

BAT-sensor



Groundwater monitoring and testing

The *BAT*-sensor combined with the *BAT*-filter tip measures accurately and against low costs the pore pressure in the ground.

This unique, re-usable sensor is equipped with a 24-bit AD converter, microprocessor, clock, network controller and memory chip. Without difficult conversion factors, this Intelligent Sensor (IS) immediately displays the measured pressure in the engineering unit kPa (mH₂O). After finishing the pore pressure measurement you can easily retrieve the sensor and use it again at another site.

The *BAT*-sensor has also been equipped with a temperature gauge, which measures the temperature at the end of the sensor.

In combination with the IS-battery holder the *BAT*-sensor can be used as stand-alone sensor or inter-connected with other sensors in a fully digital network, in combination with the IS- module.

With an additional permeability set the *BAT*-system offers the extra possibility to determine the permeability of the soil and/or to collect accurate groundwater samples.

Technical specifications <i>BAT</i> [®] -sensor	
Pressure range	0...5 bar (absolute)
Burst pressure	16 bar
Pressure hysteresis (0 → P _{max} → 0)	≤ 0.1%
Linearity error	≤ 0.15 % (tested)
Temperature range (operating)	-20 °C to + 80 °C
Temperature accuracy	± 0.5 °C
Electrostatic discharge	2500V
Memory	≈ 6,500 measurements
Power consumption	≤ 30 mA with 15V (operating)
Protection rating	IP 68 according to DIN 40 050/IEC 529
Material	Stainless steel 316
Weight sensor	224 gram
Dimensions sensor	Ø 22 mm, length 170 mm
Dimensions sensor incl. transducer assembly	Ø 22 mm, max. length 248 mm
Weight set	988 gram
Dimensions of weight set	Ø 23 mm, length 415 mm
Standard cable length	10 m or 20 m
Extra	Standpipe sensor protection cap

Accessories	
ISB.00010 <i>BAT</i> [®] -filter tip MkIII	POM with porous HDPE filter
ISB.00020 <i>BAT</i> [®] -filter tip MkIII STS (stainless steel)	Stainless steel SS2343 with porous HDPE filter
ISB.00025 <i>BAT</i> [®] -filter tip MkIII Vadose	POM with fine porous ceramic filter
ISB.00360 IS-battery holder	1 D-size Alkaline battery (operating time ≈ 4 months) 1 D-size Lithium battery (operating time ≈ 8 months)
ISB.00080 <i>BAT</i> Permeability kit and sample kit	
ISB.00330 IS-field unit Programming, read-out unit incl. internal air pressure sensor	
ISB.00357 IS-module	Internet Solar Module



BAT-filter tip MkIII



The Profound *BAT*-filter tip

The *BAT*-filter tip in combination with the *BAT*-sensor allows you to measure easily and accurately the pore pressure in the soil.

In the *BAT*-filter tip a flexible disk is fitted which allows the sensor to be coupled a hundred times to the filter tip by a hypodermic needle. The disk is also a leakage and gasproof seal of the filter tip.

The filter tip is attached to an extension pipe supplied by Profound. It is normally installed by pushing it down to the desired depth using standard one inch gas pipes.

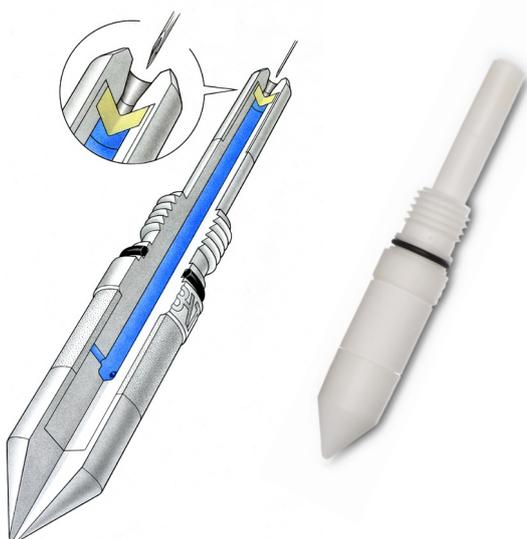
The standard *BAT*-filter tip is suitable for use in clay, silt and sand. For harder soils a stainless steel filter tip can be used.

Additionally, using the *BAT*-sensor and the *BAT*-permeability set you can measure the permeability of the soil or take liquid and gas samples.

