thickest and a flexible rim, with the result that any stress through the plate is applied to the mercury film. Extraneous deformation such as drying shrinkage has very little effect on stress through the plate (and the mercury) so the calibration is in terms of compressive stress per 0.01 per cent reduction in the resistance ratio of the sensing element. Available for both soil and concrete.

### KEY FEATURES & SPECIFICATIONS

<table>
<thead>
<tr>
<th>Description</th>
<th>Soil Stress Cells</th>
<th>Concrete Stress Cells</th>
</tr>
</thead>
<tbody>
<tr>
<td>Carlson Model No</td>
<td>S25</td>
<td>C400</td>
</tr>
<tr>
<td>Range</td>
<td>25psi</td>
<td>400psi</td>
</tr>
<tr>
<td>Resolution</td>
<td>0.1psi</td>
<td>3psi</td>
</tr>
<tr>
<td>Resolution Temp</td>
<td>0.05°C</td>
<td>0.05°C</td>
</tr>
<tr>
<td>Modus of Elasticity</td>
<td>60,000psi</td>
<td>2x10^5</td>
</tr>
<tr>
<td>Effective Area of Meter</td>
<td>42in²</td>
<td>35in²</td>
</tr>
</tbody>
</table>
CARLSON PIEZOMETER

Water pressure in the pores of a granular material like soil reduces the internal friction and therefore the stability. This pore pressure can be measured by a device which separates the water pressure from the intergranular pressure. In the CARLSON pore pressure cell, the water pressure is admitted to an internal diaphragm through a porous disc which holds back the soil or other granular material. The deflection of the internal diaphragm is measured with the same sensing element as is used in the stress meters.

- Zero displacement
- 50 year track record
- Integral temperature measurement
- Proven CARLSON design

### KEY FEATURES & SPECIFICATIONS

<table>
<thead>
<tr>
<th>Carlson Model No</th>
<th>P25</th>
<th>P50</th>
<th>P100</th>
<th>P200</th>
</tr>
</thead>
<tbody>
<tr>
<td>Range</td>
<td>25psi</td>
<td>50psi</td>
<td>100psi</td>
<td>200psi</td>
</tr>
<tr>
<td>Resolution</td>
<td>0.1psi</td>
<td>0.2psi</td>
<td>0.4psi</td>
<td>0.8psi</td>
</tr>
<tr>
<td>Resolution Temp</td>
<td>0.05°C</td>
<td>0.05°C</td>
<td>0.05°C</td>
<td>0.05°C</td>
</tr>
<tr>
<td>Weight</td>
<td>1.02kg</td>
<td>1.02kg</td>
<td>1.02kg</td>
<td>1.02kg</td>
</tr>
</tbody>
</table>

CARLSON REINFORCED CONCRETE METER

The CARLSON Reinforced Concrete Meter is a rod-like device which simulates a bar of reinforcing steel. The rod is hollow to accommodate a miniature strain meter which measures the change in length from which the stress is derived. What makes this meter unique is that it measures the change in length of the steel rod regardless of the occurrence of fine cracking which is common to reinforced concrete. It measures the average strain over most of the rod’s length.

- Robust Construction
- Ease of installation
- Proven CARLSON design
- Integral temperature measurement
- Self temperature compensating

### KEY FEATURES & SPECIFICATIONS

<table>
<thead>
<tr>
<th>Range (micro-strain)</th>
<th>±950</th>
</tr>
</thead>
<tbody>
<tr>
<td>Resolution (micro-strain)</td>
<td>3.4</td>
</tr>
<tr>
<td>Resolution (stress in steel)</td>
<td>100 psi</td>
</tr>
<tr>
<td>Resolution Temperature</td>
<td>.05°C</td>
</tr>
<tr>
<td>Maximum Street</td>
<td>±44,000psi</td>
</tr>
<tr>
<td>Weight</td>
<td>2.5kg</td>
</tr>
</tbody>
</table>

CARLSON RESISTANCE THERMOMETER

The CARLSON Resistance Thermometer is used for the remote reading of temperature where quick response is not required. It is well sealed against moisture and its diffusivity is approximately that of concrete; therefore it is especially suited for embedment in concrete to measure internal temperature.

The active element consists of a coil of copper wire wound non-inductively on an insulated spool in such a way as to be stress free.

- Long-term reliability
- Simplified Readings
- Ideal for direct embedment in concrete
- Proven Carlson design

### KEY FEATURES & SPECIFICATIONS

<table>
<thead>
<tr>
<th>Model</th>
<th>TM-1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Standard Range</td>
<td>-18 to +82°C</td>
</tr>
<tr>
<td>Resolution</td>
<td>0.05°C</td>
</tr>
<tr>
<td>Weight</td>
<td>227 grams</td>
</tr>
<tr>
<td>Dimensions</td>
<td>22mm X 95mm</td>
</tr>
<tr>
<td>Cable</td>
<td>3 conductor X#16gauge&lt;183m 3 conductor X#14gauge&lt;183m</td>
</tr>
</tbody>
</table>
The CARLSON Strain Meter is a device which can be embedded in concrete to reveal the internal deformations. It responds to any change in dimension of the concrete due to stress, creep, temperature change, moisture change or chemical growth. The main purpose of the strain meter is to determine stress indirectly. Quick changes in stress are revealed simply by multiplying the measured strain by the modulus of elasticity. But for stress which develops over a long period of time, account must be taken for changes in modulus of elasticity and of deformations due to creep and to all causes other than stress.

