

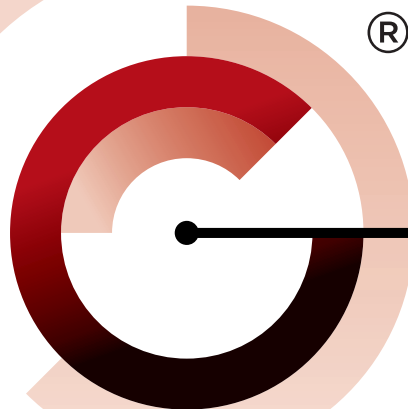
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**Robertson Geo** offers wireline conveyed, slim-hole logging services for geotechnical investigation, hydrological projects, environmental studies, mineral evaluation, hydrocarbon exploration and geoscience research worldwide.

**No project is too small, no project too large or challenging.**



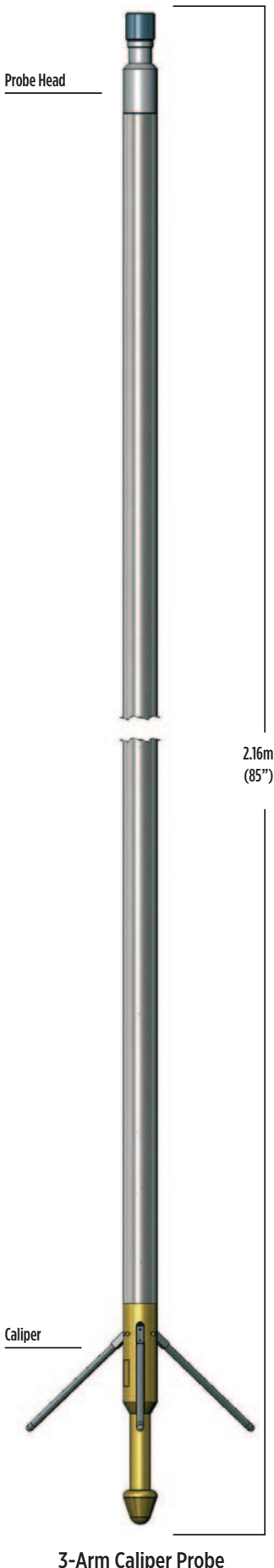
**ROBERTSON  
GEO**

Unlocking Your GeoData

**Slimhole  
Probe  
Catalogue**

# PROBES

## 3-ARM CALIPER [710MM, 1000MM AND 1500MM RANGES]



The 3-Arm Caliper probe provides a single continuous log of borehole diameter as recorded by three mechanically coupled arms in contact with the borehole wall.

710mm, 1000mm and 1500mm range calipers are available to suit a range of well diameters. The caliper is a useful first log to determine the borehole conditions before running more costly probes or those containing radioactive sources.

### Principle of Measurement:

Opening and closing of the motor-driver caliper arms is by surface command, allowing the probe to run into the borehole with the arms retracted. Once opened, the spring-loaded arms respond to borehole diameter variations as the probe is raised up the borehole.

## SPECIFICATION:

### Features

- Small diameter for slim-hole operation
- Extension arms supplied as standard for 38mm version
- Optional natural-gamma measurement
- Optional casing collar locator

### Measurements

- CCL (optional)
- Borehole volume (derived)
- Natural Gamma (optional)
- Borehole volume

### Applications

- Minerals/Water/Engineering
- Location of borehole collapse or obstructions
- Cement volume calculations for grouting
- Identification of hard and soft lithology
- Location of cracks, fissures, caving, faulting, casing breaks
- Correction of other logs affected by borehole diameter

### Operating Conditions

- Borehole type: open/cased; water/air-filled
- Centralisation: recommended in large holes
- Centralisation: recommended in inclined holes
- Recommended Logging Speed: 5m/min

### Specifications

- Temperature: 0-70°C (extended ranges available)
- Max. pressure: 20MPa

### 3-Arm Caliper (710mm range)

- Diameter: 38mm
- Length: 2.18m-2.68m (depending on CCL and extended arms)
- Weight: 7.5kg
- Range: 40-300mm and 40-710mm

### 3-Arm Caliper (1000mm range)

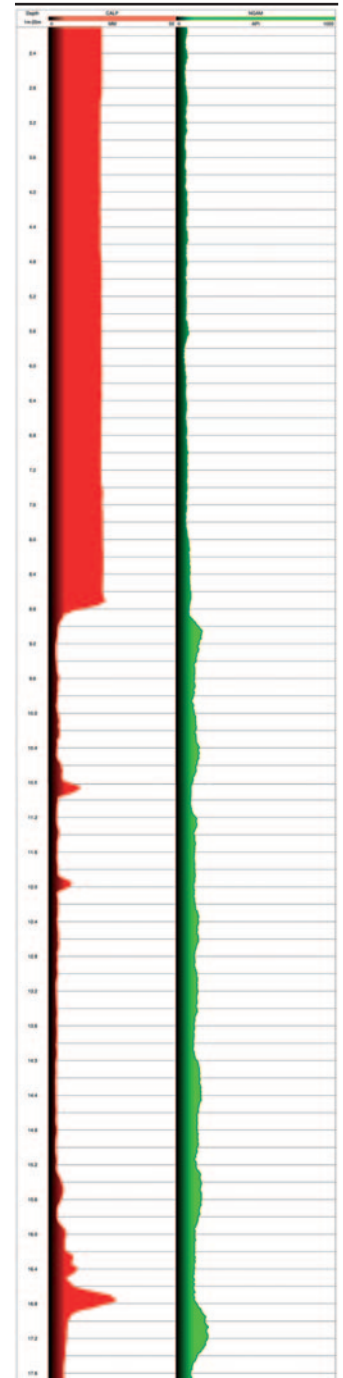
- Diameter: 60mm
- Length: 2.83m
- Weight: 15kg
- Range: 65-1000mm

### 3-Arm Caliper (1500mm range)

- Diameter: 80mm
- Length: 3.14m
- Weight: 17.5kg
- Range: 100 - 1600mm

### Part Numbers

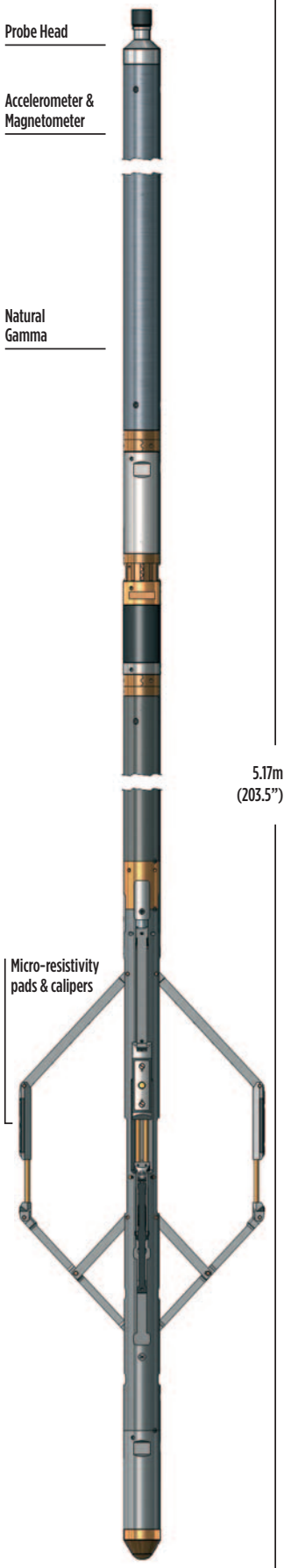
- 1002035 3-Arm Caliper (710mm range) with arm extension kit and calibrator
- 1002037 – including natural gamma
- 1002041 3-Arm Caliper (1000mm range) with calibrator
- 1002052 3-Arm Caliper (1500mm range)



Example of logging data

# PROBES

## 4-ARM DIPMETER



4-Arm Dipmeter Probe

The 4-Arm Dipmeter measures microresistivity and tool orientation data.

These can be processed to determine formation dips.

### Principle of Measurement:

The probe consists of a microresistivity section and a detachable verticality module. Microresistivity data is acquired by four high-resolution, button electrodes mounted on motorised XY caliper arms and maintained in contact with the borehole walls. A planar formation feature that does not lie perpendicular to the borehole axis is detected by each electrode at a different apparent depth. The four microresistivity measurements are correlated and combined with the verticality data to calculate the dip and dip direction.

## SPECIFICATION:

### Features

- Small diameter for slim-hole operations
- Operates in all orientations

### Measurements

- Formation dip and azimuth
- Microresistivity
- Borehole verticality and drift
- True vertical depth
- Borehole volume
- Natural Gamma

### Applications

- Engineering/minerals
- Stratigraphy
- Sedimentology
- Identification of faults and folding
- Fracture identification
- Correlation between wells

### Operating Conditions

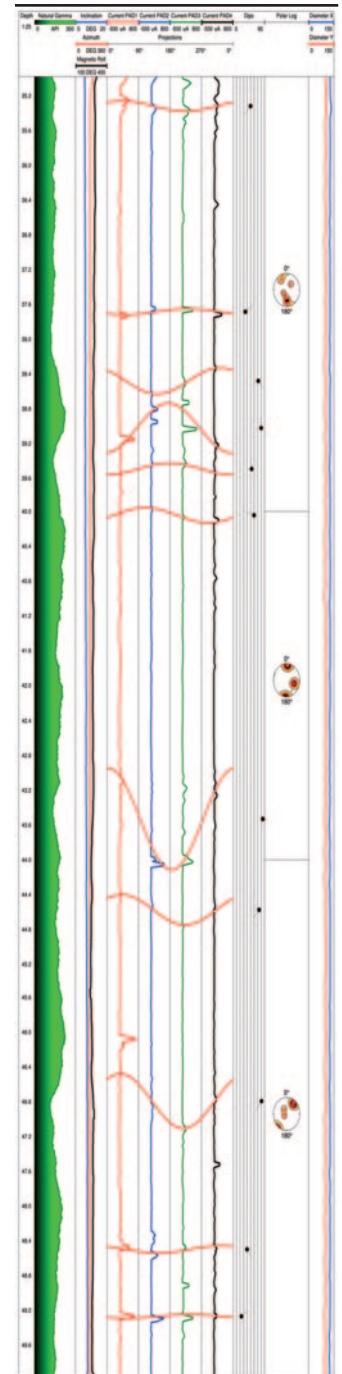
- Borehole type: open, water-filled
- Centralisation: non-magnetic centralisers required for inclined boreholes and/or diameters above 150mm
- Recommended Logging Speed: 3m/min

### Specifications

- Diameter: 61mm (when closed 66mm)
- Length: 5.17m
- Weight: 52kg (combined)
- Temperature: 0-70°C (extended ranges available)
- Max. pressure: 20MPa
- Resistivity range: 1 to 10,000 ohm-m
- Borehole inclination: any
- Caliper range: 62-380mm

### Part Numbers

- 1002171 4-Arm Dipmeter probe with natural gamma



Example of logging data

# PROBES

## BOREHOLE GEOMETRY



The Borehole Geometry probe consists of a 4-arm caliper combined with a verticality measurement.

The probe can replace the 3-Arm Caliper (710mm range) with advantage where the borehole cross-section departs from circular and where directional information is required for well-completion studies and formation stress analysis. The top section can be logged as a standard verticality.

**Principle of Measurement:**

The XY caliper provides continuous measurements of borehole diameter from two independent pairs of linked arms. The verticality section includes a triaxial magnetometer and three accelerometers. Data from these are combined by a downhole microprocessor to provide real-time, continuous logs of probe orientation and borehole inclination and direction.

**SPECIFICATION:**

**Features**

- Sensitive X-Y caliper
- Continuous orientation log for all borehole inclinations

**Measurements**

- X and Y calipers
- Borehole deviation and drift
- Borehole volume (derived)
- True vertical depth (TVD)
- Natural gamma

**Applications**

- Water/minerals/engineering
- Borehole diameter in two axes
- Borehole break-out for stress analysis
- Cracks, fissures and casing defects

**Operating Conditions**

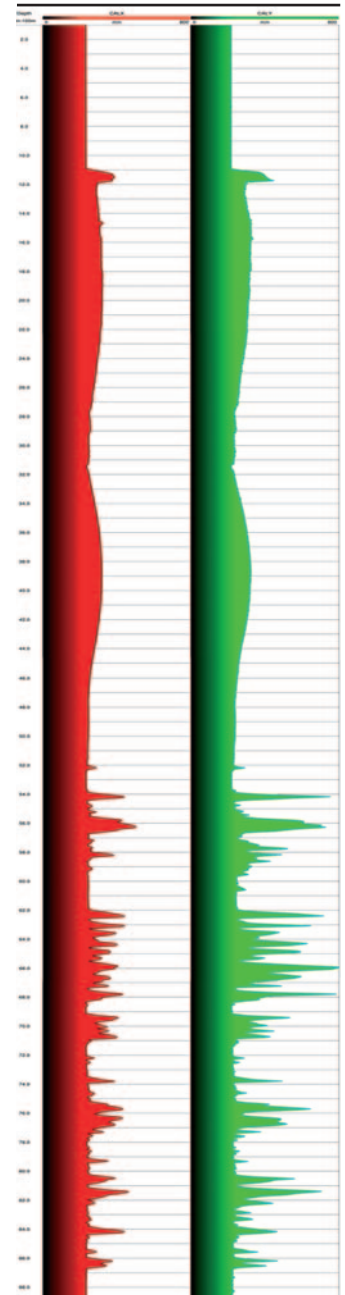
- Borehole type: open/cased, water/air-filled
- Centralisation: recommended, non-magnetic centralisers required
- Recommended Logging Speed: 5m/min

**Specifications**

- Diameter: 60mm
- Length: 3.54m (in two sections) or 1.81m
- Weight: 19.5kg complete (5.5kg for top section)
- Temperature: 0-70°C (extended ranges available)
- Max. pressure: 20MPa
- Caliper range: 75mm to 700mm

**Part Numbers**

- 1002044 Borehole Geometry probe with natural gamma



Example of logging data

Borehole Geometry Probe

# PROBES

## DENSITY GAMMA



The Density Gamma probe (sometimes referred to as a Trisonde) offers a convenient, low cost alternative to the standard Formation Density probe whenever borehole diameter is restricted and qualitative density measurements are acceptable.

One common application is in logging through drill pipe when unstable borehole conditions prevent use of unprotected nuclear probes. The probe is unfocused and indicates the average density of material surrounding the borehole.

### Principle of Measurement:

The probe contains a detachable gamma source and two high-sensitivity scintillation gamma detectors. Gamma radiation from the source is backscattered by the formation (Compton effect) and reaches the two detectors where the count-rates provide an indication of formation bulk density.

## SPECIFICATION:

### Features

- Long-spacing detector (LSD) for deep penetration
- High-resolution detector (HRD) for accurate bed-boundary detection
- Optional borehole-inclination measurement

### Measurements

- Long-spacing density (cps)
- High-resolution density (cps)
- Natural gamma
- Borehole inclination (option)

### Applications

#### Minerals:

- Bulk-density variations
- Lithology
- Correlation with other logs
- Bed thickness and boundary location
- Borehole inclination and true vertical depth

#### Engineering:

- Detection of weathered or fractured zones
- Ground compaction studies

#### Water:

- Location of aquifer and aquitard

### Operating Conditions

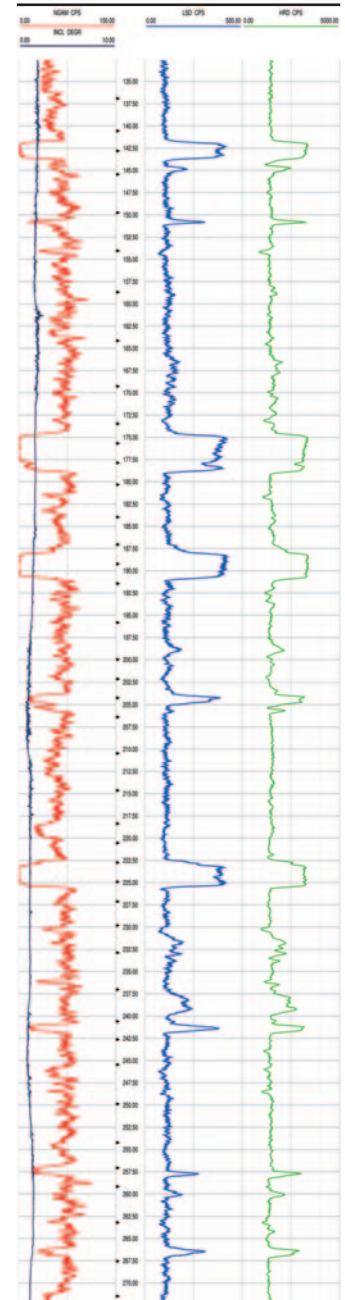
- Borehole type: all (qualitative measurement only)
- Recommended Logging Speed: 5m/min

### Specifications

- Diameter: 38mm
- Length: 2.31m
- Weight: 7.6kg
- Temperature: 0-70°C (extended ranges available)
- Max. pressure: 20MPa
- Inclination measures: 0° to 180°

### Part Numbers

- 1002010 Density Gamma probe
- 1002012 - with inclination



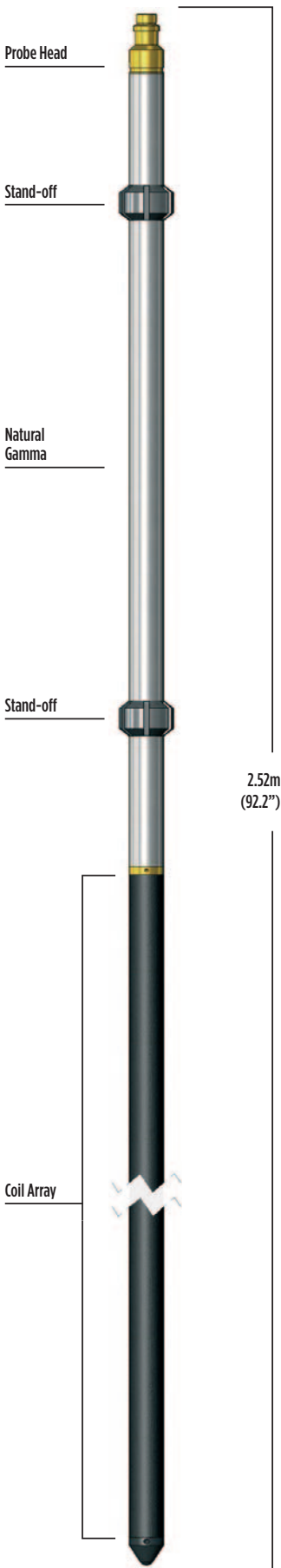
Example of logging data

Density Gamma Probe



# PROBES

## DUAL FOCUSED INDUCTION



Dual Focused Induction Probe

The Dual Focused Induction probe provides two simultaneous conductivity logs, corresponding to “medium” and “deep” radii of investigation into the formation.

