

Labcell Limited Environmental Instrumentation

Measure the environment.

1,2 Soil Moisture

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TEROS 11 - Rugged VWC & Temp
TEROS 12 - Rugged VWC, EC & Temp
EC5 - Low Cost VWC
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5TE - VWC, EC & Temp
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Soil Moisture Sensors



Measurement & Benefits	<h3>TEROS 10</h3> <p>Volumetric Water Content.</p> <p>Rugged stainless steel and epoxy design in a low cost sensor.</p>	<h3>TEROS 11</h3> <p>Volumetric Water Content, Temperature.</p> <p>Rugged stainless steel and epoxy design, SDI-12 compatible.</p>	<h3>TEROS 12</h3> <p>Volumetric Water Content, Electrical Conductivity, Dielectric Permittivity, Temperature.</p> <p>Rugged stainless steel and epoxy design, SDI-12 compatible.</p>	<h3>EC5</h3> <p>Volumetric Water Content.</p> <p>All purpose, least expensive soil moisture sensor.</p>
Range	VWC: 0 to 100%.	VWC: 0 to 100%. Temperature: -40 to 60 °C.	VWC: 0 to 100%. EC: 0 to 25 dS/m (bulk). Temperature: -40 to 60 °C.	VWC: 0 to 100%.
Accuracy	VWC: ±3%, typical mineral soils, up to 8 dS/m.	VWC: ±3%, typical mineral soils up to 8 dS/m. Temperature: ±1 °C.	VWC: ±3%, typical mineral soils up to 8 dS/m. EC: ±5% from 0 to 5 dS/m, ±10% from 15 to 25 dS/m. Temperature: ±1 °C.	VWC Mineral: ±3%, typical mineral soils up to 8 dS/m.

RT1

The rugged RT1 soil temperature sensor is an easy-to-use sensor for measuring the temperature of soil or other materials. Completely waterproof, submersible and designed for continuous outdoor use.



Measurement & Benefits

Simple, rugged temperature sensor.
Can be used with METER ZL6 Data-logger.

Range

-40 to 80 °C.

Accuracy

±1°C.



10HS

Volumetric Water Content.

Large volume of influence to decrease effects of heterogeneity.

VWC: 0 to 57%.

VWC: $\pm 3\%$, typical mineral soils up to 8 dS/m.

5TE

Volumetric Water Content, Electrical Conductivity, Dielectric Permittivity, Temperature.

Benefits:
Manage salts and fertilizers in your system, SDI-12 compatible.

VWC: 0 to 100%.

EC: 0 to 23 dS/m (bulk).

Temperature: -40 to 60 °C.

VWC: $\pm 3\%$, typical mineral soils up to 8 dS/m.

Bulk EC: $\pm 10\%$ from 0 to 7 dS/m, user calibration required above 7dS/m.

Temperature: ± 1 °C.

MAS1

Volumetric Water Content.

Benefits:
4-20 Milliamp sensor for use with PLC's and irrigation controllers.

VWC: 0 to 100%.

VWC : $\pm 6\%$ VWC with generic calibration for supported growing media up to 65% VWC, above which accuracy lessens. Increased accuracy can be achieved with a medium specific calibration.

Calibrated in a variety of soils for accurate results.

METER have experimental sites and a soils lab to test how these sensors work in a variety of soils and under real growing conditions.

METER's soil moisture sensors are calibrated using four different soil textures with varying EC values: Silt Loam, Sandy Loam, Sand and Clay.



Silt Loam



Sandy Loam



Sand



Clay



Our first soil moisture sensors were built to produce TDR-quality data without the cost and complexity. Over the past thirteen years, we've refined and extended the technology . . . hundreds of thousands of sensors later, today's METER soil moisture sensors are:

- Publication ready: literally thousands of peer-reviewed publications use METER soil moisture probes.
- Not sensitive to soil salinity and soil texture in typical soils.
- Calibrated in a variety of soils for accurate results under actual field conditions.
- Plug and play with METER data loggers with no programming necessary.

Environmental Sensors

Measure the Environment Above the Soil Surface

ATMOS 41 Weather Station



ATMOS 22 Anemometer

The ATMOS 22 is a two-dimensional sonic anemometer that measures wind speed and direction. Wind speed and direction are fundamental measurements necessary for a wide range of agricultural, forestry and micrometeorological research and management applications. The ATMOS 22 has no moving parts, does not require maintenance or recalibration and is capable of making high accuracy measurements, even at low wind speeds.



Wind Speed

Range: 0 to 30 m/s.

Resolution: 0.01 m/s.

Accuracy: 0.30 m/s or <3%, whichever is larger.

Wind Direction

Range: 0 to 359 degrees.