**キー特性と仕様**

<table>
<thead>
<tr>
<th>Description</th>
<th>Standard Concrete Strain Meters</th>
<th>Mini Concrete Strain Meters</th>
</tr>
</thead>
<tbody>
<tr>
<td>Carlson Model No</td>
<td>A8</td>
<td>A10</td>
</tr>
<tr>
<td>Range (micro strain)*</td>
<td>2600</td>
<td>2100</td>
</tr>
<tr>
<td>Resolution (micro strain)*</td>
<td>3.6</td>
<td>2.9</td>
</tr>
<tr>
<td>Resolution Temp</td>
<td>.05°C</td>
<td>.05°C</td>
</tr>
<tr>
<td>Gauge Length</td>
<td>20.3cm</td>
<td>25.4cm</td>
</tr>
<tr>
<td>Weight</td>
<td>.36kg</td>
<td>.59kg</td>
</tr>
</tbody>
</table>

*Normally set at factory for 2/3 to 3/4 or range in compression. Without limits, other settings may be specified. ** Saddle mount. Mounting diameter is 1-1/16 inches.

**CARLSON STRAIN METER**

The standard strain meter may be embedded in concrete or attached to a surface with saddle mounts. The standard comes in three lengths from 20cm to 51cm and the mini, for embedding where small size is essential, in three lengths from 10cm to 20cm.

**CARLSON MA-6B READOUT**

Reads all CARLSON instruments. Displays data in: Degrees (F and C), Resistance in Ohms and Resistance Ratio. Display: 2X20 character LCD

Analog Circuit: Provides excitation circuit, A-D converter, and EMI & RFI protection. 16 bit A-D output accuracy equivalent to 4½ digits or 1:10,000

CMOS Digital Circuit: Stores output of A-D converter; performs necessary mathematical calculations, and displays data. Readings are automatically updated once per second.

**キー特性と仕様**

Auto selection of gauge type; Simple one button operation
Auto error detection; 3 and 4 wire compatible
Allows use of economical 3 wire cable; Sealed case
Rechargeable batteries; Field rugged and reliable
Optional, heated, backlit display; Auto off to conserve battery power
DIVER® RANGE

The Diver® is a robust and compact datalogger for the automatic, accurate and reliable measuring and monitoring of groundwater levels. The Diver® range, manufactured by Schlumberger Water Services, is available in different models that can measure temperature, groundwater level and conductivity. All have a built-in battery with a lifespan on approximately 10 years and come with a three-year warranty.

APPLICATIONS: Hydrometric studies; Pump testing; Salt water intrusion and Groundwater remediation

KEY FEATURES

Available in four types: Micro-Diver, Mini-Diver, Cera-Diver and CTD Diver
Measurement range varies from 10 m H₂O to 100 m H₂O and a resolution varying 0.2 cm H₂O to 2 cm H₂O

Slimline for discrete installation
In-built datalogger
Rapid data retrieval
Field programmable
Variable sampling intervals
Free software package

MICRO-DIVER

The smallest Diver® in the range, just 18mm in diameter and small enough to fit in standard 19mm internal diameter monitoring wells. Its accuracy of ±0.1% F.S. assures extremely precise recording of the groundwater level. Various measuring methods: Fixed, event dependent, averaging & pumping tests;

APPLICATIONS
Monitoring projects
Groundwater monitoring network automation
Pumping tests

Long-term & frequent measurements; Temperature corrected measurement; Large memory capacity; Hermetically sealed in stainless steel housing.

<table>
<thead>
<tr>
<th>Type</th>
<th>DI 601</th>
<th>DI 602</th>
<th>DI 605</th>
<th>DI 610</th>
<th>DI 500(bar)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Range</td>
<td>10 m H₂O</td>
<td>20 m H₂O</td>
<td>50 m H₂O</td>
<td>100 m H₂O</td>
<td>1.5 m H₂O</td>
</tr>
<tr>
<td>Accuracy</td>
<td>1 cm H₂O</td>
<td>2 cm H₂O</td>
<td>5 cm H₂O</td>
<td>10 cm H₂O</td>
<td>0.5 cm H₂O</td>
</tr>
<tr>
<td>Resolution</td>
<td>0.2 cm H₂O</td>
<td>0.4 cm H₂O</td>
<td>1 cm H₂O</td>
<td>2 cm H₂O</td>
<td>0.1 cm H₂O</td>
</tr>
</tbody>
</table>

DIMENSIONS
18mm x 19mm

Memory (non-volatile) 48,000 measurements
Sample rate 0.5 sec to 99 hours *
Material housing/ sensor RVS 316L/ceramic
Temperature Range -20-80°C
Accuracy ±0.1°C
Resolution 0.01°C
Compensated Range 0°C to 40°C

* various measuring methods (fixed, event based, and pumping tests)

MINI-DIVER

The original Diver®, now enhanced with new electronics and now even shorter in length. Will fit in virtually any monitoring well. Like the other Diver® models the Mini-Diver is hermetically sealed to external effects, to ensure that the measurement result will be unaffected by moisture and/or electrical influences.