Technical specifications <i>BAT</i> [®] -filter tip MkIII	
Pressure range	0...16 bar (absolute) 0...160 m H ₂ O (absolute)
Flow factor	F = 0,23 meter ¹
Penetration resistance	Max. ≈ 25 MPa
No. of couplings	» 500
Max. load	20 kN
Correction height (<i>BAT</i> [®] -sensor)	215 mm
Material filter	Porous HDPE
Material tip	Thermoplastic material (POM)
Weight filter tip	122 gram
Dimensions filter	Ø 31 mm, length 36 mm
Dimensions filter tip	Ø 31 mm, length 209 mm
Weight extension pipe	565 gram
Dimensions extension pipe	Ø 1 inch, length 250 mm

¹ Hvorslev, M.J. "Time lag and soil permeability in ground water observations". 1951. Bulletin No. 36, Corps of Engineers. Waterways Experiment Station, U.S. Army.

Accessories	
ISB.002xx <i>BAT</i> [®] -sensor with integrated datalogger	
Gas pipe per meter with couplings	Thread: 1 inch gas BSP (Ø 33.2 mm, 11 per inch) Pipe: 1 inch (33.9 mm exterior, 27.2 interior)
Preparation set	Single-ended needle (yellow) and syringe, centralisation adapter (white)



BAT-filter tips MkIII



The Profound BAT-filter tips MkIII

The BAT-filter tip MkIII is the latest generation of BAT-filter tips. It contains no mechanical or electrical components. It is easier to assemble and install than older versions of BAT-filter tips. The standard filter tip is made of polyacetal plastic with a filter of porous polyethylene.

The BAT-filter tip MkIII is permanently installed in the soil at desired depth. To the filter tip a variety of equipments may be coupled which will interact directly with the soil fluids.

Connection with the filter tip is made with a system of hypodermic needles based on the unique quick-connect coupling. Connections can be performed hundreds of times without losing the sealing function in the unique quick-connect coupling.

After proper installation the BAT-sensor is connected to the filter tip simply by lowering it down the extension pipe. Upon disconnection the equipment is simply pulled up again. The connection/disconnection of measuring equipment will only have minimal affect on the surrounding soil system.

Overview	
ISB.00010 BAT®-filter tip MkIII	POM with porous HDPE filter
ISB.00020 BAT®-filter tip MkIII STS (stainless steel)	Stainless steel SS2343 with porous HDPE filter
ISB.00025 BAT®-filter tip MkIII Vadose	POM with fine porous ceramic filter

Accessories	
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BAT-filter tip MkIII



BAT-filter tip Vadose



BAT-filter tip Stainless Steel



Profound BV

Limaweg 17
2743 CB Waddinxveen
The Netherlands

Tel. +31 (0) 182 640 964
info@profound.nl
www.profound.nl

BAT-system applications

BAT-pore pressure measurement

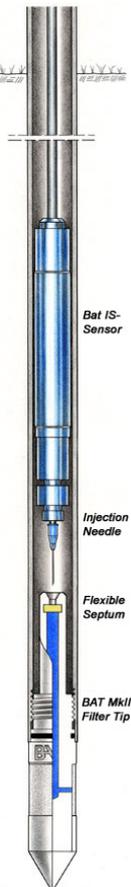
The BAT-system enables both direct read-out of pore pressures as well as the option to accurately track fluctuations in the pore pressure remotely.

Efficient

The BAT-system consists of a filter tip and a sensor. It is easy to install the filter tip since the tip neither contains any sensitive elements nor is connected to an electrical cable or tubing during installation. The filter tip is connected to an extension pipe, for example a standard one-inch gas pipe, and pushed down to the desired installation depth.

After installation the sensor is lowered down and connects with the filter tip. The BAT-sensor immediately displays the measured pore pressures in the chosen engineering unit.

Together with a replaceable, ordinary alkaline battery the BAT-sensor can collect and store data in a stand-alone mode for about eight months. The BAT-sensor can also be interconnected with other sensors in a fully digital network in combination with the IS-module.



BAT Permeameter

The BAT-permeameter combines with the BAT-sensor and the BAT-filter tip. In situ hydraulic conductivity tests can be routinely performed, both in unsaturated and saturated soils.

Conducting a permeability test

The BAT-permeameter incorporates a test container that is sealed in both ends with a flexible septum. At its lower end the test container connects with the BAT-filter tip, using a double-ended injection needle. At its upper end the test container interconnects with the BAT-pressure sensor, also by using an injection needle. This allows for measurement of the pressure, P , inside the test container.

By using the logging function of the BAT IS Sensor, pressure data is collected automatically at a preselected time-interval. Analysis of the time-pressure record thus yields the coefficient of permeability, k .

Applications

Typical in-situ applications for the BAT-permeability set are:

- control of k -values of compacted clay liners
- control of k -values of in-situ slurry walls
- checking quality of containment systems at landfills and tailings dams
- checking design parameters for ground improvement systems, such as vertical drains
- general geotechnical investigation