Resolution: 1 degree.

Accuracy: ±3 degrees.

Barometric pressure

Range: 50 to 110 kPa.

Resolution: 0.01 kPa.

Accuracy: ± 0.1 kPa.

The ATMOS 41 packages 12 weather sensors into a single, compact device for atmospheric conditions. There are no moving parts to fail. So, installation and maintenance have been simplified to the maximum.

Most all-in-one weather stations give you the option to measure solar radiation or precipitation, but not both. ATMOS 41 provides both measurements in one device, so you never have to compromise.

ATMOS 41 weather data e.g. humidity, temperature or atmospheric pressure are transmitted over a single wire. That means you don't have to use all of the ports on your data logger just for weather measurements. Plus, if you are using the ATMOS 41 with EM60G data loggers, you have the flexibility to add any of our other sensors, like soil moisture.

The ATMOS 41 works seamlessly with the ZL6 for simple, plug-and-play atmospheric data logging and cloud-based data storage and management. You can set up an entire weather monitoring system without any complex wiring or programming.

Solar radiation

Range: 0 to 1750 W/m².

Resolution: 1 W/m².

Accuracy: ± 5% of measurement.

Precipitation

Range: 0 to 400 mm/h.

Resolution: 0.017 mm.

Accuracy: ± 5% of measurement.

Relative humidity

Range: 0 to 100%.

Resolution: 0.1%.

Accuracy: ±3%.

Air temperature

Range: -40 to 50 °C.

Resolution: 0.1 °C.

Accuracy: ± 0.6 °C.

Horizontal wind speed

Range: 0 to 30 m/s.

Resolution: 0.01 m/s.

Accuracy: the greater of 0.3 m/s or 3%.

Wind gust

Range: 0 to 30 m/s.

Resolution: 0.01 m/s.

Accuracy: the greater of 0.3 m/s or 3%.

Wind direction

Range: 0 to 359°.

Resolution: 1°.

Accuracy: ± 5°.

Diameter: 100 mm.

Sensor Body Height (w/mount): 155 mm.

Communication: SDI-12.

Connector Types: 3.5 mm (stereo) plug or stripped & tinned lead wires.

Cable length: 5m, custom cable lengths available on request.



ECRN50

Low-resolution Rain Gauge

The single-spoon mechanism tips at 1 mm; accuracy $\pm 2\%$.

The ECRN-50 can be reconfigured to measure the output of irrigation systems in terms of gallons or liters per hour.

Resolution: 1 mm.
Funnel Size: 5 x 10 cm.



ECRN100

High-resolution Rain Gauge

High-resolution rain gauge with 0.2 mm (0.01 in) resolution.

Resolution: 0.2 mm.
Funnel Size: 17 x 14.2 cm.



Infrared Thermometer

Infrared Thermometer

Non-contact continuous temperature measurement of any surface. Industry-leading specifications. Multiple field of view options. Calibrated over a large temperature range. Rugged and lightweight, capable of withstanding extreme weather conditions.

Measurement Range: -30 to 65 °C.
Accuracy: ± 0.2 °C when sensor body is within 20 °C of target temperature.
Field of View Options: 14 to 22° (half angle).



PHYTOS 31

Measure duration of leaf wetness

Requires no painting or calibration and detects trace amounts of water or ice on the sensor surface.

Measurement Speed: 10 ms.
Sensor Type: Frequency domain.
Output: 320 - 1000 mV @ 3 V excitation.
Operating Environment: -40 to 50 °C.
Expected Lifetime: 2+ years continuous use.
Power: 2.5 VDC @ 2 mA, to 5 VDC @ 7 mA.
Cable Length: 5 m standard, custom lengths.
Connector Type: 3.5 mm plug or stripped and tinned lead wires.
Dimensions: 11.2 x 5.8 x .075 cm.



ATMOS 14

Temperature, Relative Humidity, Vapour Pressure

Rugged sensor measures the temperature, relative humidity and vapour pressure of air. Completely waterproof, submersible and designed for continuous use.

Probe RH Range: 0 to 100% RH.
Temperature Range: -40 to 80 °C.
Vapour Pressure Range: 0 to 47 kPa.
Temperature Accuracy: ± 1 °C.
RH Accuracy: $\pm 2\%$ from 10 to 90% RH, $\pm 3\%$ from 0 to 10% RH and 90 to 100% RH.



ES2

Temperature and Electrical Conductivity

The ES2 allows you to obtain additional EC measurements for salt balance studies and nutrient monitoring. Monitor EC in pipes, tanks or wells.

Range: 0 to 120 dS/m (mS/cm).
Accuracy: ± 0.01 dS/m or $\pm 10\%$ (whichever is greater).
Resolution: 0.001 dS/m.
Range: -40 to +50 °C.
Accuracy: ± 1 °C.
Resolution: 0.1 °C.