The two depths of penetration are useful in porous, permeable formations where displacement of formation fluids by drilling mud creates an “invasion zone” with different electrical properties. The 1” focussed induction probe produces a single medium penetration conductivity log. It finds particular application in small-diameter dry or plastic-lined boreholes used for mineral exploration and for conductivity/resistivity in dry holes.

### Principle of Measurement:

An oscillating high-frequency magnetic field from a transmitter coil within the probe induces an alternating electrical current within the surrounding conductive formation. This current, in turn, induces voltages within receiver coils proportional to the formation conductivity. The transmitter-receiver spacings determine the depth of investigation of the measurements. Additional focussing coils minimise the contribution of the borehole signal.

### SPECIFICATION:

#### Features

- Formation conductivity measurement in wet/dry boreholes or through plastic casing
- Separate deep and medium penetrating measurements give information on invaded zone
- Focussed measurements for minimum borehole signal PSD (phase-sensitive detector) discriminates between magnetic susceptibility and conductivity signals

#### Measurements

- Deep formation conductivity
- Medium formation conductivity
- Natural Gamma

#### Applications

- Water**
  - Indicator of permeable zones and porosity
  - Formation water salinity
  - Long-term well monitoring
- Mineral/Engineering**
  - Ore identification and quality
  - Correlation
- Other**
  - Indication of hydrocarbons

#### Operating Conditions

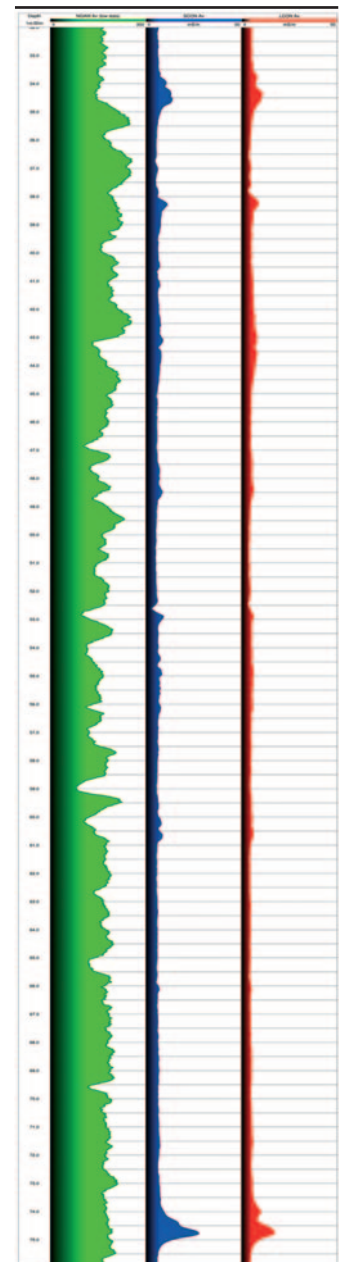
- Borehole type: open/plastic or grp cased, air/water-filled
- Recommended Logging Speed: 5m/min

#### Specifications

- Diameter: 43mm
- Length: 2.52m
- Weight: 8.6kg
- Temperature: 0-70°C (extended ranges available)
- Max. pressure: 20MPa
- Number of coils: 6 coils: Tx and Ref, Bucking1, Receiver1, Bucking2, Receiver2
- TX-RX spacings: ILM 50cm (20”), ILD 81cm (32”)
- Conductivity range: 3 to 3300mS/m

#### Part Numbers

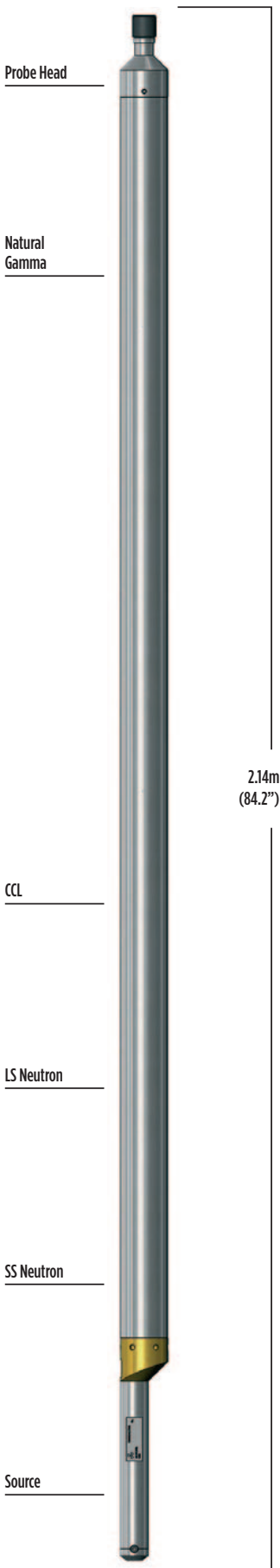
- 1002087 Dual Focussed Induction probe with natural gamma



Example of logging data

# PROBES

## DUAL NEUTRON



The Dual Neutron probe provides a calibrated borehole-compensated neutron porosity measurement in mud-filled open holes.

It is the probe of choice for quantitative formation-fluid studies.

A single-detector neutron probe is also available for qualitative porosity logging under most borehole conditions including through steel or plastic casing and drill-pipe.

**Principle of Measurement:**

The Dual Neutron measurement uses two <sup>3</sup>He proportional detectors and a detachable, sealed <sup>241</sup>Am-Be neutron source. Fast neutrons emitted by the source are scattered and slowed to thermal levels, principally by hydrogen in the formation. The ratio of the neutron flux reaching the near and far detectors depends on the hydrogen index and porosity. Use of dual detectors and a ratio method provides a porosity measurement compensated for borehole diameter but not independent of it.

**SPECIFICATION:**

**Features**

- Real-time porosity measurement
- Compensation for borehole diameter

**Measurements**

- Compensated porosity
- Neutron (raw counts)
- Natural gamma
- Option: Casing-collar locator (CCL)

**Applications**

**Minerals / Water / Engineering**

- Lithology identification
- Location of aquifer and aquitard
- Fracture analysis in coals
- Correlation between open and cased-hole logs
- Strata correlation between wells

**Operating Conditions**

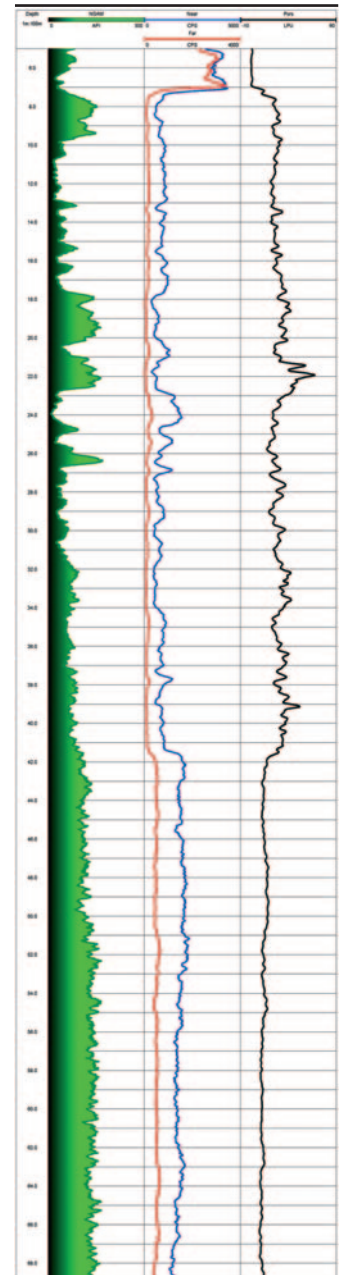
- Borehole type: open/cased, water-filled
- Centralisation: ex-centralised with bowspring
- Recommended Logging Speed: 4m/min

**Specifications**

- Diameter: 65mm
- Length: 2.14m
- Weight: 19.5kg
- Temperature: 0-70°C (0-125°C optional)
- Max. pressure: 20MPa
- Range: 15 to 45% Limestone Porosity Units (LPU)

**Part Numbers**

- 1002029 Dual Neutron probe with natural gamma
- 1002030 - includes CCL



Example of logging data

Dual Neutron Probe

# PROBES

## ELASTMETER

The Elastmeter is a borehole lateral load tester designed to figure out deformation characteristics of the ground ranging from soft rock to hard rock. The deformation characteristics become useful information especially for the construction of large scale structures such as dams, bridges and high-rise buildings.

The Elastmeter has a range of probes to provide pressuremeter tests of rock in BQ (60 mm), NQ (76 mm) and HQ (98 mm) boreholes. Both pressure and displacement are measured directly in the probe using electrical transducers. A mechanical arm is used for the measurement of displacement making maintenance easier. Applied pressure is measured by a precise semi-conductor transducer in the probe.

### Pressmeter and data recorder:

The system comes complete with data recorder, probe and cables for up to 200m use.

## SPECIFICATION:

### Specifications

Probe Types:	BQ (60 mm), NQ (76 mm) and HQ (98 mm)
Max Pressure:	20MPa
Deformation range:	BQ Probe 66-80mm NQ Probe 76-90mm HQ Probe 100-115mm
Probe Diameter:	BQ Probe 62mm NQ Probe 72mm HQ Probe 96mm
Weight:	BQ Probe 20kg NQ Probe 20kg HQ Probe 30kg

### Part Numbers

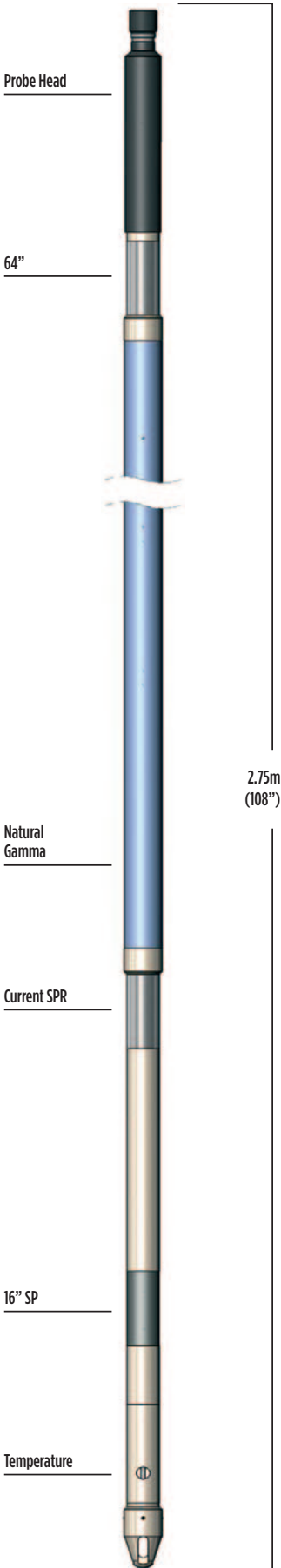
Model 4023	Elast Recorder
Model BQ	Elastmeter Probe BQ
Model NQ	Elastmeter Probe NQ
Model HQ	Elastmeter Probe HQ
Model 4185	High Pressure Pump
04181-2001	Control Cable 100m
Model 4153	High Pressure Cable
04181-4024	Carrying case for probe - wooden
04149-6005	Tool Kit
04154-4005	Calibration pipe 76mm I.D for NX
04154-4007	Calibration pipe 82mm I.D for NX
15491-2010	Packer tube for NX - hard
01167-0501	Battery pack with carrying bag
12539-2015	Battery charger - 100 or 220V AC
12539-9001	Step-down transformer





# PROBES

## ELECTRIC LOG



Electric Log Probe

The classic water-well combination probe combining shallow, medium and deep penetrating resistivity measurements with Self-Potential (SP).

### Principle of Measurement:

A low-frequency bi-directional electric current from a source electrode on the probe returns through the formation to the cable armour above an insulated bridle. Potentials due to this current flow are measured on various sense electrodes on the probe with respect to a voltage reference 'fish' normally located at the surface. These measurements are converted to apparent formation resistivities within the probe and transmitted to the surface.

### SPECIFICATION:

#### Features

- Digital down-hole measurement avoids errors due to cable effects
- Constant-power down-hole current source

#### Measurements

- 16" Normal resistivity
- 64" Normal resistivity
- Single-point resistance
- Self-Potential (SP)
- Natural-gamma
- Fluid Temperature
- Optional 8" and 32" Normal resistivity

#### Applications

- Water
- Determination of water quality
- Indication of permeable zones and porosity
- Minerals/Engineering
- Bed-boundary positions
- Strata correlation between boreholes
- Fracturing Indication

#### Operating Conditions

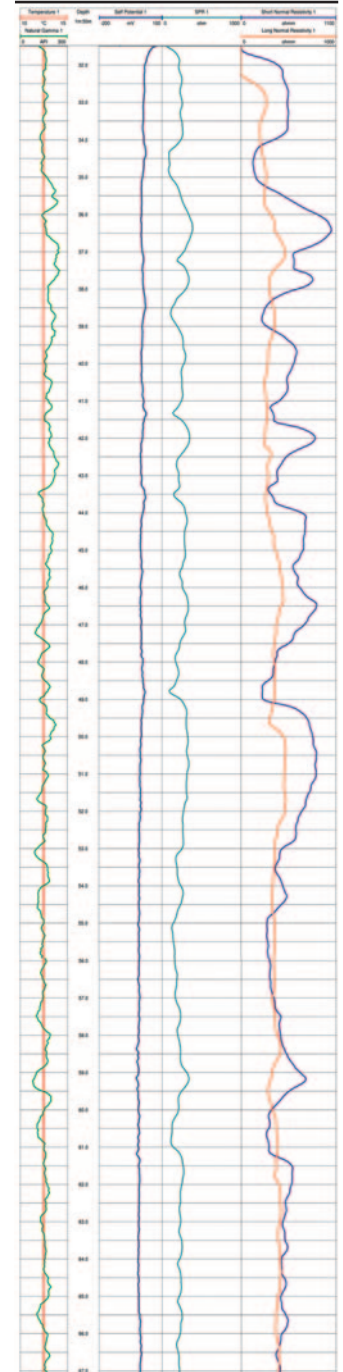
- Borehole type: open-hole, water-filled
- Recommended Logging Speed: 4m per min

#### Specifications

- Diameter: 45mm
- Length: 2.75m or 3.16m (with 8" and 32" option)
- Weight: 11kg
- Temperature: 0-70°C (extended ranges available)
- Max. pressure: 20MPa
- Resistivity range: 1 to 10,000 ohm-m

#### Part Numbers

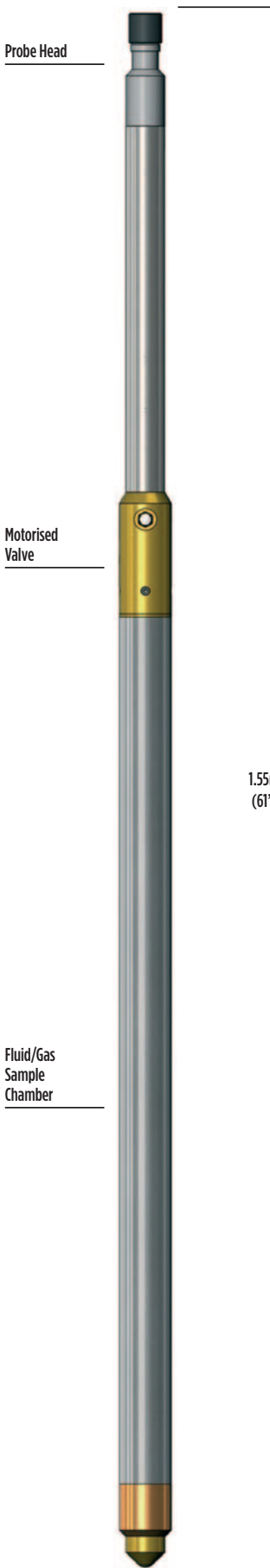
- 1002072 Electric Log probe with natural gamma and temperature
- 1002111 - including 8" and 32" normal resistivity



Example of logging data

# PROBES

## FLUID/GAS SAMPLER



Fluid and Gas Sampler probes are used to take a discrete sample of well fluid at a particular depth and to return it uncontaminated to the surface.

### Principle of Measurement:

**Fluid Sampler:** The Fluid Sampler includes a chamber incorporating motor-actuated valves at the top and base. While the probe is being lowered into the borehole, the valves are held open, allowing well fluid to flow freely through the chamber. At the desired depth, the motor is activated under surface control, closing the valves to seal the chamber and contents ready for retrieval.

**Gas Sampler:** The Gas Sampler is designed to retrieve uncontaminated samples of well fluids comprising or containing gas whilst maintaining the original well pressure. The probes contain a sealed sample chamber with a moveable piston and motor-actuated valve. Prior to logging, the piston is withdrawn manually and locked into position, leaving a partial vacuum within the sample chamber. For sampling, the valve is opened under surface control, allowing the well fluid to enter the chamber. The valve is then closed, enclosing the sample under ambient pressure. At the surface, the fluid can be transferred while still under pressure to a suitable container for analysis.