APPLICATIONS
Monitoring projects
Groundwater monitoring network automation

Long-term & frequent measurements; Temperature corrected measurement; Reliable & accurate measurement data; Non-volatile memory; Compact.

<table>
<thead>
<tr>
<th>Type</th>
<th>DI 501</th>
<th>DI 502</th>
<th>DI 505</th>
<th>DI 510</th>
<th>DI 500(bar)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Range</td>
<td>10 m H₂O</td>
<td>20 m H₂O</td>
<td>50 m H₂O</td>
<td>100 m H₂O</td>
<td>1.5 m H₂O</td>
</tr>
<tr>
<td>Accuracy</td>
<td>0.5 cm H₂O</td>
<td>1 cm H₂O</td>
<td>2.5 cm H₂O</td>
<td>5 cm H₂O</td>
<td>0.5 cm H₂O</td>
</tr>
<tr>
<td>Resolution</td>
<td>0.2 cm H₂O</td>
<td>0.4 cm H₂O</td>
<td>1 cm H₂O</td>
<td>2 cm H₂O</td>
<td>0.1 cm H₂O</td>
</tr>
</tbody>
</table>

Dimensions 22 mm x 90 mm
Memory (non-volatile) 24,000 measurements
Sample rate 0.5 sec to 99 hours
Material housing/ sensor RVS 316L/ceramic
Temperature Range -20°C to 80°C
Accuracy ±0.1°C
Resolution 0.01°C
Compensated Range 0°C to 40°C
DIVER MATE

Plug-in, download and store data right in the field. Diver-Mate is a simple storage device which connects directly to Diver data cables.
It is cost effective & minimizes need for carrying laptops into the field.

The MiniSD card (2GB) means the Diver-Mate stores an almost unlimited number of full Diver memory reads.
Powered by an internal rechargeable battery (charged by USB port), with time to read more than 500 Divers.

CTD-DIVER

In addition to a pressure and temperature sensor, the CTD-Diver has a four-electrode sensor for determining conductivity across a large temperature range. It is accommodated in a ceramic casing which is resistant to the most aggressive substances.

APPLICATIONS: Aquifer recharge projects; Saltwater intrusion projects; Surveillance against (illegal) discharges; Surveillance on waste disposal sites; Monitoring groundwater or surface water quality.

CERA-DIVER

The same size as the Mini-Diver, but constructed entirely in ceramic to prevent any possibility of corrosion in aggressive groundwater.
The new Cera-Diver has been specifically developed for semi-saline water projects and seawater-intrusion projects and for the monitoring of landfill sites, locations where the use of stainless steel as material for the pressure sensor and casing is inappropriate due to the threat of corrosion.

APPLICATIONS: Monitoring projects; Groundwater monitoring network automation.

<table>
<thead>
<tr>
<th>Dimensions</th>
<th>22 mm x 90 mm</th>
</tr>
</thead>
<tbody>
<tr>
<td>Memory (non-volatile)</td>
<td>48,000 measurements</td>
</tr>
<tr>
<td>Sample rate *</td>
<td>0.5 sec to 99 hours</td>
</tr>
<tr>
<td>Material</td>
<td>Ceramic (ZrO2) &amp; Al2O3</td>
</tr>
<tr>
<td>Temperature range</td>
<td>-20°C to 80°C</td>
</tr>
<tr>
<td>Accuracy</td>
<td>±0.1°C</td>
</tr>
<tr>
<td>Resolution</td>
<td>0.01°C</td>
</tr>
<tr>
<td>Compensated Range</td>
<td>0°C to 40°C</td>
</tr>
</tbody>
</table>

* various measuring methods (fixed, event based and pumping tests)

DIVER® data loggers

KEY FEATURES & SPECIFICATIONS

Robust construction - ceramic, corrosion resistant; Various measuring methods: Fixed, event dependent & pumping tests

<table>
<thead>
<tr>
<th>Type</th>
<th>DI 701</th>
<th>DI 702</th>
<th>DI 705</th>
<th>DI 710</th>
<th>DI 500 (baro)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Range</td>
<td>10 mH2O</td>
<td>20 mH2O</td>
<td>50 mH2O</td>
<td>100 mH2O</td>
<td>1.5 mH2O</td>
</tr>
<tr>
<td>Accuracy</td>
<td>0.5 cmH2O</td>
<td>1 cmH2O</td>
<td>2.5 cmH2O</td>
<td>5 cmH2O</td>
<td>0.5 cmH2O</td>
</tr>
<tr>
<td>Resolution</td>
<td>0.2 cmH2O</td>
<td>0.4 cmH2O</td>
<td>1 cmH2O</td>
<td>2 cmH2O</td>
<td>0.1 cmH2O</td>
</tr>
</tbody>
</table>

KEY FEATURES & SPECIFICATIONS

Various measuring methods: fixed & event dependent; Simple calibration;
Measures conductivity, temperature & pressure.