### SPECIFICATION:

#### Features

- Simple, motor-operated actuation
- Fluid sample chamber easily cleaned
- Fluid/gas sample retained at borehole pressure

#### Applications

- Fluid**
- Sampling well fluid at depth for surface analysis
- Groundwater and water well studies

#### Operating Conditions

- Borehole type: open/cased, water-filled
- Recommended Logging Speed: Static sampling

#### Specifications

##### Fluid Sampler

Volume: 0.25L	Diameter: 38mm	Length: 0.96m	Weight: 5kg
Volume: 0.5L	Diameter: 38mm	Length: 1.27m	Weight: 5kg
Volume: 1.0L	Diameter: 38mm	Length: 1.88m	Weight: 5kg
Volume: 1.25L	Diameter: 38mm	Length: 2.19m	Weight: 5kg
Temperature:	0-70°C (extended ranges available)		
Max. pressure:	20MPa		

##### Gas Sampler

Volume: 0.5L	Diameter: 51mm	Length: 1.18m	Weight: 10kg
Volume: 1.0L	Diameter: 51mm	Length: 1.55m	Weight: 10kg
Temperature:	0-70°C (extended ranges available)		
Max. pressure:	20MPa		

#### Part Numbers

1002198	Fluid Sampler probe 1li
1002206	Gas Sampler probe 1li

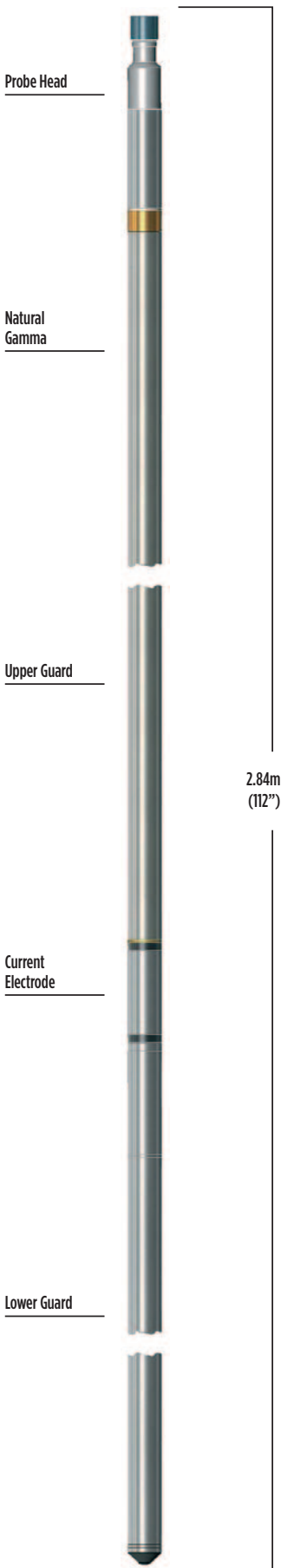


Mechanical valve assembly where the sample is extracted

Fluid/Gas Sampler Probe

# PROBES

## FOCUSSED ELECTRIC (GUARDLOG)



The focussed resistivity (LL3) measurement provides excellent vertical resolution and a reasonable depth of investigation.

The Guardlog replaces the classic Electric Log in conditions of low mud resistivity and high formation resistivity.

### Principle of Measurement:

The probe includes a central current-source electrode between two guard electrodes, maintained at the same potential by internal electronics. Current from the centre electrode is constrained to a thin disk by the presence of the guards and returns to the cable armour above a 10m insulated section. The potential of the central electrode with respect to a surface voltage-reference stake and the measured current are combined by a down-hole microprocessor to calculate apparent formation resistivity.

## SPECIFICATION:

### Features

- Good depth of penetration with excellent bed-boundary resolution
- Down-hole calibration check using internal resistor
- Digital down-hole measurement avoids errors due to cable effects in deeper boreholes
- Constant-power down-hole current source give 4 decades of measurement without range switching

### Measurements

- Focussed resistivity
- Natural Gamma

### Applications

#### Water

- Determination of water quality
- Indication of permeable zones and porosity

#### Minerals/Engineering

- Strata correlation between boreholes
- Indication of fractures and permeable zones
- Bed-boundary and thickness measurements
- Moisture determination in coal

### Operating Conditions

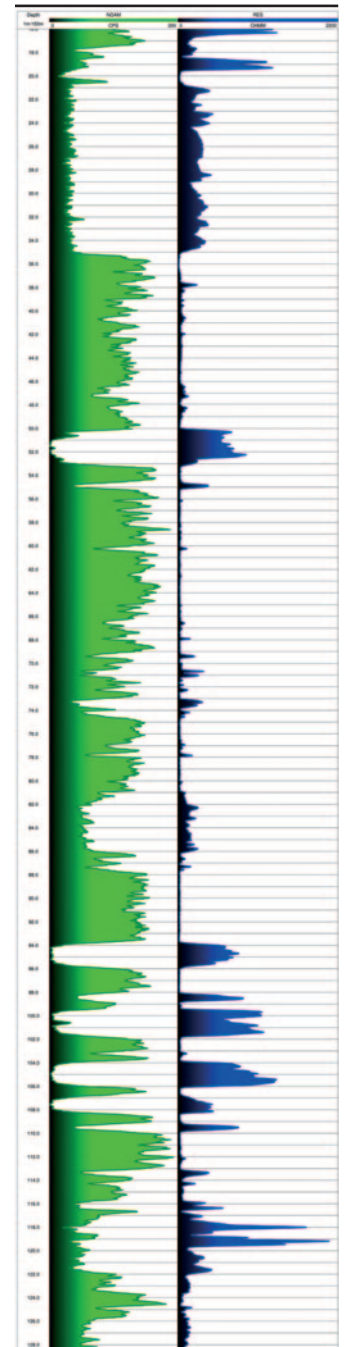
- Borehole type: open-hole, water-filled
- Centralisation: standoff recommended. The logging cable armour should be insulated for 10m above probe head
- Recommended Logging Speed: 4m/min

### Specifications

- Diameter: 38mm
- Length: 2.84m
- Weight: 9.5kg
- Temperature: 0-70°C (extended ranges available)
- Max. pressure: 20MPa
- Resistivity range: 1 to 10,000 ohm-m

### Part Numbers

- 1002078 Focussed Electric (Guardlog) probe includes natural gamma

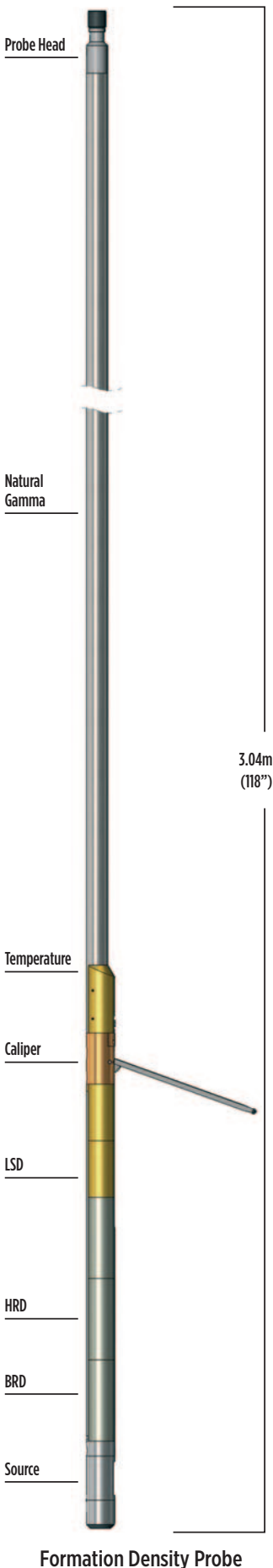


Example of logging data

Focussed Electric (Guardlog) Probe

# PROBES

## FORMATION DENSITY, DENSITY GUARDLOG & IRON ORE DENSITY



The Formation Density probe uses dual shielded detectors to provide a borehole-compensated density measurement with good bed-boundary resolution.

The Density Guardlog probe offers an additional LL3 focussed electrical measurement with good vertical resolution and depth of investigation. The Iron Ore Density probe includes extra collimation, different source-detector spacings and a higher activity source to extend the density range to 5g/cc for iron ore logging.

### Principle of Measurement:

The probes contain a detachable <sup>137</sup>Cs gamma source and two scintillation gamma detectors. The active windows of the source and detectors are maintained in contact with the borehole wall by a motorised caliper arm. Gamma radiation back-scattered by the formation (Compton effect) reaches the detectors where the relative count rates provide a measure of formation density.

### SPECIFICATION:

#### Features

- Compensated density output in engineering units (g/cc)
- Short-spacing detector for high vertical resolution
- Tungsten shielding reduces borehole effects
- Standard calibration blocks for field or base use

#### Measurements

- Bulk density
- High-resolution density (HRD)
- Natural gamma
- Caliper
- Options: Guard resistivity, Bed-resolution density (BRD), Temperature
- Dual calibrated density channels
- Fluid Temperature

#### Applications

##### Minerals:

- Density and porosity
- Lithology
- Bed thickness and boundary location
- Coal ash and moisture content

##### Engineering:

- Rock strength and elasticity parameters (with sonic log)
- Detection of weathered or fractured zones

##### Water:

- Location of aquifer and aquitard
- Detection of cavities and missing cement

#### Operating Conditions

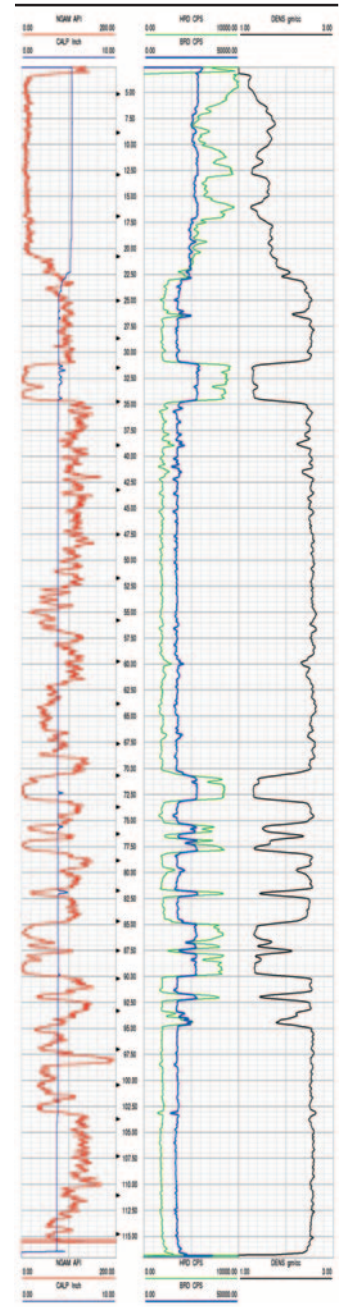
- Borehole type: All, including air filled (qualitative measurement only)
- Recommended Logging Speed: 4m/min

#### Specifications

- Diameter: 51mm
- Length: Formation Density 3.04m / Density Guardlog 2.89m
- Weight: 21kg (Density Guardlog 28.5kg)
- Temperature: 0-70°C (extended ranges available)
- Max. pressure: 20MPa
- Density range: 1.1 to 2.95g/cc (Formation Density and Density Guardlog probes)  
1.5 to 5.0g/cc (Iron Ore Density probe)
- Caliper range: 50mm to 300mm
- Resistivity range: 1-10000 ohm-m

#### Part Numbers

- 1002013 Formation Density probe
- 1002016 – includes BRD and temperature
- 1014720 Density Guardlog probe with BRD
- 1018309 Iron Ore Density probe

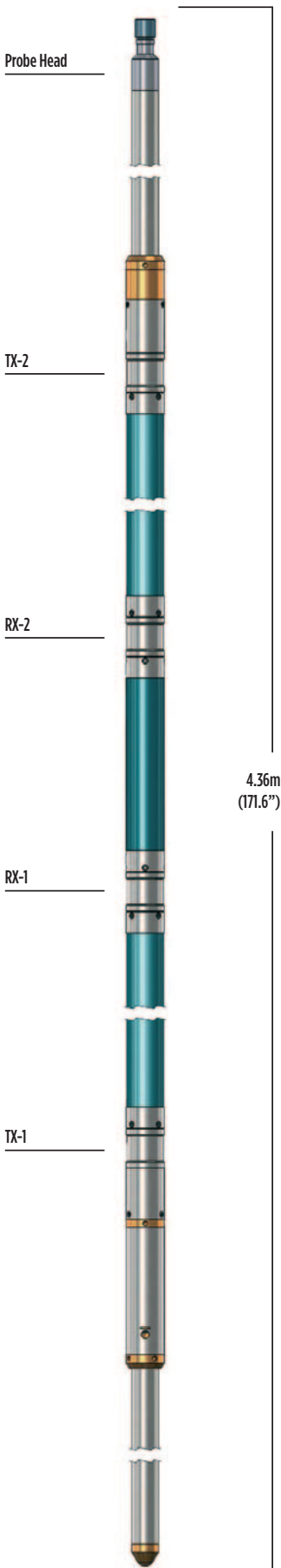


Example of logging data



# PROBES

## FULL WAVEFORM SONIC



Full Waveform Sonic Probe

The Full Waveform Sonic probe uses a dual-transmitter dual-receiver array to provide high quality formation acoustic-velocity data.

Options are available for display of full-waveform data and cement-bond data (CBL) in cased boreholes.

### Principle of Measurement:

A piezoelectric transmitter stimulated by a high-voltage pulse radiates a high-frequency acoustic wavelet. This is coupled via the borehole fluid and formation to each receiver. An accurate quartz clock measures the first arrival transit time. The first arrival in open hole corresponds to the p-wave path in the formation.

**Full Waveform Sonic mode:** Two pairs of transmitters and receivers are used to allow cancellation of the borehole fluid path and determination of formation velocity (slowness). The full sonic waveform from both receivers is displayed as a variable-density log (VDL) or waveform ('wiggles') trace.

**Cement Bond Log (CBL) mode:** The probe records the amplitude and arrival time of the first casing arrival at the near receiver and full sonic waveforms from both receivers.

**GeoCAD® Sonic Module:** This optional package allows shear wave slowness processing from the full waveform data. These can be combined with additional density data to determine elastic moduli. First arrivals and waveform amplitudes can also be determined by the CBL function to provide cement bond quality reports.

## SPECIFICATION:

### Features

- Down-hole digitisation of waveform data
- Compensation for poor centralisation or casing
- Variable density log (VDL) or wavelet ('wiggles') display

### Measurements

- Formation velocity (slowness)
- Shear (S) velocity (where shear wave exists)
- Full waveform Time of first arrival (delta-t)
- Amplitude of first arrival (CBL)
- Integrated transit time
- Natural Gamma optional

### Applications

#### Water / Minerals / Engineering

- Porosity
- Rock strength and elasticity (with density log)
- Correction of seismic velocity
- Fracture and permeability indication in hard rock
- Location of poor or missing cement behind casing

### Operating Conditions

#### Borehole type:

- Sonic: open-hole, water-filled
- CBL: cased-hole, water-filled
- Centralisation: required
- Recommended Logging Speed: 4m/min

### Specifications

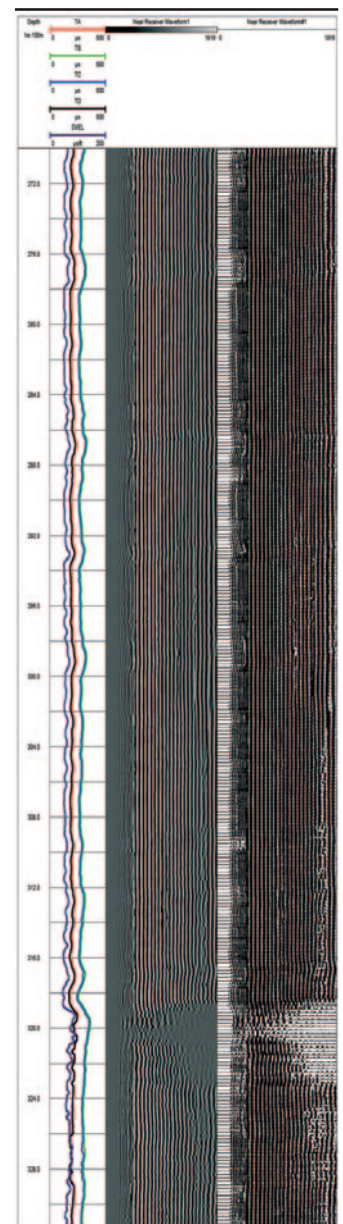
- Diameter: 60mm
- Length: 4.36m (4.78m with gamma)
- Weight: 30kg (33kg with gamma)
- Temperature: 0-70°C (extended ranges available)
- Max. pressure: 20MPa

### Part Numbers

- 1002128 Full Waveform Sonic probe with CBL

#### GeoCAD® Sonic Module

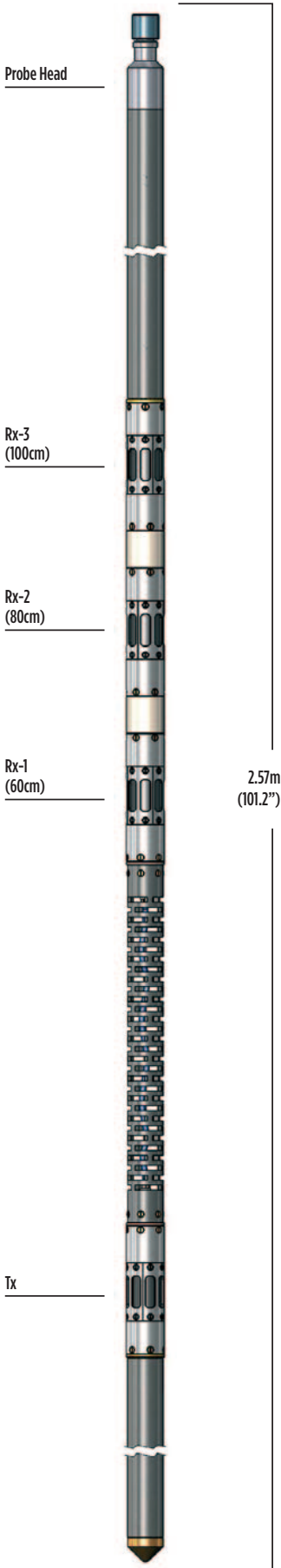
- 1020983 GeoCAD® Sonic Module



Example of logging data

# PROBES

## FULL WAVEFORM TRIPLE SONIC



The Full Waveform Triple Sonic probe is a highly compact slimhole tool designed specifically for geotechnical and mining applications.

The probe acquires transit-time and full-waveform data simultaneously from a single transmitter and three receivers.

### Principle of Measurement:

The piezoelectric transmitter is stimulated by a high-voltage pulse and radiates a high-frequency acoustic wave through the borehole fluid and formation to each receiver. An accurate quartz clock measures the first arrival transit time.

**Formation Velocity:** The probe measures the time of the first arrival at each receiver. The difference in arrival times between the three receiver pairings allows formation velocity to be calculated in triplicate, independent of the borehole fluid path.

**Full Waveform Log:** The probe records the full sonic wave-train at all receivers simultaneously. This can be displayed either as a variable-density log (VDL) or waveform ("wiggles") trace. The waveform data can be exported to be used in software packages, such as GeoCAD® for calculation of compressional (P), shear (S) and Stoneley velocities.

**GeoCAD® Sonic Module:** This optional package allows shear wave slowness processing from the full waveform data. These can be combined with additional density data to determine elastic moduli. First arrivals and waveform amplitudes can also be determined by the CBL function to provide cement bond quality reports.

## SPECIFICATION:

### Features

- Short probe can be handled by single operator and easily transported
- Slim diameter for narrow boreholes
- Rigid construction for effective centralisation
- Down-hole digitisation of waveform data
- Detection gain and threshold under operator control
- Detection point and wavelet display shown in real-time

### Measurements

- Formation velocity (slowness)
- Time of first arrival (delta-t)
- Integrated transit time
- Full-waveform data from 3 receivers
- Shear and Stoneley velocities (requires additional interpretation software)
- Natural Gamma

### Applications

#### Geotechnical / Mining / Water

- Fracture and permeability indication in hard rock
- Rock strength and elasticity
- Lithology identification
- Porosity
- Correction of seismic velocity

### Operating Conditions

#### Borehole type:

- Sonic: open-hole, water-filled
- Centralisation: required
- Recommended Logging Speed: 3m/min

### Specifications

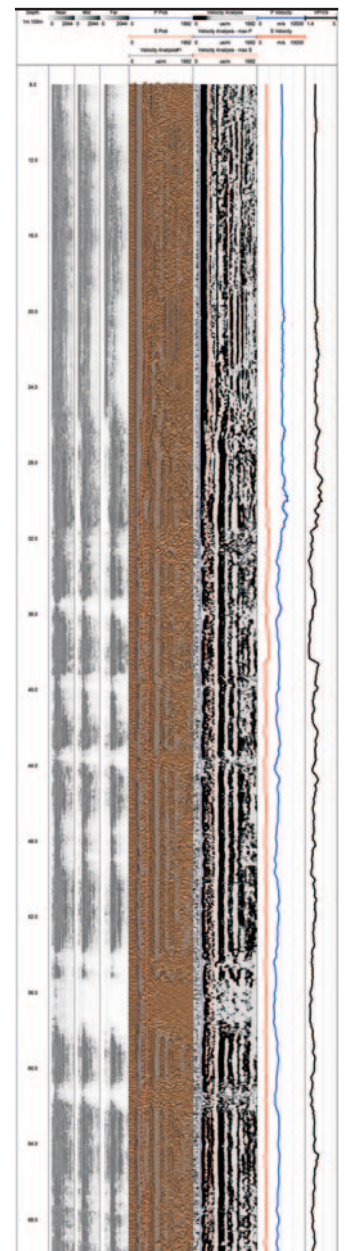
- Diameter: 45mm
- Length: 2.57m (2.96m with natural gamma)
- Weight: 11.5kg with natural gamma
- Temperature: 0-70°C (extended ranges available)
- Max. pressure: 20MPa

### Part Numbers

- 1013861 Full Waveform Triple Sonic probe with natural gamma

#### GeoCAD® Sonic Module

- 1020983 GeoCAD® Sonic Module

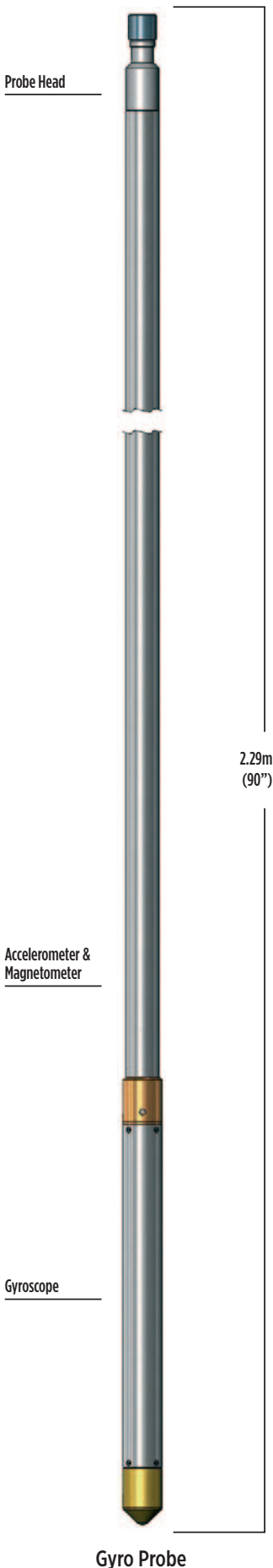


Example of logging data

Full Waveform Triple Sonic Probe

# PROBES

## GYRO



The Gyro probe acquires borehole inclination/azimuth logs in situations where metal casing or magnetic materials around the borehole prevent use of the standard verticality probe.

The Gyro Magnetometer version also acquires 3D-magnetic data for location of magnetic ore bodies.

### Principle of Measurement:

The standard probe includes a gimbal-mounted directional gyroscope for orientational measurement and three accelerometers for inclination. In the Gyro Magnetometer probe, an additional triaxial fluxgate magnetometer continuously measures X, Y and Z magnetic components. These are used to compute the magnitude and direction of the magnetic field around the probe.

## SPECIFICATION:

### Features

- Continuous log of borehole inclination/azimuth
- Not influenced by metal casing or magnetic materials
- Low drift compared to 'rate' gyroscopes
- Natural-gamma measurement
- Magnitude and direction of surrounding magnetic field

### Measurements

- Borehole inclination
- Borehole drift
- True vertical depth
- Natural Gamma
- Magnitude and direction of surrounding magnetic field

### Applications

#### Water / Minerals / Engineering

- Verticality measurements in steel casing or in the presence of magnetic ores
- Detection of nearby magnetic ore bodies (Gyro Magnetometer probe)

### Operating Conditions

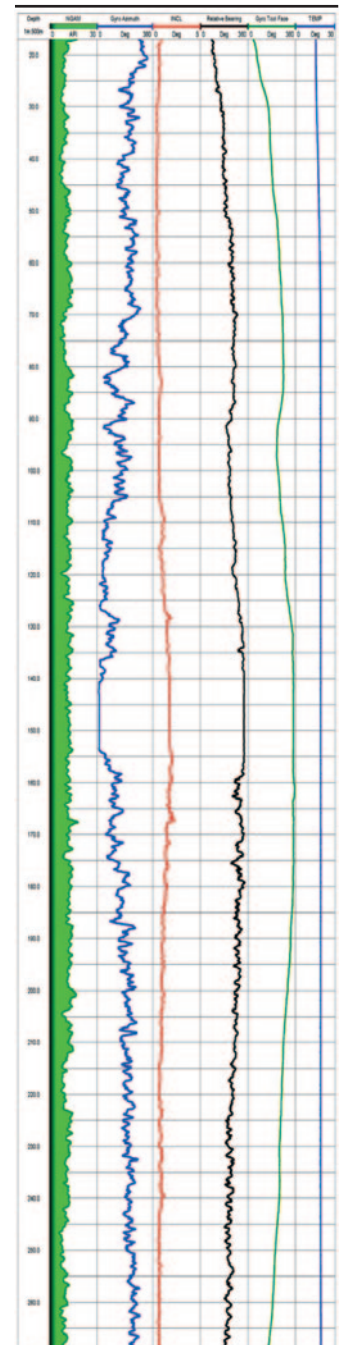
- Borehole type: open/cased hole; water/air-filled
- Centralisation: required
- Recommended Logging Speed: 3m/min

### Specifications

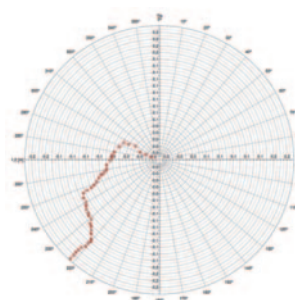
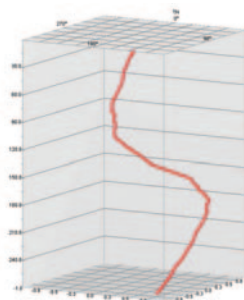
- Diameter: 45mm
- Length: 2.29m
- Weight: 12kg
- Temperature: 0-70°C (extended ranges available)
- Max. pressure: 20MPa
- Inclination range: 0 to 30°
- Azimuth range: 0 to 360°
- Magnetometer range: +/-100  $\mu$ T

### Part Numbers

- 1002150 Gyro probe with natural gamma
- 1014559 Gyro Magnetometer probe with natural gamma



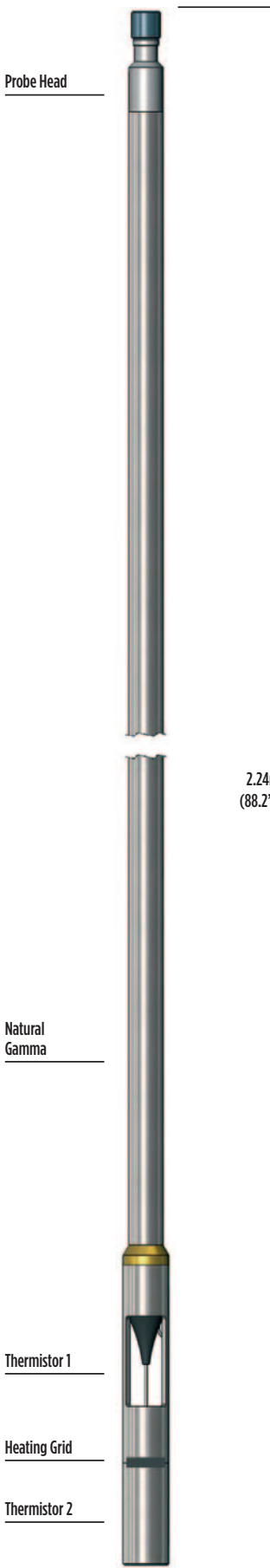
Examples of logging data





# PROBES

## HEAT-PULSE FLOWMETER



The Heat-Pulse Flowmeter probe is used to detect low vertical flows within a borehole below the threshold limits of conventional impeller tools.

The probe is designed for stationary measurements only. Normal logging practice involves measurements at a series of depths across the zone of interest.

### Principle of Measurement:

The probe contains a horizontal wire-grid heating element and thermistors located above and below it. Apertures in the tool permit the free flow of well fluid through the assembly. Pulses of electric current are applied to the heating grid under surface command, warming fluid in the vicinity of the grid. The warm fluid front migrates towards the thermistors where it is detected. Depending on the direction of flow, either upper or lower thermistor detects the warm fluid front first. The time taken to reach the detector gives an indication of flow rate.

## SPECIFICATION:

### Features

- Detection of very low vertical flow rates
- Auto-null command cancels tool offsets prior to each measurement

### Measurements

- Up/down flow

### Applications

#### Water

- Location of permeable zones in water wells
- Casing leak detection

### Operating Conditions

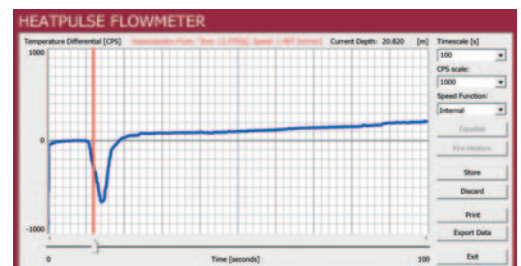
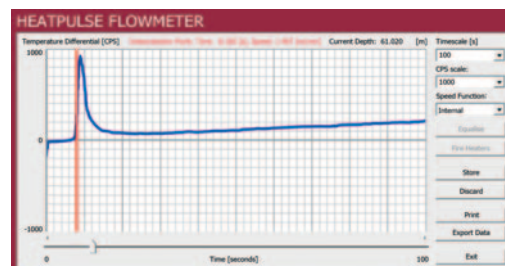
- Borehole type: open/cased hole, water-filled
- Centralisation: required
- Recommended Logging Speed: static measurements

### Specifications

- Diameter: 51mm
- Length: 2.24m
- Weight: 8.0kg
- Temperature: 0-50°C
- Max. pressure: 20MPa
- Measurement range: 0.1 to 3m/min

### Part Numbers

- 1002119 Heat-Pulse Flowmeter probe



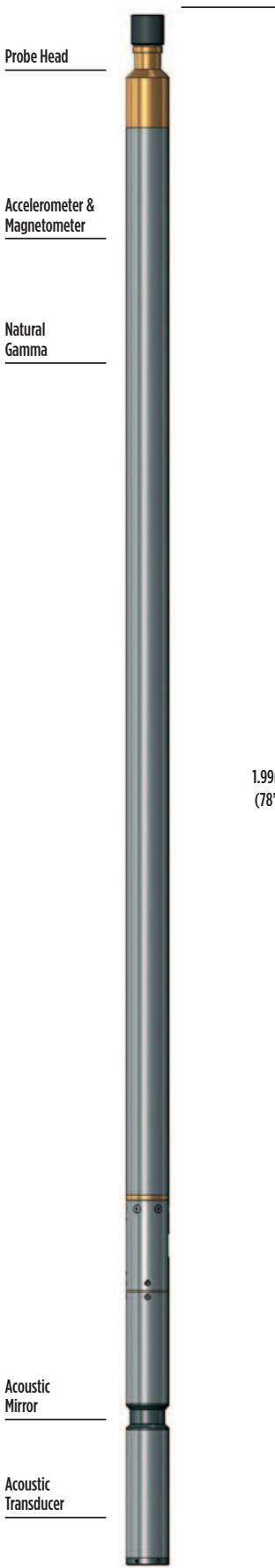
Examples of logging data

Heat-Pulse Flowmeter Probe



# PROBES

## HIGH RESOLUTION ACOUSTIC TELEVIEWER (HRAT)<sup>®</sup>



The High Resolution Acoustic Televiewer (HRAT)<sup>®</sup> provides a continuous high-resolution oriented ultrasound image of the borehole wall.

The probe uses a fixed acoustic transducer and a rotating acoustic mirror to scan the borehole walls with a focussed ultrasound beam. The amplitude and travel time of the reflected acoustic signal are recorded as separate image logs.

Features such as fractures reduce the reflected amplitude and appear as dark sinusoidal traces on the log. The travel-time log is equivalent to a 360-arm caliper and shows diameter changes within open fractures and 'break-outs'. Directional information is also recorded and used to orient the images in real time.

**GeoCAD<sup>®</sup> Televiewer Module:** is a Windows-based package for processing, interpreting and displaying acoustic and optical televiewer image logs. Standard log presentations include tadpole and stick plots, stereographic projections of poles to planes and azimuth frequency diagrams. The synthetic core display allows convenient comparison of log and field data for orientation of fractured or incomplete core sections.

### SPECIFICATION:

#### Applications

- Fracture identification and orientation
- Stratigraphic studies
- Local stress studies (break-out)
- Core orientation
- Cased-hole studies

#### Operating Conditions

- Borehole Type: Fluid filled
- Recommended Logging Speed: 2.5m/min

#### Specifications

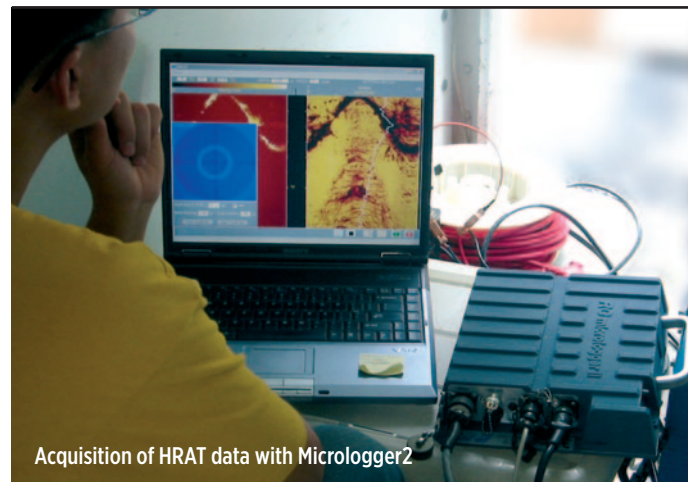
- Diameter: 42mm
- Length: 1.99m
- Weight: 5kg
- Temperature (max): 70°C
- Transducer type: 1.5MHz piezo-composite
- Rotation rate: 5 - 20rev/s
- Sample rate: up to 360/rev

#### Part Numbers

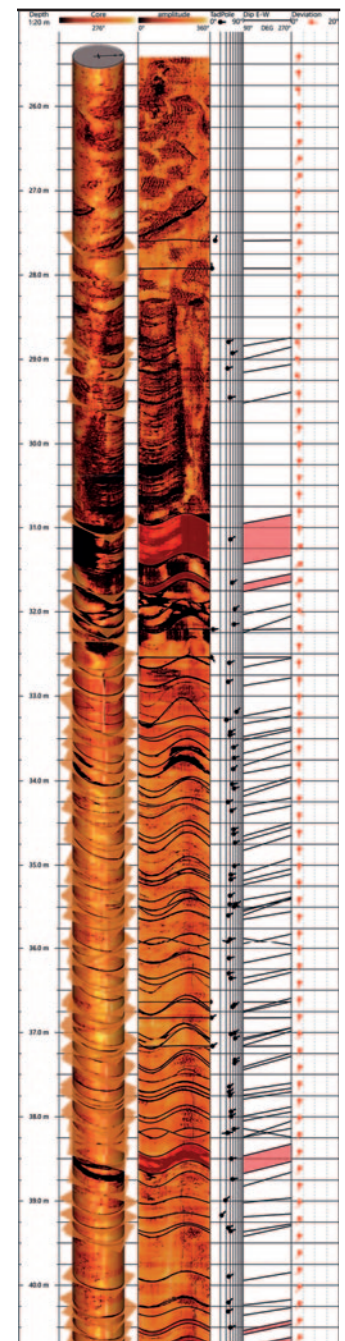
- 1002184 HRAT<sup>®</sup> probe
- 1002192 HRAT<sup>®</sup> including natural-gamma

#### GeoCAD<sup>®</sup> Televiewer Module

- 1020248 GeoCAD<sup>®</sup> Televiewer Module



Acquisition of HRAT data with Micrologger2



Example of logging data

High Resolution Acoustic Televiewer (HRAT)<sup>®</sup> Probe

# PROBES

## HIGH RESOLUTION OPTICAL TELEVIEWER (Hi-OPTV)<sup>®</sup>



2.13m - 2.14m  
(83.9" - 84.3")

The High Resolution Optical Televiewer (Hi-OPTV)<sup>®</sup> provides a continuous very high resolution oriented image of the borehole walls using a conventional light source.