<table>
<thead>
<tr>
<th>Type</th>
<th>DI 261</th>
<th>DI 263</th>
<th>DI 265</th>
<th>DI 500 (baro)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Range</td>
<td>10 mH2O</td>
<td>30 mH2O</td>
<td>100 mH2O</td>
<td>1.5 mH2O</td>
</tr>
<tr>
<td>Accuracy</td>
<td>1 cmH2O</td>
<td>3 cmH2O</td>
<td>10 cmH2O</td>
<td>0.5 cmH2O</td>
</tr>
<tr>
<td>Resolution</td>
<td>0.2 cmH2O</td>
<td>0.6 cmH2O</td>
<td>2 cmH2O</td>
<td>0.1 cmH2O</td>
</tr>
</tbody>
</table>

KEY FEATURES & SPECIFICATIONS

Various measuring methods: (fixed & event based, and pumping tests)

<table>
<thead>
<tr>
<th>Type</th>
<th>DI 701</th>
<th>DI 702</th>
<th>DI 705</th>
<th>DI 710</th>
<th>DI 500 (baro)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Range</td>
<td>10 mH2O</td>
<td>20 mH2O</td>
<td>50 mH2O</td>
<td>100 mH2O</td>
<td>1.5 mH2O</td>
</tr>
<tr>
<td>Accuracy</td>
<td>0.5 cmH2O</td>
<td>1 cmH2O</td>
<td>2.5 cmH2O</td>
<td>5 cmH2O</td>
<td>0.5 cmH2O</td>
</tr>
<tr>
<td>Resolution</td>
<td>0.2 cmH2O</td>
<td>0.4 cmH2O</td>
<td>1 cmH2O</td>
<td>2 cmH2O</td>
<td>0.1 cmH2O</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Dimensions</th>
<th>22 mm x 183 mm</th>
</tr>
</thead>
<tbody>
<tr>
<td>Memory (non-volatile)</td>
<td>16,000 measurements</td>
</tr>
<tr>
<td>Sample rate *</td>
<td>0.5 sec to 99 hours</td>
</tr>
<tr>
<td>Housing Material</td>
<td>Ceramic ZrO2</td>
</tr>
<tr>
<td>Temperature range</td>
<td>-20°C to 80°C</td>
</tr>
<tr>
<td>Accuracy</td>
<td>±0.1°C</td>
</tr>
<tr>
<td>Resolution</td>
<td>0.01°C</td>
</tr>
</tbody>
</table>

* various measuring methods (fixed & event based)
DIVER OFFICE

A desktop solution which simplifies readout and programming of the Diver in the office and prepare data in advance using the Waterloo Hydrogeologic Software suite.

KEY FEATURES & SPECIFICATIONS

- Built-in features include CTD-Diver Calibration Wizard and Barometric Compensation Wizard
- Export to various file formats for advanced analysis (eg) CSV, MON, NITG etc
- Requirements: Windows 2000, XP and Vista, USB port and one Serial COM port

DIVER-POCKET

SIMPLE SOFTWARE SOLUTION FOR IN THE FIELD

A Personal Digital Assistant (PDA) software package which can be used on a PocketPC for programming Divers and reading stored measurements.

KEY FEATURES & SPECIFICATIONS

- Available in two versions:
  - Diver-Pocket Reader which reads data
  - Diver-Pocket Manager which also includes the Diver programming facility.
DIVER-NETZ

A COMPLETE WIRELESS GROUNDWATER MONITORING SYSTEM

From wireless field data collection and recording to project execution in the office, Diver-NETZ is a network of first class technologies which integrate superior field instrumentation with the latest communication and data management.

Collecting and assessing vital groundwater field data is now quite literally in the palm of your hands!

KEY FEATURES & SPECIFICATIONS

Connect wirelessly to groundwater monitoring networks
A complete solution of groundwater dataloggers, transceivers, acquisition instrumentation and software
Dramatically improves data collection in the field - up to 70% more efficient than traditional methods

DIVER DXT

Diver Data Exchange Transceiver expands Diver dataloggers to a wireless solution.
Acquire data and adjust settings wirelessly.
The DXT connects directly to Diver dataloggers in the well and instantly links to your hand-held device.