A unique optical system based on a fisheye lens allows the probe to survey 360 degrees simultaneously. This information is processed in real time to produce a complete 'unwrapped' image of the borehole oriented to magnetic north. The probe offers superior resolution to the High Resolution Acoustic Televiewer (HRAT)<sup>®</sup> and produces images in real colour. While, unlike the HRAT<sup>®</sup>, it can operate in air-filled boreholes, it is unsuitable for boreholes containing mud or cloudy fluids.

GeoCAD<sup>®</sup> Televiewer Module: is a Windows-based package for processing, interpreting and displaying acoustic and optical televiewer image logs. Standard log presentations include tadpole and stick plots, stereographic projections of poles to planes and azimuth frequency diagrams. The synthetic core display allows convenient comparison of log and field data for orientation of fractured or incomplete core sections.

### SPECIFICATION:

#### Applications

- Fracture identification and orientation
- Stratigraphic studies
- Local stress studies (break-out)
- Core orientation
- Cased hole studies

#### Operating Conditions

- Borehole Type: Air filled or clear fluid
- Recommended Logging Speed: 3m/min

#### Specifications

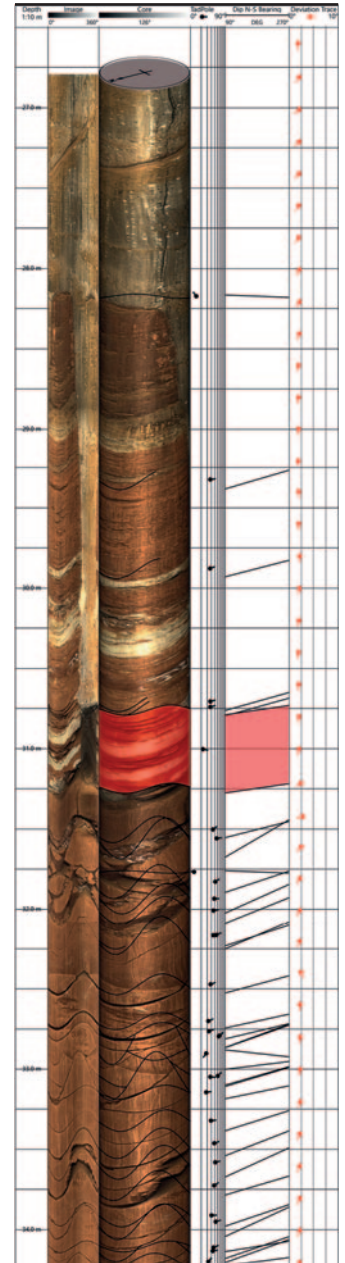
- Length: 2.13m - 2.14m (10MPa/20MPa window)
- Diameter: 46mm (10MPa) & 58mm (20MPa)
- Weight: 6kg (10MPa) or 7.2kg (20MPa)
- Temperature (max): 60°C
- Circular resolution: user definable 360/540/720 /900/1080/1260/1440 pixels
- Sensor type: 1280 x 1024 pixels CMOS image sensor
- Colour resolution: 24 bit RGB

#### Part Numbers

- I017187 Hi-OPTV<sup>®</sup> probe (46mm)
- I017188 Hi-OPTV<sup>®</sup> probe (46mm) with gamma
- I017125 Hi-OPTV<sup>®</sup> probe (58mm)
- I017216 Hi-OPTV<sup>®</sup> probe (58mm) with gamma
- I015464 Gamma Test Blanket

#### GeoCAD<sup>®</sup> Televiewer Module

- I020248 GeoCAD<sup>®</sup> Televiewer Module



Examples of logging data

High Resolution Optical Televiewer (Hi-OPTV)<sup>®</sup> Probe

# PROBES

## IMPELLER FLOWMETER



**Impellers can detect differential flow rates as low as 1.0m/min.**

Logging at a range of speeds allows detection of flow of any rate (although for high precision in low flow rates use of the Heat-Pulse Flowmeter is advised).

### Principle of Measurement:

The probes are equipped with lightweight helical impellers mounted on double sapphire bearings. The impellers contain magnets which actuate Hall-effect switches within the probe to detect impeller rotation. Separate log channels record the time of rotation according to fast and slow timebases for improved resolution at high and low flow rates. Uphole and downhole rotations are distinguished within the probe.

## SPECIFICATION:

### Features

- Jewelled bearings for minimum friction
- Low-drag sensors
- Choice of head diameters
- Cable-speed readout

### Measurements

- Flow
- Cable velocity
- Optional natural gamma

### Applications

#### Water

- Flow measurement within a water well
- Location of permeable zones
- Casing leak detection

### Operating Conditions

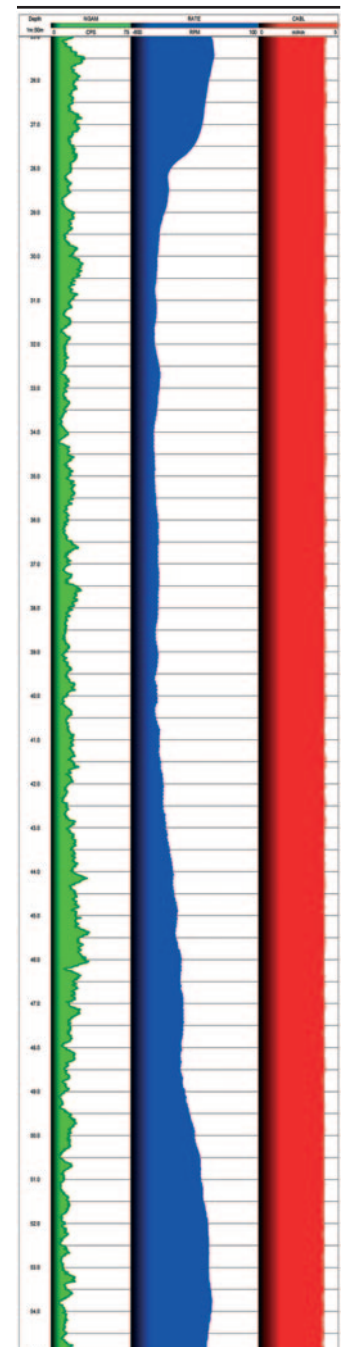
- Borehole type: open/cased, water-filled
- Centralisation: required
- Recommended Logging Speed: Multiple passes, varied speeds 2-7 m/min

### Specifications

- Diameter: 45mm, 70mm
- Length: 1.53m
- Weight: 4.0kg
- Temperature: 0-70°C (extended ranges available)
- Max. pressure: 20MPa

### Part Numbers

- 1002122 Impeller Flowmeter 45mm
- 1002115 Impeller Flowmeter 70mm



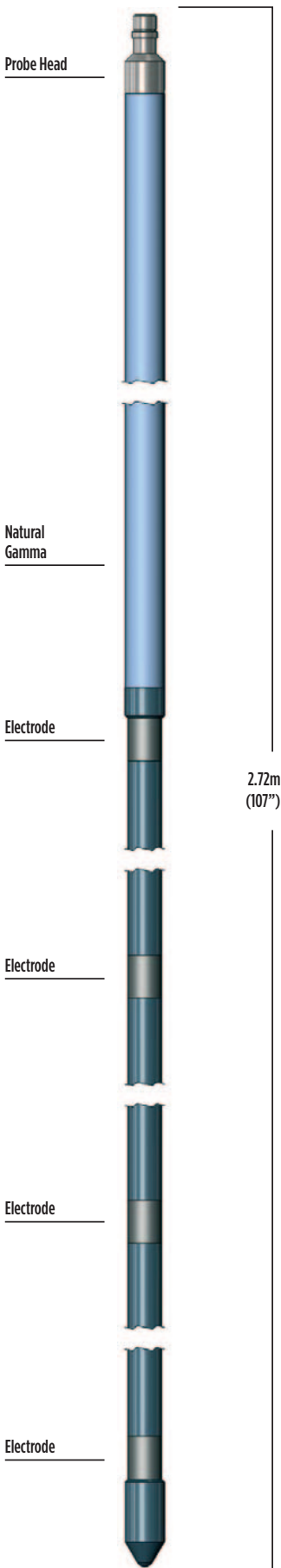
Example of logging data

Impeller Flowmeter Probe



# PROBES

## INDUCED POLARISATION



Induced Polarisation Probe

The Induced Polarisation probe measures the charge separation or 'chargeability' in porous, water-saturated, mineralised rocks caused by the passage of a low-frequency alternating current.

The main cause of induced polarisation is a current-induced electron-transfer reaction between ions of an electrolyte in contact with grains of semi-conducting metallic minerals.

### Principle of Measurement:

The probe passes a controlled current through the formation between two outer electrodes and detects the variation with time of the resulting voltage measured between two inner electrodes after the device is removed. The integrated area under the voltage-time curve is a measure of chargeability.

### SPECIFICATION:

#### Features

- Microprocessor-controlled drive voltage
- Down-hole integration and ratio computation

#### Measurements

- Chargeability
- Formation resistance
- Natural Gamma

#### Applications

##### Minerals

- Indication of mineralisation, particularly of disseminated sulphides
- Differentiation of haematite and magnetite

##### Water

- Qualitative permeability studies

#### Operating Conditions

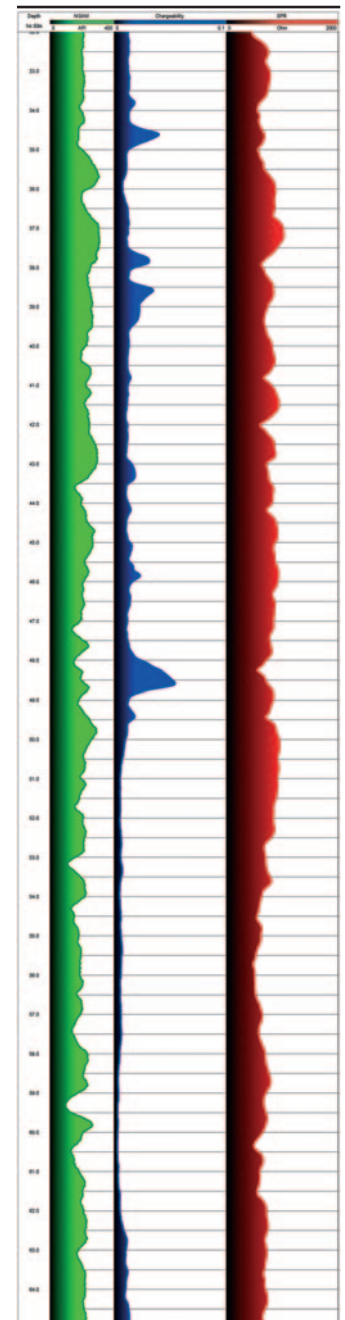
- Borehole type: open-hole, water-filled
- Recommended Logging Speed: 3m/min

#### Specifications

- Diameter: 45mm
- Length: 2.72m
- Weight: 11kg
- Temperature: 0-70°C (extended ranges available)
- Max. pressure: 20MPa

#### Part Numbers

- 1002102 Induced Polarisation probe with natural gamma

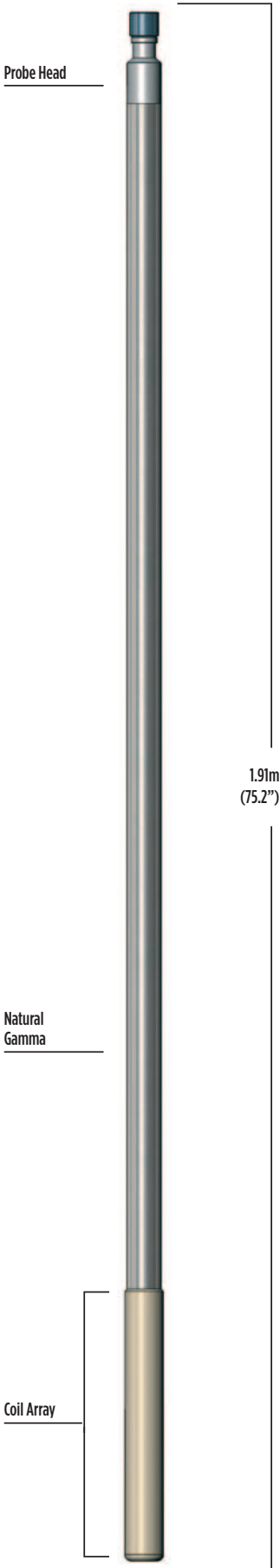


Example of logging data



# PROBES

## MAGNETIC SUSCEPTIBILITY



Magnetic Susceptibility Probe

The Magnetic Susceptibility probe is based on the industry-standard Bartington Instruments™ product.

It is a low-frequency device and is specifically designed for mining applications. The probe has excellent stability against pressure and temperature variations.

### Principle of Measurement:

An oscillating magnetic field in the probe produces a current within a toroidal zone in the surrounding formation. The oscillating current produces a secondary field that is detected by the receiver coils. The 'quadrature' signal is a measure of susceptibility.

## SPECIFICATION:

### Features

- Operates in dry or water-filled boreholes
- Unaffected by plastic casing Ideal for use in small-diameter exploration boreholes
- Excellent thermal/pressure stability across specified operating range

### Measurements

- Magnetic susceptibility
- Natural Gamma

### Applications

The probe has particular use for detecting uranium where the log shows a negative correlation with uraniferous compounds. Susceptibility logs are highly sensitive to iron and show large contrasts according to its oxidation state. The frequent occurrence of iron with other redox-sensitive metals can provide a valuable indicator of the presence of other minerals.

### Operating Conditions

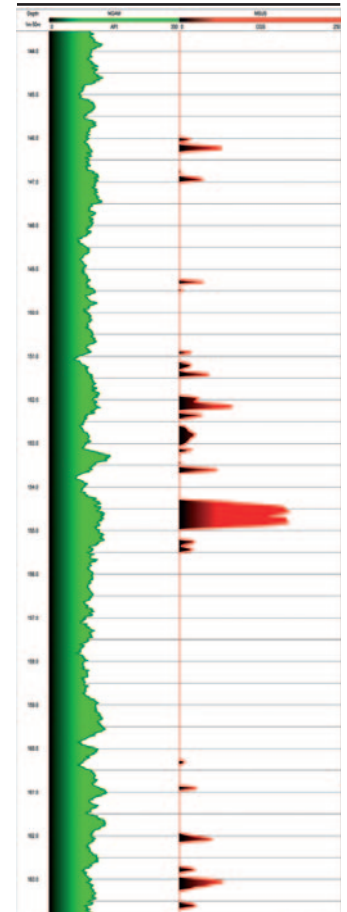
- Borehole type: open/cased (plastic), water/air-filled
- Centralisation: fin stand-off recommended
- Recommended Logging Speed: 3m/min

### Specifications

- Diameter: 43mm
- Length: 1.91m
- Weight: 5.5kg
- Temperature: 0-70°C (extended ranges available)
- Max. pressure: 20MPa
- Operating frequency: 1.439kHz
- Range: 10<sup>-5</sup> to 10<sup>-1</sup> cgs (Gaussian)

### Part Numbers

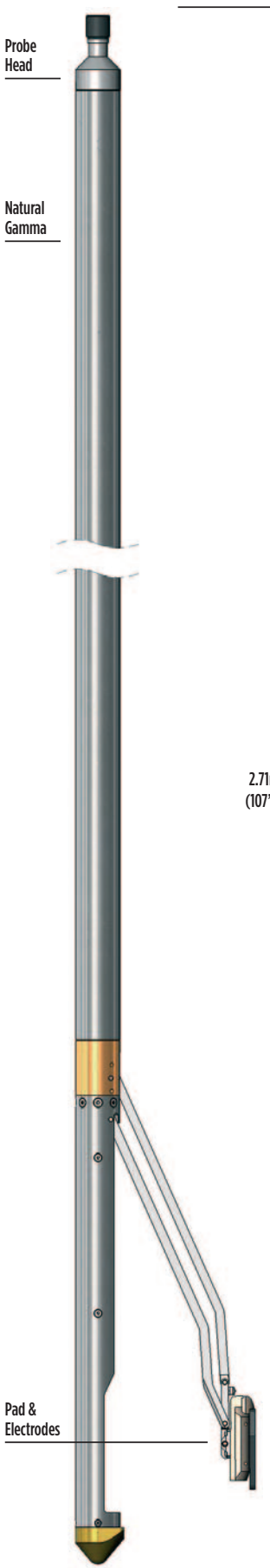
- 1002095 Magnetic Susceptibility probe with natural gamma



Example of logging data

# PROBES

## MICRORESISTIVITY



The Microresistivity probe provides a focussed pad resistivity measurement with high vertical resolution combined with a caliper and natural gamma.

### Principle of Measurement:

The resistivity measurement is based on the guard principle where a ring electrode maintained at the same potential as the central measurement electrode focusses the measure current into a narrow beam. The electrodes are contained within a flexible pad mounted on a motor-driven arm and maintained in contact with the borehole wall during logging. The same arm also operates the caliper mechanism. A natural-gamma measurement is included to aid correlation with other logs.

### SPECIFICATION:

#### Features

- Small electrode spacing for high resolution
- Pad design minimises borehole effects

#### Measurements

- Focussed microresistivity
- Caliper
- Natural Gamma

#### Applications

##### Minerals / Water / Engineering

- High-precision bed boundary and thickness determination
- Resolution of seam partings
- Invasion profile (in combination with other resistivity methods)

#### Operating Conditions

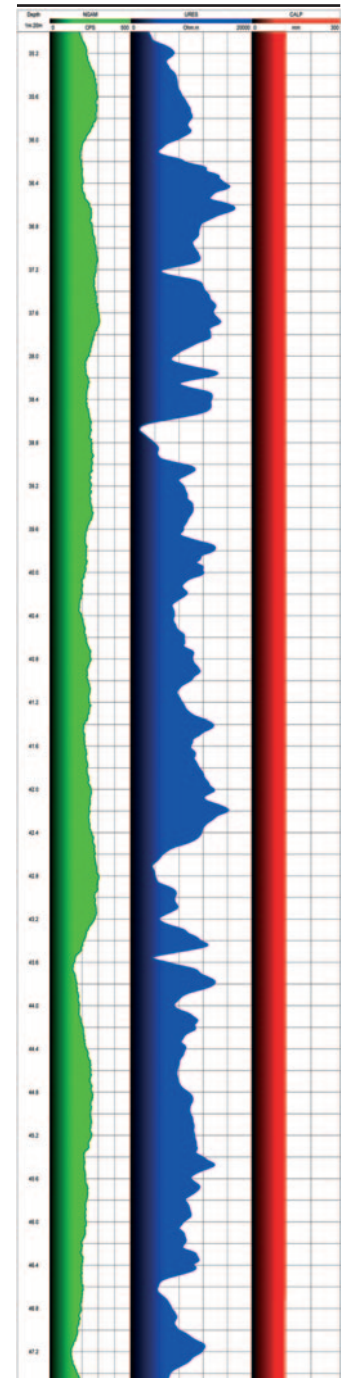
- Borehole type: open-hole, water-filled
- Centralisation: excentralised with caliper arm

#### Specifications

- Diameter: 58mm
- Length: 2.71m
- Weight: 23kg
- Temperature: 0-70°C (extended ranges available)
- Max. pressure: 20MPa
- Resistivity range: 0.2 to 2000 ohm-m
- Caliper range: 58mm to 400mm

#### Part Numbers

- 1002084 Microresistivity probe with natural gamma

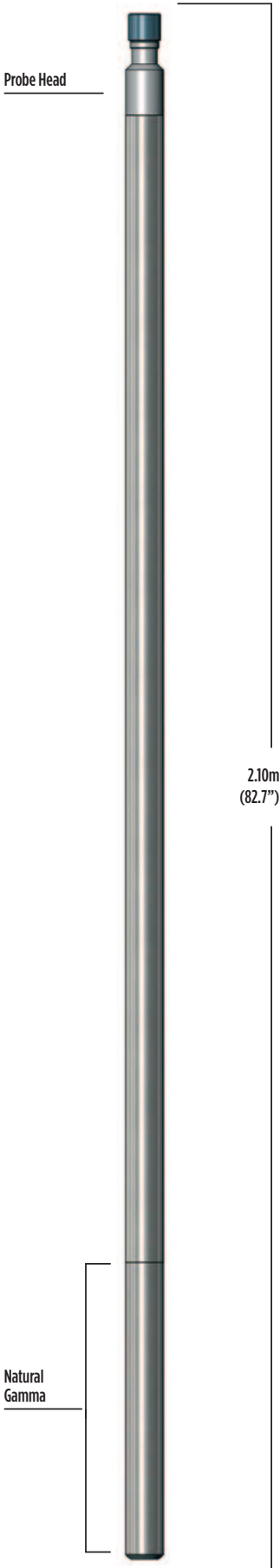


Example of logging data

Microresistivity Probe

# PROBES

## NATURAL GAMMA [TRIPLE GAMMA & ULTRA-SLIM GAMMA]



The Triple Gamma and Ultra-Slim Gamma probes measure the activities of naturally occurring or man-made isotopes.

### Principle of Measurement:

The probes are based on scintillation gamma detectors. The detectors measure the natural gamma radiation released from potassium and the decay products of uranium and thorium in the borehole.

### SPECIFICATION:

#### Features

- Small diameter for slim-hole operations
- Multiple detectors with different sensitivities

#### Measurements

Natural Gamma

#### Applications

- Mineral detection
- Strata correlation between wells

#### Operating Conditions

- Borehole type: open/cased, water/air-filled
- Recommended Logging Speed: 4m/min (slower in low gamma lithology)

#### Specifications

##### Triple Gamma Probe

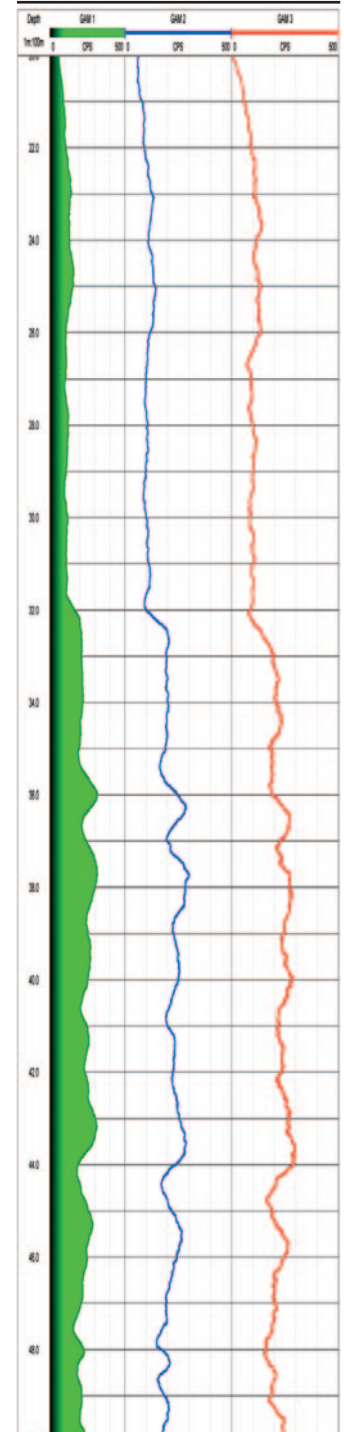
- Diameter: 38mm
- Length: 2.10m
- Weight: 6kg
- Natural-gamma detectors: 25mm x 25mm NaI(Tl)  
50mm x 25mm  
100mm x 25mm
- Temperature: 0-70°C (extended ranges available)
- Max. pressure: 20MPa

##### Ultra-Slim Gamma Probe

- Diameter: 27mm
- Length: 0.79m
- Weight: 4kg
- Natural-gamma detectors: 125mm x 17.5mm Cs(Tl)
- Temperature: 0-70°C (extended ranges available)
- Max. pressure: 10MPa

#### Part Numbers

- 1002009 Triple Gamma probe
- 1002007 Ultra-Slim Gamma probe

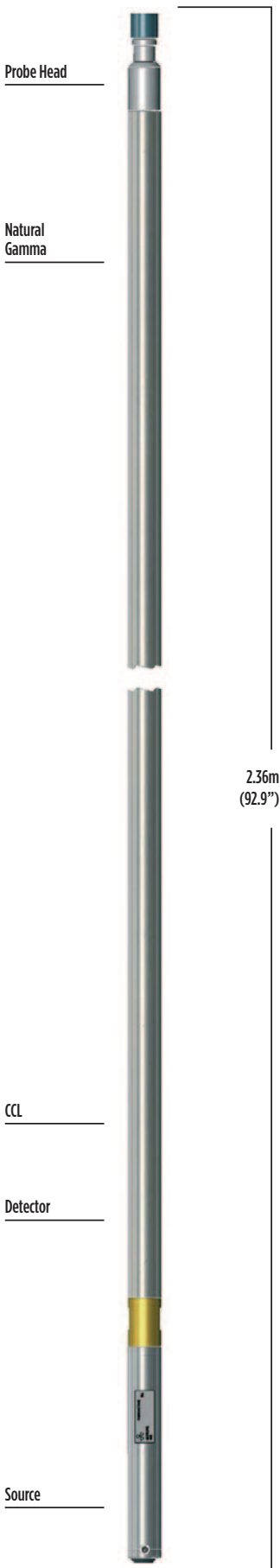


Example of logging data

Natural Gamma Probe

# PROBES

## NEUTRON | NEUTRON SP/SPR



Neutron Probe

The Neutron probe provides qualitative porosity logging under most borehole conditions including through steel or plastic casing and drill-pipe.

A Dual Neutron probe is also available which provides a calibrated borehole-compensated neutron porosity measurement in mud-filled open holes. It is the probe of choice for quantitative formation-fluid studies.

### Principle of Measurement:

The neutron measurement uses a <sup>3</sup>He proportional detector and a detachable, sealed <sup>241</sup>Am-Be neutron source. Fast neutrons emitted by the source are scattered and slowed to thermal levels, principally by hydrogen in the formation. The Neutron SP/SPR probe combines this with a resistivity measurement, giving two independent indicators of formation porosity.

## SPECIFICATION:

### Features

Real-time qualitative porosity measurement

### Measurements

#### Neutron:

- Neutron (raw counts)
- Natural gamma
- Option: Casing collar locator (CCL)

#### Neutron SP/SPR:

- Neutron (raw counts)
- Natural gamma
- Short normal resistivity
- Self potential

### Applications

#### Minerals / Water / Engineering

- Lithology identification
- Location of aquifer and aquitard
- Shale content
- Correlation between open and cased-hole logs
- Strata correlation between wells

### Operating Conditions

- Borehole type: open/cased, water-filled
- Recommended Logging Speed: 4m/min

### Specifications

#### Neutron:

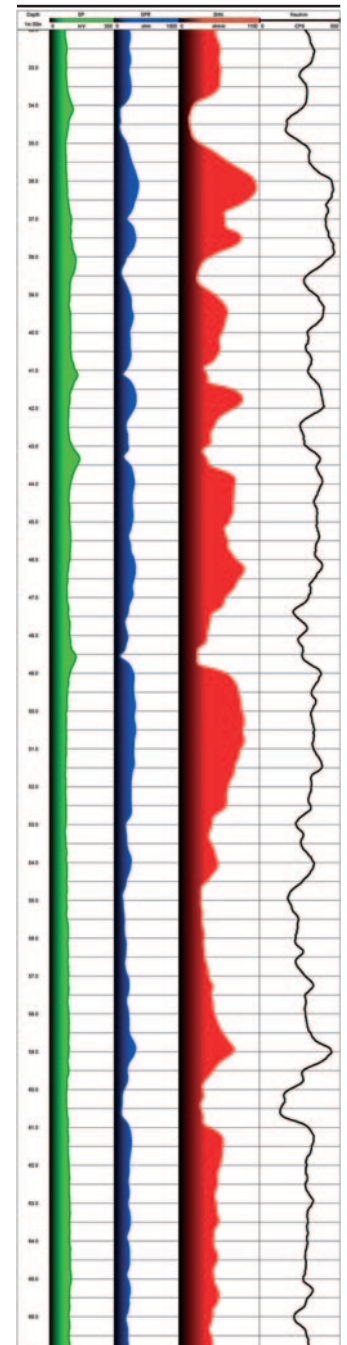
- Diameter: 38mm
- Length: 2.36m
- Weight: 7.5kg
- Temperature: 0-70°C (0-125°C optional)
- Max. pressure: 20MPa

#### Neutron SP/SPR:

- Diameter: 45mm
- Length: 2.86m
- Weight: 11.5kg
- Temperature: 0-70°C
- Max. pressure: 20MPa
- Range: 1-10000Ωm

### Part Numbers

- 1002029 Neutron/Natural Gamma
- 1017443 Neutron SP/SPR probe with natural gamma
- 1015483 - includes natural gamma and CCL



Example of logging data



# NMR Javelin® Wireline Slim

## Small-Diameter Nuclear Magnetic Resonance Wireline Logging Tool



Javelin Slim Downhole Digital Module (2.38in., 60mm)

JPY238

JPY350

### For professional geophysical logging operators

The new Javelin® Wireline Slim provides high-resolution, continuous measurements of principal aquifer properties for groundwater and environmental investigations:

- Porosity
- Pore size distribution
- Natural gamma
- Bound and mobile water content
- Hydraulic conductivity

### SPECIFICATION:

#### Applications

- Geotechnical site investigations
- Groundwater resource management
- Aquifer storage and recovery
- Environmental site characterization
- Mine water engineering
- Brine and leach mining

#### Features

##### Interchangeable Probes

- 2.38in (60mm) and 3.5in (89mm) probes allow operation in a wide range of core holes and groundwater wells
- Integrated field joints for rapid and secure deployment

##### Widest Diameter of Investigation

- Largest Diameter of Investigation of any small or medium diameter magnetic resonance logging tool
- Measures properties of native formation past the disturbed zone

##### Multiple Depths of Investigation

- Two independent DOI shells measured during a single logging run allows users to assess radial variability

##### Ultra-Short Echo Spacing

- Echo spacing as short as 450 microseconds ensures accurate measurement of clay-bound water content

##### Industry-Standard Wireline Compatibility

- Operation on 4-conductor or 7-conductor wireline cable ensures seamless integration with existing logging operations

##### Flexible Surface Station

- Surface station housing tool power, control, and telemetry electronics operates both the Javelin® Wireline Slim and larger Javelin® Wireline Max logging systems

#### Specifications

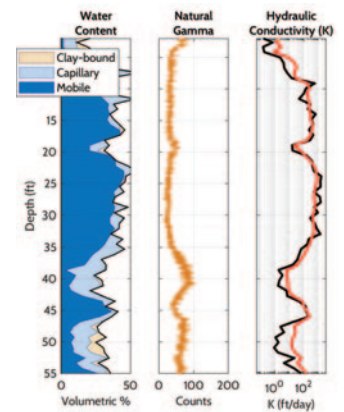
Javelin Probes:	JPY238	JPY350
Diameter:	2.38in (60mm)	3.5in (89mm)
Length:	74in (188cm)	72in (183cm)
Weight:	25lb (11kg)	55lb (25kg)
Pressure Rating:	2350 PSI	1700 PSI
Sensitive Diameters:	F <sub>1</sub> : 9in (23cm)	F <sub>1</sub> : 12in (30cm)
	F <sub>2</sub> : 11in (28cm)	F <sub>2</sub> : 15in (38cm)
Vertical Resolution:	9in (25cm)	18in (50cm)
Echo Spacing:	450µs	600µs

#### Downhole Digital Module:

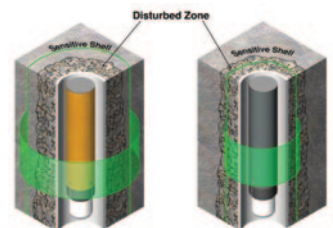
Diameter:	2.38in (60mm)
Length:	70in (178cm)
Weight:	39lb. (18kg)
Length w/ Gamma Sensor:	85in (217cm)
Weight w/ Gamma Sensor:	45lb. (20kg)
Natural Gamma Sensor:	Optional Logging Speed: 100-500 ft/hr
Cable:	3/16 inch (or larger), 4-core or 7-core



Two independent measurement shells (shown to scale)



Examples of logging data



Javelin deep-view sensitivity

Unusable data without deep-view

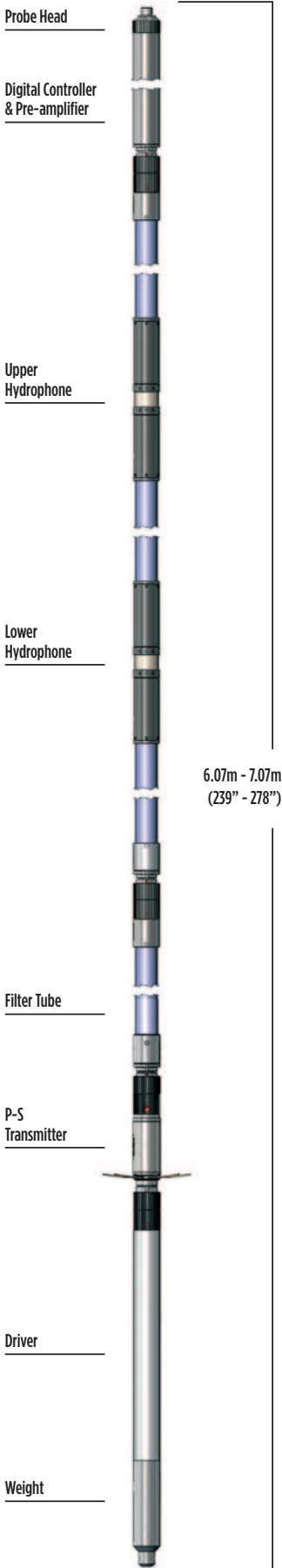


Surface Station is available as a rackmount unit (4U) or housed in a compact, shock-mounted case.

CE Certified, FCC, CTick, CE Emissions Compliant  
 Protected by US Patents: US 10,162,026 B2; US 10,302,733 B2; US 8,816,684 B2; US 9,348,054 B2; US 9,588,068 B2.  
 JAVELIN is a registered trademark of Vista Clara.

# PROBES

## PS LOGGER®



PS Logger® Probe

The PS Logger® probe is a low-frequency acoustic probe designed to measure compressional and shear-wave velocities in soils and soft rock formations.

It operates using indirect excitation rather than mode conversion as in a conventional sonic. It is capable of acquiring high resolution P and S wave data in borehole depths of up to 600m in water.

### Principle of Measurement:

The PS Logger® probe contains a unique design of powerful hammer source and two receivers, separated by acoustic damping tubes. To acquire data, the probe is stopped at the required depth and the source is fired under surface command. Firing causes a solenoid-operated shuttle aligned across the borehole axis to strike plates on opposite sides of the probe in turn, setting up a pressure doublet in the surrounding fluid. The resultant fluid motion produces a tube wave at the borehole wall with velocity close to the shear velocity of the formation together with a compressional wave.

As the waves propagate parallel to the borehole axis, they set up corresponding fluid movements that are detected by the two neutral buoyancy 3D hydrophone receivers and geophones, allowing the wave velocity to be determined.

The facility to stack multiple shots and filter the data as in normal seismic data acquisition is included in the operating software.