KEY FEATURES & SPECIFICATIONS

Built-in power supply with up to five-day battery life (based on typical use)
Standard lengths (1, 2, 2.5, 5, 10, 20, 40, 160, 320 meters) with the option to further customise lengths in the field
Transmits data following AES-128 data encryption

DIVER-DXT

<table>
<thead>
<tr>
<th>Description</th>
<th>DIVER-DXT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interface</td>
<td>Optical for Diver</td>
</tr>
<tr>
<td>Dimensions housing</td>
<td>Ø18mm (insertion well) Ø44mm (well top)</td>
</tr>
<tr>
<td>Operating Temp</td>
<td>-20°C to 80°C</td>
</tr>
<tr>
<td>Storage/Transport Temp</td>
<td>-40°C to 85°C</td>
</tr>
<tr>
<td>Time to Connect</td>
<td>Typical 15 sec</td>
</tr>
<tr>
<td>Battery life expectancy</td>
<td>5 years @ 20°C</td>
</tr>
<tr>
<td>Radio Range</td>
<td>&lt;150m</td>
</tr>
<tr>
<td>Max Cable Length</td>
<td>320m</td>
</tr>
</tbody>
</table>

DIVER DXD

The Data Exchange Dongle wireless connects to the Diver DXT in the field and instantly downloads Diver data. A detachable ‘antenna’ offers secure data streaming to the handheld device.

KEY FEATURES & SPECIFICATIONS

Operates with most PDA compact flash drives
Powerful transmission of up to 150 meter range (may vary according to site conditions)
Secure data transmission using AES-128 data encryption

DIVER-DXD

<table>
<thead>
<tr>
<th>Description</th>
<th>DIVER-DXD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interface</td>
<td>Compact Flash</td>
</tr>
<tr>
<td>Dimensions housing</td>
<td>CF Type II</td>
</tr>
<tr>
<td>Operating Temp</td>
<td>-20°C to 80°C</td>
</tr>
<tr>
<td>Storage/Transport Temp</td>
<td>-40°C to 85°C</td>
</tr>
<tr>
<td>Time to Connect</td>
<td>Typical 15 sec</td>
</tr>
<tr>
<td>Battery life expectancy</td>
<td>&lt;150m</td>
</tr>
<tr>
<td>Radio Range</td>
<td>&lt;150m</td>
</tr>
<tr>
<td>Max Cable Length</td>
<td></td>
</tr>
</tbody>
</table>
**VW TEMPERATURE SENSOR**

Used for the measurement of temperature in rock, concrete and soil. It consists of a stainless steel body, a tensioned wire, an electromagnetic coil and signal cable. The body of the sensor expands and contracts with changes in temperature, increasing or decreasing the tension of the wire. When a readout is connected, it sends an electric pulse to the coil, which plucks the wire and causes it to vibrate at its natural frequency. A second coil picks up the vibration and returns a frequency to the readout. The reading is converted to units of temperature by applying calibration factors.

- **High accuracy**
- **VW compatible**: The VW temperature sensor is especially convenient when there are other VW sensors at the site.
- **Manual or automatic readings**: Read manually using the VW Data Recorder or automatically using a data logger.
- **Reliable signal transmission over long distances**

### KEY FEATURES & SPECIFICATIONS

- **Measuring Range**: -20 to +80°C
- **Accuracy**: ±0.1% F.S.
- **Resolution**: 0.025°C
- **Response Time**: 2.5 minutes for 60% of full thermal equilibrium
- **Full Thermal Equilibrium**: 15 minutes

---

**THERMISTOR STRINGS**

RST thermistor string assemblies are environmentally hardened to provide accurate and reliable long-term measurements under demanding conditions. The strings incorporate interchangeable curve tracking, negative temperature coefficient (NCT) thermistors. As the thermistors are curve matched to desired temperature tolerance over selected temperature ranges, this permits the use of multiple sensors with a single readout or datalogger, eliminating the need for costly calibration procedures. Readout instruments available.

- **High reliability, ensured by triple encapsulation**
- **Precision matched, interchangeable thermistors**
- **Pre-assembled to specific lengths and spacing**
- **Heavy duty, direct burial cable standard**
- **Also available with digital RS485 output**

### KEY FEATURES & SPECIFICATIONS

<table>
<thead>
<tr>
<th>DESCRIPTION</th>
<th>HIGH PRECISION</th>
<th>STANDARD PRECISION</th>
<th>SUPER-STABLE HIGH PRECISION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interchangeability Tolerance</td>
<td>±0.1°C</td>
<td>±0.2°C</td>
<td>±0.05°C</td>
</tr>
<tr>
<td>Interchangeability Temp range</td>
<td>0 to +75°C</td>
<td>0 to +75°C</td>
<td>0 to +75°C</td>
</tr>
<tr>
<td>Operating Temp Range</td>
<td>-80 to +75°C</td>
<td>-80 to +75°C</td>
<td>-80 to +75°C</td>
</tr>
<tr>
<td>Stability</td>
<td>0.01°C or better /100months at 0°C</td>
<td>0.01°C or better /100months at 0°C</td>
<td>0.01°C or better /100months at 0°C</td>
</tr>
<tr>
<td>Resistance at 25°C</td>
<td>2252, 3k, 5k, 10k Ohms</td>
<td>2252, 3k, 5k, 10k Ohms</td>
<td>2252, 3k, 5k, 10k Ohms</td>
</tr>
</tbody>
</table>

---

**VW V-NOTCH WEIR SENSOR**

A precise water level monitoring system which uses a vibrating wire transducer as a highly sensitive and stable means of monitoring levels. The system employs a stainless steel weir plate through which the flow to be measured is channelled. A measuring point is located at a suitable position upstream of the weir.