## SPECIFICATION:

### Features

- High energy shear-wave source has typically 20x power of conventional sonic probes
- Low-frequency measurement, more representative of engineering situations
- Stacking of multiple shots
- Probe separates for shipping
- Real-time wavelet (wiggle) display
- Compatible with Robertson Geo Micrologger2

### Measurements

- Formation compressional wave velocity
- Formation shear-wave velocity

### Applications

- Site Investigation - foundation studies, windfarms, offshore structures, dam safety
- Physical properties of soil/rock - shear modulus, bulk modulus, compressibility and Poission's ratio
- Earthquake engineering - characterization of strong motion sites
- Velocity control for seismic reflection surveys
- Engineering

### Operating Conditions

- Borehole type: open-hole, water-filled
- Recommended Logging Speed: Static measurements

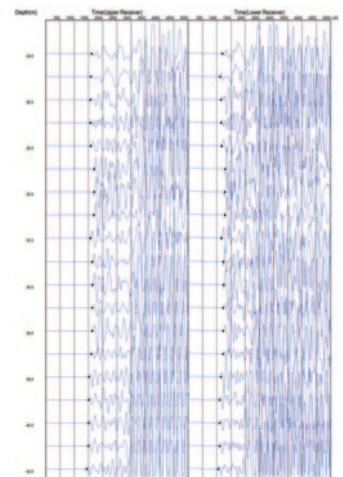
### Specifications

- Diameter: 50mm
- Assembled length: 6.07m - 7.07m (1 or 2m filter)
- Shipping case length: 1.45m (4.75ft)  
supplied in two transport cases
- Assembled weight: 26.5kg - 28kg (1 or 2m filter)
- Max. temperature: 70°C
- Max. pressure: 6.5MPa
- Transducer type: solenoid and hammer
- Receiver type: 3D hydrophones (p), geophones (s)
- Receiver spacing: 1000mm (3.28ft)
- Waveform acquisition period: 5.12mS to 409.6mS
- Sampling: 2.5µs minimum
- Down-hole gain: 0db to 42db (surface control)

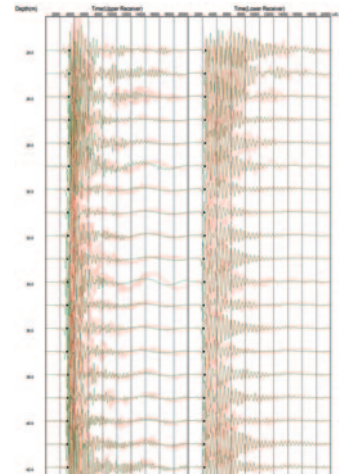
### Part Numbers

- 1002244 PS Logger® probe in carrying case

P Waves



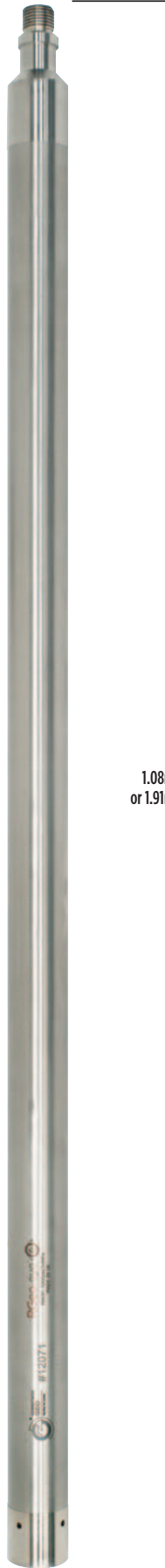
S Waves



Examples of logging data

## PROBES

### RGeo-EYE® DOWNHOLE CAMERA



1.08m  
or 1.91m

RGeo-eye®

RGeo-eye® is a slimline full colour downward view camera, operating on a 4-core or coaxial cable at a high transmission rate and is fully compatible with existing Robertson Geo winches and surface systems. Application software supplied with the system enables control of camera functionality and real time deep subsurface video feed for the operative.

This is an innovative development of downhole camera use and availability for the geophysical data acquisition markets. The RGeo-eye® camera, an in-house design and build system by Robertson Geo, is fully backed by a technical resource that only a proven original equipment manufacturer can provide.

It provides a deep subsurface range of 3,000m (10,000ft), operates on industry standard 4-core or coaxial wireline cable and offers pressure ratings to 5000 psi with a minimum 75°C temperature rating.

## RGeo-eye®

### SPECIFICATION:

#### Applications

- Borehole and casing integrity inspection
- Surveillance of mines, shafts, caverns and voids
- Assessment of deep concrete piles
- Pre-logging borehole examination
- Damage detection in subsurface structures

#### Operating Conditions

- Borehole Type: Air / water-filled; open hole or cased hole
- Recommended Logging Speed: 2 - 5m/min
- Depth rating: 3,000m on 4-core cable or 1,000m on coaxial cable\*

#### Specifications

- Diameter: 43mm
- Length: 1.08m, or 1.91m with sinker bar
- Weight: 5kgs
- Communication rate: RGeo-fast® 1 Megabit/sec
- Resolution: Up to 30 frames per sec SVGA (800x600) or (600 x 600) - User selectable
- 'Snapshot' mode: high resolution still image at UXGA (1600 x 1200)
- Standard temperature rating: 0-90°C at 5000psi (3000m) - 1,000m, 2,000m and 3,000m versions available
- Max pressure: 5000 psi (3,000m)
- Autofocus
- Frontal LED internal array, with adjustable lighting intensity
- Light output: 6 x 282lm @ 3,000K LEDs
- Additional lighting options for large diameter voids



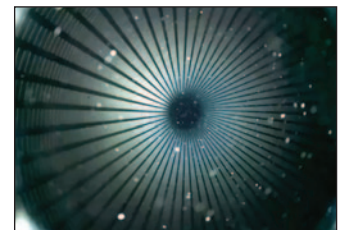
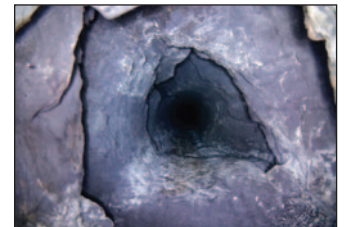
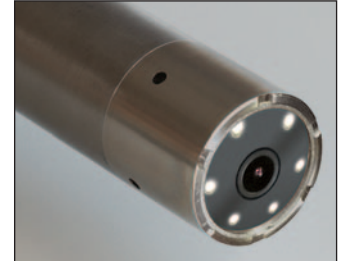
CE Certified and manufactured within an ISO9001:2015 quality system

Recommended minimum computer specification:  
i7 7700 processor with 500GB SSD, 16GB of memory running Intel HD Graphics 630 card running Windows 10 64-bit

#### Part Numbers

- |         |                                       |
|---------|---------------------------------------|
| 1020263 | GeoEye Digital Camera (1,000m)        |
| 1020408 | GeoEye Digital Camera (2,000m)        |
| 1020409 | GeoEye Digital Camera (3,000m)        |
| 1020412 | Custom Peli Case for RGeo-eye® Camera |
| 1020264 | GeoEye Centraliser 76-110mm           |
| 1020265 | GeoEye Centraliser 90-1800mm          |
| 1020266 | GeoEye Centraliser 180-260mm          |
| 1020267 | GeoEye Sinker Bar                     |

\* The depth rating on coaxial cable is dependent on the coaxial cable properties.



## RGeo-fast®

The system incorporates RGeo-fast® delivering 1 Megabit/sec communication speed enabling the acquisition of high resolution video feed from downhole (to 3000m) in air or water filled open or cased boreholes while allowing real-time viewing for the surface operative.

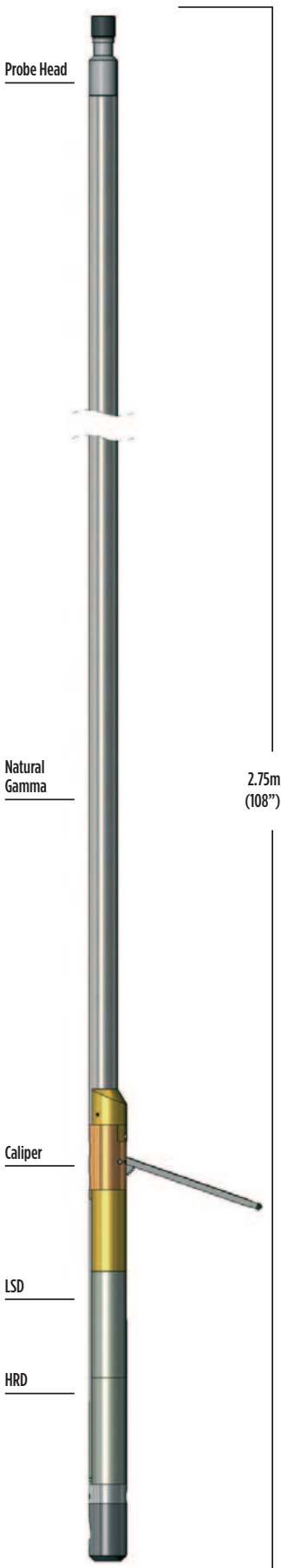
The camera has auto focus, a frontal LED internal array with adjustable lighting intensity, and a viewing resolution of SVGA (800 x 600) at 25frames/sec.

The acquisition software supplied with RGeo-eye® allows screen shots to be captured and text editing whilst viewing/recording. Where more detail is required, full colour 'snapshot' images can also be captured at 1600 x 1200

First release of the RGeo-eye® camera is rated at 75°C (high temp versions coming soon).

# PROBES

## SMALL-SOURCE DENSITY



Small-Source Density Probe

Stringent legislation on the transport and handling of radioactive materials increasingly prevents use of conventional density logging probes.

The Small-Source Density probe provides calibrated and borehole-compensated density logs at sensible logging speeds using a very low activity <sup>60</sup>Co gamma source that may not require a radiation licence in certain territories.

### Principle of Measurement:

The probe contains a detachable collimated gamma source and two high-sensitivity scintillation gamma detectors. The detectors are protected against direct radiation from the source or via the borehole by extensive heavy-metal shielding. The active windows of source and detector are maintained in contact with the borehole walls by a motorised caliper arm. The detected backscattered gamma radiation depends on the formation density. The probe includes a third gamma detector mounted remotely from the source for 'stripping' natural background radiation.

### SPECIFICATION:

#### Features

- Compensated density output directly in engineering units (g/cc)
- Tungsten shielding reduces borehole influence on measurement
- Separate short-spacing detector for accurate bed-boundary location

#### Measurements

- Bulk density
- High-resolution density (HRD)
- Caliper
- Natural Gamma

#### Applications

##### Minerals

- Lithology
- Density and porosity
- Correlation with other logs
- Bed thickness and boundary location
- Ash and moisture content in coal

##### Engineering

- Rock strength and elasticity parameters (with sonic log)
- Detection of weathered or fractured zones

##### Water

- Location of aquifer and aquitard
- Location of cement cavities behind casing

#### Operating Conditions

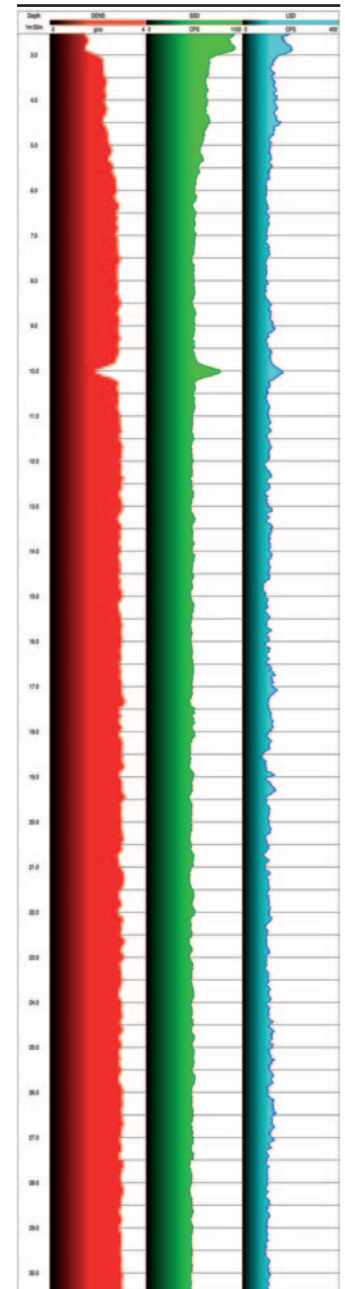
- Borehole type: open-hole, water-filled
- Qualitative measurements are possible in air-filled boreholes

#### Specifications

- Diameter: 51mm
- Weight: 19kg
- Temperature: 0-70°C (extended ranges available)
- Max. pressure: 20MPa
- Density range: 1.1- 2.9g/cc
- Caliper range: 50 - 250mm

#### Part Numbers

- 1002017 Small-Source Density probe

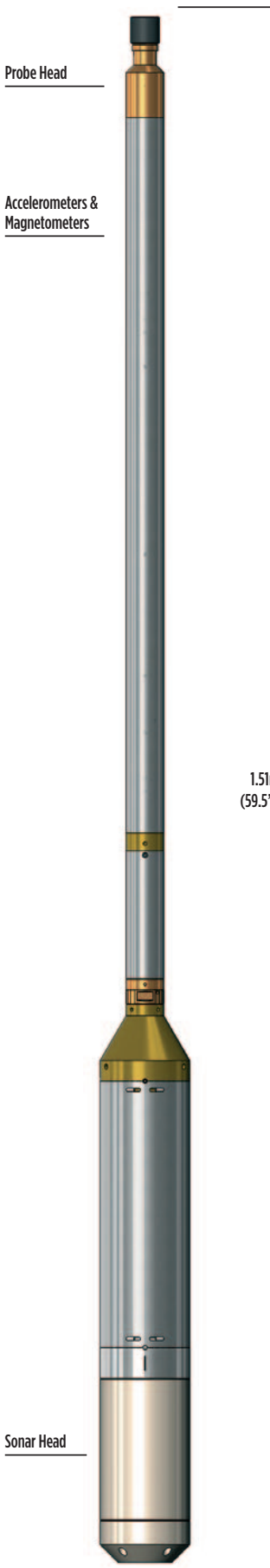


Example of logging data



# PROBES

## SONAR CALIPER



The Sonar Caliper Probe has been developed to provide a scaled and orientated cross-section of large bores, shafts, caverns and trench walls; combining accurate diameter measurement with a fully orientated 360° view of its surroundings.

700kHz and 200kHz models are available to suit varying in-situ fluid conditions.

**Principle of Measurement:**

Sonar operates by emitting a pulse of sound that is reflected by a solid object; timing the delay between emission and the arrival of the reflected sound wave back at the probe allows for a calculation of distance. The Sonar Caliper Probe makes 400 individual radius measurements in a 360° arc around the probe and then orientates them to magnetic north.

**SPECIFICATION:**

**Features**

- Real time large diameter measurement
- Layout orientation/mapping

**Measurements**

- Spatial diameter
- Orientation
- Spatial volume – derived value

**Applications**

- Large diameter boreholes (> 1500mm)
- Trench walls
- Shafts, caverns and voids

**Operating Conditions**

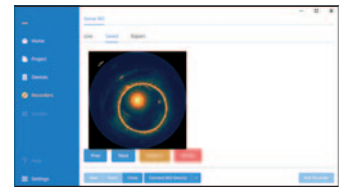
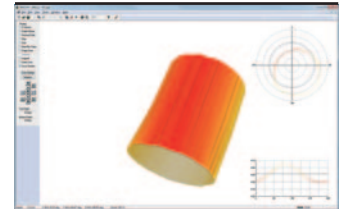
- Borehole type: Fluid filled
- Centralisation: Vertical borehole and central suspension point are advisable
- Recommended Logging Speed: Stationary at discreet points

**Specifications**

- Max Diameter: 700kHz - 75mm  
200kHz - 100mm
- Length: 1.51m
- Weight: 16kg
- Temperature: 70°C
- Pressure: 10MPa
- Range: 700kHz - 50m in clear water and brines  
200kHz - TBA

**Part Numbers**

- 1002193 Sonar Caliper Probe

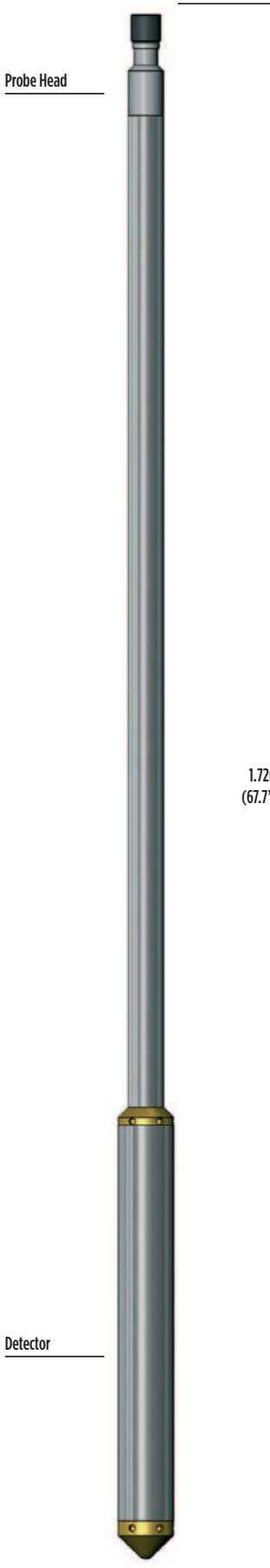


Examples of logging data

Sonar Caliper Probe

# PROBES

## SPECTRAL GAMMA



The Spectral Gamma probe analyses the energy spectrum of gamma radiation from naturally occurring or man-made isotopes in the formation surrounding a borehole.

The probe corrects for temperature drift in real-time by matching the acquired spectrum to the base spectra of the main natural emitters (potassium, uranium and thorium) determined during the tool master calibration. Available outputs are full-spectrum (static mode only) and continuous log measurements of elemental concentrations. Borehole corrections are available for casing thickness, borehole diameter, formation density and mud/fluid radioactivity for both centralized and side-walled tool positions.

### Principle of Measurement:

Gamma photons produced by the decay of naturally occurring potassium, uranium, thorium and/or unstable man-made isotopes in the formation are detected by a large-volume gamma scintillation counter and converted to electrical pulses. The amplitude of the pulses depends on the photon energy. An analyzer within the probe separates the pulses into channels according to their amplitudes. Count-rates from groups of channels are converted in real-time by the surface software to concentrations of the originating elements using predetermined algorithms.