- **High sensitivity & stability**
- **Low maintenance**
- **Force transducer immune to zero drift & has low response to temperature changes**
- **Not affected by long signal cables**
- **Measured by portable readout or datalogger**

### KEY FEATURES & SPECIFICATIONS

<table>
<thead>
<tr>
<th>DESCRIPTION</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Standard Ranges</td>
<td>150, 300, 500, 1500mm</td>
</tr>
<tr>
<td>Accuracy</td>
<td>±0.1% F.S.</td>
</tr>
<tr>
<td>Resolution</td>
<td>0.025% F.S. (min)</td>
</tr>
<tr>
<td>Linearity</td>
<td>&lt;0.5% F.S.</td>
</tr>
<tr>
<td>Stability</td>
<td>±0.05% F.S. per year</td>
</tr>
<tr>
<td>Temp Range</td>
<td>+1 to +80°C</td>
</tr>
</tbody>
</table>
GROUT MONITORS

Available as either Compaction or Permeation Systems providing operators and engineers real time or near-real time displays of key grouting parameters to enhance the understanding of site conditions.

The monitor is invaluable in providing a permanent record of key grouting parameters for quality assurance, documented quantities, pressure & flow readings.

The monitors have a 1 million readings/2mb standard memory.

KEY FEATURES & SPECIFICATIONS

Non-invasive
Doppler ultrasonic
Low maintenance diaphragm seal
Digital flow and analog pressure
Real-time computer display
Customisable display

PERMEATION GROUT MONITOR

Flow: CFM
0.4 to 40.1 CFM (3-30 GPM)

Temperature
-20°C to 85°C

Materials
Compaction & low mobility grouts

Accuracy
±2% above 0.3 FPS

Pressure Trans
0-1000 PSI 0.25% FSO

Output
4-20mA or 0-2.5V

COMPACTION GROUT MONITOR

Flow: GPM
0.5 to 25 and 8-400 GPM

Temperature
-20°C to 85°C

Dissolved Solids
0-40%

Accuracy
±1% above 1 FPS

Pressure Trans
0-1000 PSI 0.25% FSO

Output
4-20mA or 0-2.5V

TERMINAL SWITCH BOXES & ACCESSORIES

Terminal boxes are available to connect up to 12, 23 or 34 instruments.

They are equipped with up to three 12-position rotary switch boards with connectors for readout output. Housed in a waterproof IP67 wall mounting plastic or steel lockable enclosure.

KEY FEATURES & SPECIFICATIONS

Simple to use & install
Reduces monitoring time
IP67 protection
Robust construction
Compatible with readouts & data loggers

REFLECTIVE TARGETS

Model GSRT2 is a 2-dimensional reflective Bireflex target used primarily for tunnel convergence monitoring. It has reflectors on both sides.

Models GSRT3/4 are 3-dimensional triple mini prism targets primarily used for measuring the deflection of buildings. Both are mounted on universal joints so they can be orientated in any direction required and are made from high impact and resistant plastic with a bottom fitting which allows them to be mounted on a wide range of fixings such as convergence and reference bolts and prism poles.

KEY FEATURES & SPECIFICATIONS

High precision
Range of retro reflective targets available
Robust construction
Range of reflective targets available
Range of prism diameters
WILD/LEICA compatible

<table>
<thead>
<tr>
<th>Description</th>
<th>GSRT2</th>
<th>GSRT3</th>
<th>GSRT4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prism diameter</td>
<td>60mm</td>
<td>25mm</td>
<td>38mm</td>
</tr>
<tr>
<td>Cut Accuracy</td>
<td>NA</td>
<td>&lt;0.5”</td>
<td>&lt;0.5”</td>
</tr>
<tr>
<td>Off Set (prism constant)</td>
<td>2mm</td>
<td>-17.5mm</td>
<td>-34mm</td>
</tr>
<tr>
<td>Range</td>
<td>10-150m</td>
<td>~1000m</td>
<td>~1000m</td>
</tr>
<tr>
<td>Materials</td>
<td>Polyamide</td>
<td>Polyamide</td>
<td>Polyamide</td>
</tr>
<tr>
<td>Weight</td>
<td>0.2kg</td>
<td>0.2kg</td>
<td>0.2kg</td>
</tr>
</tbody>
</table>
Geotechnical instrumentation used to measure the performance and safety of structures requires secure and reliable connections between the sensors and the data retrieval location.

Geosense uses the highest quality cables made to British and European standards. They have excellent strength and flexibility which makes them ideal for installation within applications such as dams, tunnels, bridges etc.

APPLICATIONS
- Standard sensor installations
- Heavy loading applications
- High temperature environments
- Abrasion resistant requirements

OUTER SHEATHING
Standard Geosense cables are fitted with PUR outer sheaths but other materials such as PVC, PE, Neoprene and Teflon are available.

CABLE CONDUCTORS
The number of conductors required is normally determined by the number & type of sensors that need to be connected. Standard Geosense cables have Stranded Tinned Copper (22-24 AWG) conductors. Other sizes are available.

SHIELDING & INSULATION
Shielding gives protection from electromagnetic interference from nearby sources such as generators and other construction equipment and all Geosense cables are fitted with Mylar type shields to minimise these effects. Other types of shield are available to suit individual project requirements.

Insulation of the individual conductors is normally with PE or PVC insulation. Specialist insulations to meet environmental conditions are also available.

<table>
<thead>
<tr>
<th>Cable Type</th>
<th>Type 900/1</th>
<th>Type 900/2</th>
<th>Type 910/8</th>
<th>Type 910/12</th>
<th>Type 910/30</th>
</tr>
</thead>
<tbody>
<tr>
<td>Outer Sheath Type</td>
<td>PUR</td>
<td>PUR</td>
<td>PE</td>
<td>PE</td>
<td>PE</td>
</tr>
<tr>
<td>Outer Sheath OD</td>
<td>6.5mm</td>
<td>4.9mm</td>
<td>8.9mm</td>
<td>10.1mm</td>
<td>12.5mm</td>
</tr>
<tr>
<td>Outer Sheath Colour</td>
<td>Orange, black, red, grey</td>
<td>Orange, black, red, grey</td>
<td>Orange, black, red, grey</td>
<td>Orange, black, red, grey</td>
<td>Orange, black, red, grey</td>
</tr>
<tr>
<td>Conductor Type</td>
<td>Stranded tinned copper</td>
<td>Stranded tinned copper</td>
<td>Stranded tinned copper</td>
<td>Stranded tinned copper</td>
<td>Stranded tinned copper</td>
</tr>
<tr>
<td>Conductor Number</td>
<td>4 core</td>
<td>4 core</td>
<td>4 twisted pair</td>
<td>6 twisted pair</td>
<td>15 twisted pair</td>
</tr>
<tr>
<td>Conductor Size</td>
<td>22 AWG 0.5mm², 0.25mm</td>
<td>24 AWG 0.35mm², 0.25mm</td>
<td>24 AWG 0.35mm², 0.25mm</td>
<td>24 AWG 0.35mm², 0.25mm</td>
<td>24 AWG 0.35mm², 0.25mm</td>
</tr>
<tr>
<td>Conductor Insulation</td>
<td>PE</td>
<td>PE</td>
<td>PVC</td>
<td>PVC</td>
<td>PVC</td>
</tr>
<tr>
<td>Shield</td>
<td>Aluminium foil</td>
<td>Aluminium foil</td>
<td>Aluminium foil</td>
<td>Aluminium foil</td>
<td>Aluminium foil</td>
</tr>
<tr>
<td>Resistance</td>
<td>60 ohms per km</td>
<td>104 ohms per km</td>
<td>82 ohms per km</td>
<td>82 ohms per km</td>
<td>82 ohms per km</td>
</tr>
<tr>
<td>Temperature Range</td>
<td>-30 to +80°C</td>
<td>-30 to +80°C</td>
<td>-30 to +80°C</td>
<td>-30 to +80°C</td>
<td>-30 to +80°C</td>
</tr>
<tr>
<td>Weight kg/km</td>
<td>44</td>
<td>28</td>
<td>72</td>
<td>93</td>
<td>170</td>
</tr>
</tbody>
</table>

ARMOUR
Where extra protection against point loads is required typically within rock fills, landfills, embankments etc, wire-armoured cable is often used. A wide range of armouring is available to suit the individual protection requirement.

VENTED CABLES
Vented cable can be used for products such as vented piezometers and liquid level settlement systems to allow a path for the changes in barometric pressure to act upon both sides of the sensing element and thus negate the need for barometric compensation calculations.

ACCESSORIES
A wide range of splicing kits, cable end protectors and connectors are also available to ensure cabling connections on site are quick & easy.
### DENSITY