## SPECIFICATION:

### Features

- Large-volume scintillation detector for high sensitivity
- Temperature compensation ensures freedom from drift

### Measurements

- Uranium (ppm)
- Thorium (ppm)
- Potassium (%)
- Gross Gamma
- Full spectrum display 100keV – 3MeV

### Applications

#### Minerals / Water / Engineering

- Shale/Clay typing
- Correlation in complex situations
- Mineral detection
- Radioactive waste pollution measurement
- Lithology determination

### Operating Conditions

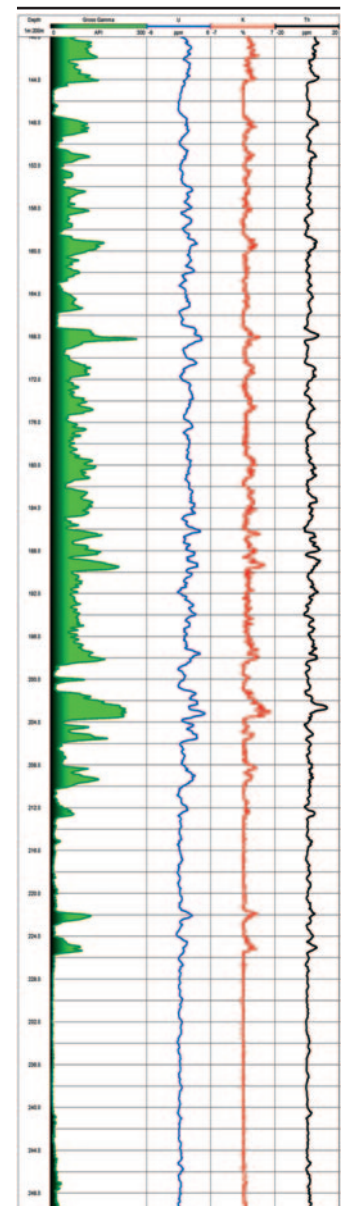
- Borehole type: open/cased, water/air filled
- Recommended Logging Speed: 1m/min

### Specifications

- Diameter: 48mm
- Length: 1.72m (for both types)
- Weight: 7kg (60mm version)
- Temperature: 0-70°C
- Max. pressure: 20MPa
- Detector: NaI(Tl) scintillator
- Detector Size: 38mm x 150mm
- Energy range: 100keV to 3MeV

### Part Numbers

- I012998 Spectral Gamma probe



Example of logging data

Spectral Gamma Probe

# PROBES

## TEMPERATURE CONDUCTIVITY



This probe combination provides a continuous, depth-based measurement of fluid temperature and conductivity.

Both parameters can be output in absolute and in differential forms. A natural gamma detector is included for correlation purposes.

### Principle of Measurement:

The temperature and conductivity sensors are located in an insulated housing at the base of the probe. During logging, borehole fluid flows freely through ports on the side and base of this housing and over the sensors. The log is recorded downwards while running into the hole to minimise fluid disturbance.

## SPECIFICATION:

### Features

- Stable, high-quality, semiconductor temperature sensor
- Graphite conductivity electrodes resist corrosion and are easily cleaned

### Measurements

- Fluid temperature/differential temperature
- Fluid conductivity/differential conductivity
- Natural Gamma

### Applications

#### Water

- Fluid salinity
- Location of zones of different water quality
- Water-well monitoring
- Identification of zones of in-flow/out-flow
- Temperature gradient
- Water-level determination
- Location of grout behind casing
- Temperature compensation of other logs

### Operating Conditions

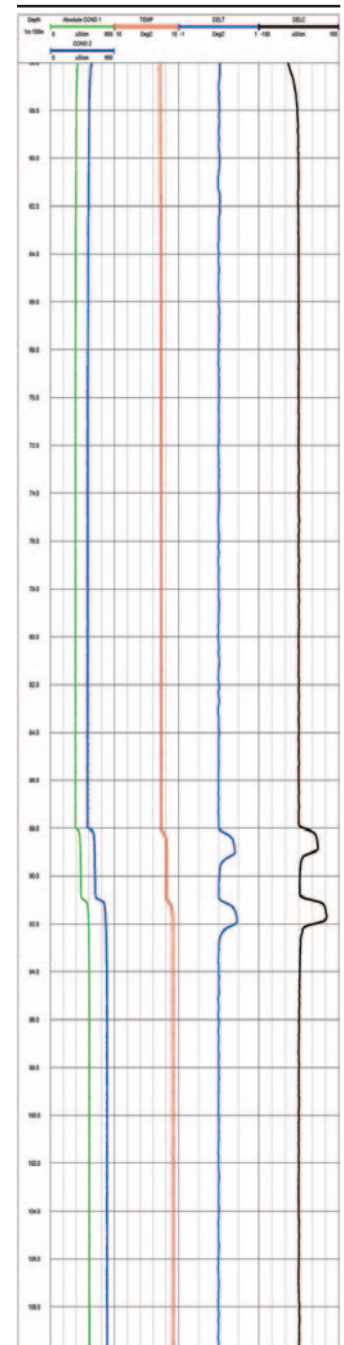
- Borehole type: open/cased holes, water-filled
- Recommended Logging Speed: 5m/min

### Specifications

- Diameter: 38mm
- Length: 1.69m
- Weight: 4.5kg
- Temperature: 0-70°C (extended ranges available)
- Max. pressure: 20MPa
- Temp. range: 0-70°C (extended ranges available)
- Conductivity range: 50 to 50,000  $\mu\text{S} / \text{cm}$

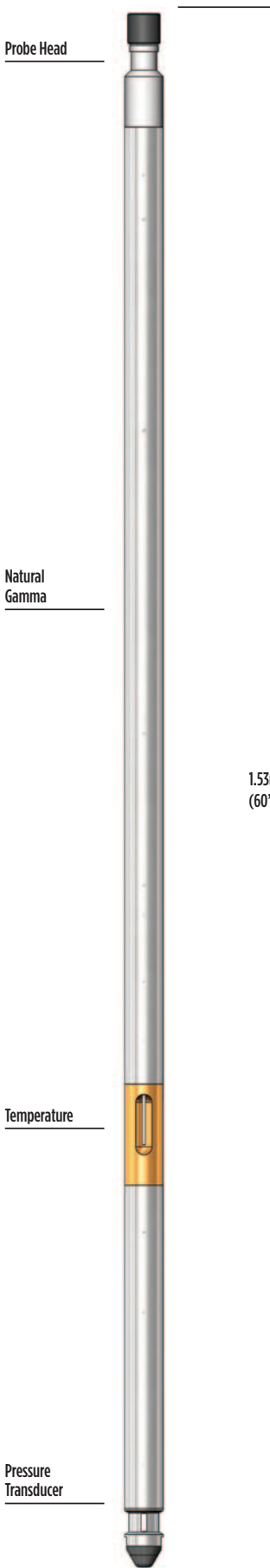
### Part Numbers

- 1002055 Temperature Conductivity probe with gamma



# PROBES

## TEMPERATURE/PRESSURE



This probe combination provides a continuous, depth-based measurement of fluid temperature and pressure.

### Principle of Measurement:

The temperature and pressure sensors are located in the probe. Our advanced expertise and experience with quartz crystal technology enable us to provide high quality transducers with minimal drift at the high temperatures and pressures often found in oil and gas wells.

### SPECIFICATION:

#### Features

- Stable, high-quality, semiconductor temperature sensor
- Quartz crystal technology provides high quality pressure measurement with minimal drift at the high temperatures and pressure

#### Measurements

- Fluid Temperature/differential temperature
- Borehole pressure

#### Applications

##### Water/Gas

- Borehole pressure
- Location of gas zones
- Identification of zones of in-flow/out-flow Temperature gradient
- Water-level determination
- Location of grout behind casing Temperature compensation of other logs

#### Operating Conditions

Borehole type: open/cased holes, water-filled

#### Specifications

- Diameter: 38mm
- Length: 1.53m
- Weight: 4kg
- Max. pressure: 20MPa
- Temp. range: 80°C (extended ranges available)
- Pressure range: 1-5,000 ps
- Pressure transducer accuracy: offers 0.01% FS accuracy over the laboratory temperature range of 0 to 40 °C and 0.02% FS accuracy over the field (outdoor) range from -40 °C to +85 °C.

#### Part Numbers

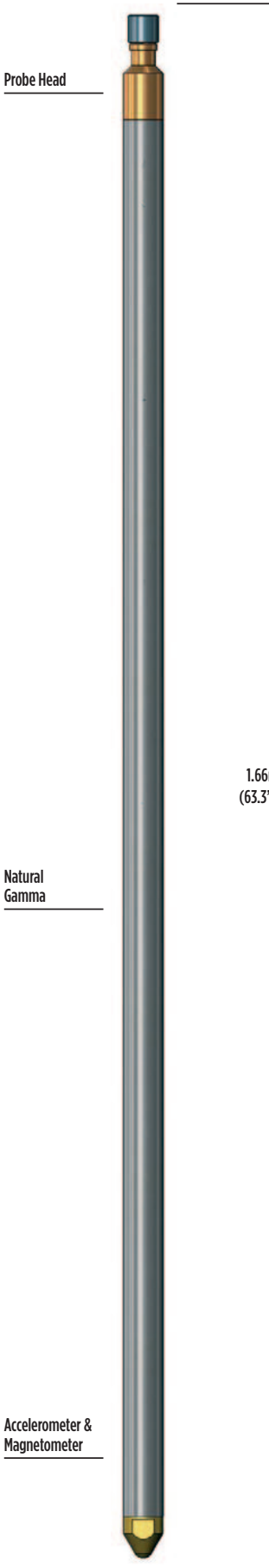
1018742 Temperature/Pressure probe

Temperature/Pressure Probe



# PROBES

## VERTICALITY



The Veracity probe provides accurate, continuous measurements of borehole inclination and direction.

These are output directly as log traces or may be processed further to produce tabular and graphical outputs of borehole position, borehole drift and true vertical depth.

**Principle of Measurement:**

The probe includes a triaxial magnetometer to determine the bearing of a reference in the probe relative to magnetic North and three accelerometers to measure inclination. The outputs from the transducers are processed by a downhole microprocessor to give final borehole inclination and azimuth data in real time.

**SPECIFICATION:**

**Features**

- Small diameter for slimhole operations
- Continuous borehole orientation log
- Suitable for all borehole inclinations and directions

**Measurements**

- Borehole inclination
- Borehole direction
- Borehole drift
- True vertical depth
- Natural Gamma

**Applications**

**Minerals / Water / Engineering**

- Bed-thickness estimation
- Surveying and deviation checks
- True seam depth

**Operating Conditions**

- Borehole type: open/plastic-cased, water/air-filled
- Centralisation: non-magnetic centralisers required
- Recommended Logging Speed: 4m/min

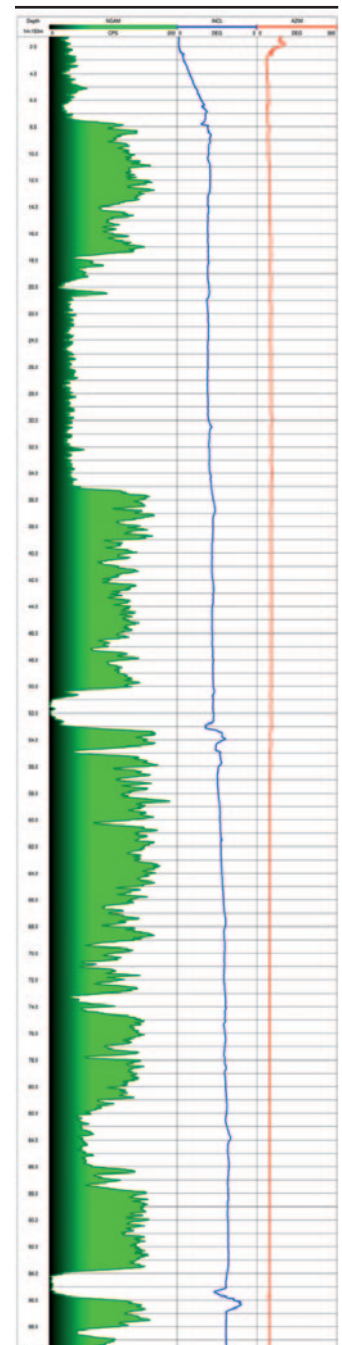
The operation of the probe is limited in steel casing or in the presence of magnetic minerals which affect the magnetometer. Under such conditions, only borehole inclination (without directional information) can be logged. The Gyro probe should be used in preference to the standard verticality probe in such cases.

**Specifications**

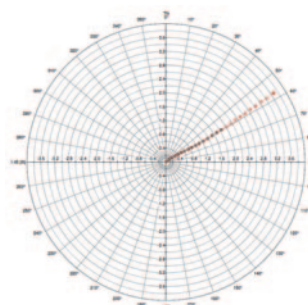
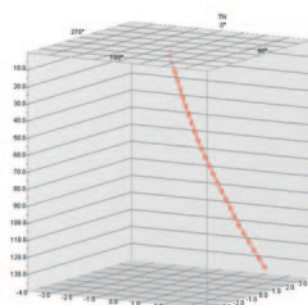
- Diameter: 42mm
- Length: 1.66m
- Weight: 5.5kg
- Temperature: 0-70°C (extended ranges available)
- Max. pressure: 20MPa
- Inclination range: Horizontal +/- 90°
- Azimuth range: 0 to 360°

**Part Numbers**

- 1002141 Veracity probe with natural gamma



Examples of logging data



Veracity Probe

# PROBES

## WATER QUALITY



The Water Quality probe is based on the industry-standard Ocean Seven 310™ Borehole probe manufactured by Idronaut Srl.

The tool is available in ‘saline’ and ‘fresh-water’ versions with different conductivity ranges and available measurements. The probe enables a rapid, continuous profile to be taken of all the selected parameters throughout the borehole either for direct use or as a guide for subsequent sampling.

### Principle of Measurement:

The probe contains up to seven specific sensors to acquire fluid-property measurements from a water-well. Use of the latest robust membrane sensor technology and low drift electronics eliminates the need for complex field calibrations.

Correction of measurements to standard temperature and pressure is carried out automatically on the Robertson Geo Micrologger surface system.

## SPECIFICATION:

### Features

- Continuous log of fluid properties
- Measurement in-situ reduces sample storage requirements and contamination

### Measurements

- Temperature
- Pressure
- Fluid conductivity
- Oxygen (ppm)
- pH
- Redox (fresh water version only)

### Applications

#### Water

- Water quality measurements
- Location of aquifers
- Groundwater flows
- Contamination studies

### Operating Conditions

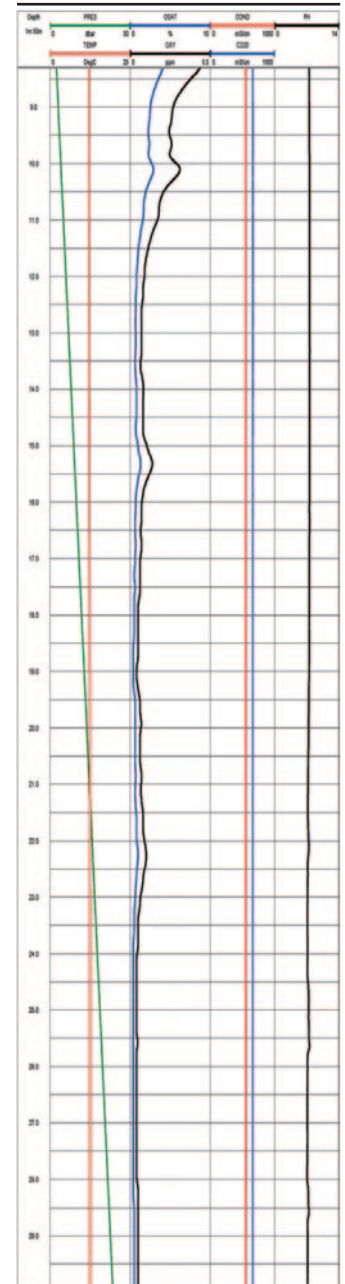
- Borehole type: open/cased, water-filled
- Recommended Logging Speed: 1.5m/min

### Specifications

Version:	Fresh Water	Saline Water
Length:	1.67m	1.67m
Diameter:	45mm	45mm
Weight:	5.5kg	5.5kg
Max temperature rating:	50°C	50°C
Max pressure:	10MPa	10MPa
Pressure: range:	0-10MPa	0-10MPa
Temperature range:	-5 to +50°C	-5 to +50°C
Conductivity range:	0 to 7000 µS/cm 0 to 350mS/cm (brine)	0 to 90mS/cm 0 to 350mS/cm (brine)
Oxygen optical:	0 to 45mg/l 0 to 250% sat.	0 to 45mg/l 0 to 250% sat.
pH range:	1 to 13 pH	1 to 13 pH
Redox measurement:	Range -1000 to +1000mV	N/A

### Part Numbers

- 1021901 Water Quality probe (fresh-water version)
- 1021902 Water Quality probe (saline water version)



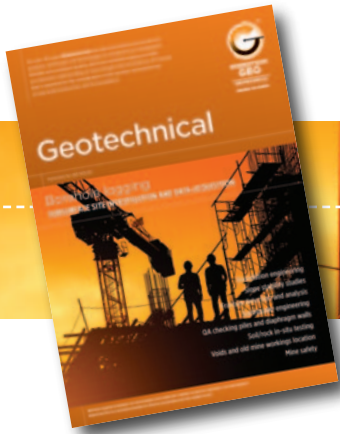
Example of logging data

Water Quality Probe





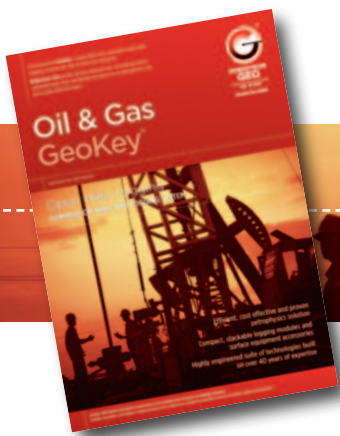
Our complete range of brochures:



**Geotechnical**  
SUBSURFACE SITE INVESTIGATION AND  
DATA ACQUISITION



**Mining & Minerals**  
SUBSURFACE RESOURCE EXPLORATION  
AND MINE SAFETY PLANNING



**Oil & Gas GeoKey®**  
SLIMHOLE OR THRU-PIPE OPEN HOLE  
LOGGING SYSTEM



**Renewables**  
SUBSURFACE DATA ACQUISITION  
AND CHARACTERISATION



**Water & Environmental**  
SUBSURFACE CHARACTERISATION AND  
DATA ACQUISITION



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