<table>
<thead>
<tr>
<th>Tonne/m³</th>
<th>Mg/m³</th>
<th>g/cm³</th>
<th>kg/m³</th>
<th>lb/in³</th>
<th>UK ton/yd³</th>
<th>US ton/yd³</th>
<th>lb/ft³</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1000</td>
<td></td>
<td></td>
<td>0.03613</td>
<td>0.75247</td>
<td>0.8428</td>
<td>62.432</td>
</tr>
<tr>
<td>10⁻¹</td>
<td>1</td>
<td>3.613x10⁻¹</td>
<td>7.525x10⁻¹</td>
<td>8.428x10⁻¹</td>
<td>6.243x10⁻²</td>
<td></td>
<td></td>
</tr>
<tr>
<td>27.680</td>
<td>27680</td>
<td></td>
<td>1</td>
<td>20.828</td>
<td>23.238</td>
<td>1.728x10³</td>
<td></td>
</tr>
<tr>
<td>1.3289</td>
<td></td>
<td>4.801x10⁻³</td>
<td>1</td>
<td>1.12</td>
<td>82.955</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.1865</td>
<td></td>
<td>4.287x10⁻³</td>
<td>0.8929</td>
<td>1</td>
<td>74.074</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.602x10⁻³</td>
<td>16.019</td>
<td>5.787x10⁻⁴</td>
<td>1.205x10⁻⁴</td>
<td>1.35x10⁻⁵</td>
<td>1</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### FORCE & WEIGHT

<table>
<thead>
<tr>
<th>MN</th>
<th>kN</th>
<th>N</th>
<th>kgf</th>
<th>tonf</th>
<th>lbf</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1000</td>
<td>10¹</td>
<td>1.0196x10⁰</td>
<td>100.4</td>
<td>2.248x10⁶</td>
</tr>
<tr>
<td>10⁻³</td>
<td>1</td>
<td>10⁻³</td>
<td>101.96</td>
<td>0.1004</td>
<td>224.82</td>
</tr>
<tr>
<td>10⁻⁴</td>
<td>1</td>
<td>10⁻⁴</td>
<td>1</td>
<td>0.10196</td>
<td>0.2248</td>
</tr>
<tr>
<td>9.807x10⁻⁶</td>
<td>9.807</td>
<td>1</td>
<td>9.807</td>
<td>9.824x10⁻⁵</td>
<td>2.2048</td>
</tr>
<tr>
<td>9.964x10⁻⁶</td>
<td>9.964</td>
<td>1</td>
<td>9964</td>
<td>0.9964</td>
<td>224.0</td>
</tr>
<tr>
<td>4.448x10⁻³</td>
<td>4.448</td>
<td>1</td>
<td>4.448</td>
<td>0.45355</td>
<td>4.464x10⁻⁴</td>
</tr>
</tbody>
</table>

### PERMEABILITY

<table>
<thead>
<tr>
<th>m/s</th>
<th>cm/s</th>
<th>m/year</th>
<th>Darcy</th>
<th>ft/yr</th>
<th>ft/day</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>100</td>
<td>3.156x10⁰</td>
<td>1.04x10⁰</td>
<td>1.035x10⁰</td>
<td>2.835x10⁰</td>
</tr>
<tr>
<td>0.01</td>
<td>1</td>
<td>3.156x10⁻¹</td>
<td>1.04x10⁻¹</td>
<td>1.035x10⁻¹</td>
<td>2.834x10⁻¹</td>
</tr>
<tr>
<td>3.169x10⁻³</td>
<td>3.169x10⁻³</td>
<td>1</td>
<td>3.28x10⁻¹</td>
<td>3.281</td>
<td>8.982x10⁻³</td>
</tr>
<tr>
<td>9.66x10⁻⁶</td>
<td>9.66x10⁻⁶</td>
<td>304</td>
<td>1</td>
<td>1000</td>
<td>2.74</td>
</tr>
<tr>
<td>9.658x10⁻⁶</td>
<td>9.659x10⁻⁶</td>
<td>0.304</td>
<td>10⁻³</td>
<td>1</td>
<td>2.378x10⁻³</td>
</tr>
<tr>
<td>3.527x10⁻⁶</td>
<td>3.527x10⁻⁶</td>
<td>111.33</td>
<td>0.365</td>
<td>365.25</td>
<td>1</td>
</tr>
</tbody>
</table>

### PRESSURE, STRESS & MODULUS OF ELASTICITY

<table>
<thead>
<tr>
<th>MN/m² MPa</th>
<th>kN/m²</th>
<th>kPa</th>
<th>kp/ft²</th>
<th>bar</th>
<th>atm</th>
<th>m H₂O</th>
<th>ft H₂O</th>
<th>mm Hg</th>
<th>Tonf/ft²</th>
<th>psi</th>
<th>lbf/ft²</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1000</td>
<td>10¹</td>
<td></td>
<td>10²</td>
<td>9.869</td>
<td>102.2</td>
<td>335.2</td>
<td>750.6</td>
<td>9.320</td>
<td>145.04</td>
<td>20886</td>
</tr>
<tr>
<td>0.001</td>
<td></td>
<td>10⁻²</td>
<td>0.0100</td>
<td>9.87x10⁻¹</td>
<td>0.1022</td>
<td>0.3352</td>
<td>7.506</td>
<td>0.0093</td>
<td>0.14504</td>
<td>20.886</td>
<td></td>
</tr>
<tr>
<td>9.807x10⁻²</td>
<td></td>
<td>98.07</td>
<td></td>
<td>1</td>
<td>9.9678</td>
<td>10.017</td>
<td>32.866</td>
<td>735.6</td>
<td>0.9139</td>
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