Canopy Sensors

Measure the Environment Above the Soil Surface



PAR Photon Flux Sensor/ Pyranometer

**Photosynthetically Active Radiation
or Total Solar Radiation.**

Completely waterproof, submersible and designed for continuous outdoor use.

Cable Length: 5 m.

Range PAR: 0 to 5,000 $\mu\text{mol}/\text{m}^2\text{s}$.

Range PYR: 0 to 1750 Wm^{-2} .

Dimensions: 24 mm diameter, 29 mm height.

Accuracy: $\pm 5\%$.

AccuPAR LP-80 Ceptometer

Measure both PAR and LAI.

Measure transmitted PAR and calculate LAI at any location within a plant or forest canopy. Use to estimate biomass production and determine radiation interception.

Features.

- Non destructive.
- Lightweight and rugged field-ready design.
- External PAR sensor included.

AccuPar LP-80 Specifications.

Operating Environment: 0 to 50 °C, 0 to 100% relative humidity.

Number of Sensors: 80.

Overall Length: 102 cm (40.25 in).

Microcontroller Dimensions: 15.8 x 9.5 x 3.3 cm (6.2 x 3.75 x 1.3 in).

PAR Range: 0 to $>2,500 \mu\text{mol m}^{-2} \text{s}^{-1}$.

Resolution: $1 \mu\text{mol m}^{-2} \text{s}^{-1}$.

Data Storage Capacity: 1MB RAM, 2,000 readings.

Unattended Logging Interval: User selectable, between 1 and 60 minutes.

Data Retrieval: Direct via RS-232 cable.

Power: 4 AA Alkaline batteries.

Extension Cable Option: 7.6 m (25 ft).



SC-1 Leaf Porometer

Get high quality data without fans, tubes, or pumps.

Steady state design makes accurate stomatal conductance measurements affordable and practical for everyday research. Use stomatal conductance to evaluate plant water use, quantify water stress and compare physiological response of different species.

Features.

- Automatic sampling mode eliminates user subjectivity.
- No tubes, pumps or fans.

Leaf Porometer Specifications.

Conductance Range: 0 to 1000 $\text{mmol m}^{-2} \text{s}^{-1}$.

Accuracy: $\pm 10\%$.

Operating Environment: 5 to 40 °C, 0 to 100% RH, non-condensing.

Units: $\text{mmol m}^{-2} \text{s}^{-1}$, $\text{m}^2/\text{s mol}^{-1}$, s/m

Sample Chamber Aperture: 6.3 mm.

Sensor Head Cable Length: 1.2 m.

Measurement Time: 30 s in auto mode.

Power: Four AA alkaline batteries.

Data storage: 4,095 measurement in flash memory.



Spectral Reflectance Sensor



Monitor the normalized difference Vegetation Index or the Photochemical Reflectance Index.

The SRS is designed for long-term autonomous measurement of vegetation indices under field conditions. One of its primary design goals is to reduce the cost of collecting high quality spatially distributed data in quantity over an entire growing season.

Hemispherical or directional field of view.

NDVI and PRI are calculated as the ratio between reflected and incident radiation, measured using downlooking and uplooking sensors, respectively. Depending on ambient sky conditions, one uplooking sensor may be able to provide reference values for multiple downlooking sensors.

Uplooking SRS sensors have a hemispherical view with Teflon diffusers providing a cosine corrected response. They should be mounted above the canopy with an unobstructed view of the sky.

Downlooking sensors are equipped with field stops that restrict the field of view of the SRS to 36°. The field stops allow you to aim the sensor at a specific target and exclude non-canopy elements, such as a tower infrastructure, from the field of view. The sensor can be mounted to monitor single plants, row crops, plots, or forest stands. Mounting height will determine the measurement area. The measurement spot size at a nadir view angle is 0.35*height above canopy.

Sensors are typically mounted above the canopy using a pole, post, tripod, or tower depending on the height of the canopy. Small size, low weight, and durable construction make the SRS suitable for attaching to a mobile sampling platform. They can also be attached to a mobile platform.

The SRS provides readout of the individual bands in $W\ m^{-2}\ nm^{-1}$ or $W\ m^{-2}\ nm^{-1}\ sr^{-1}$, depending on sensor type.

NDVI wavebands: 630±5 and 800±5 nm peak wavelengths.

PRI wavebands: 531±3 and 570±3 nm peak wavelengths.

Accuracy: 10% or better for spectral irradiance and radiance values.

Dimensions: 43 x 40 x 27 mm.

Data logger compatibility: METER ZL6, Campbell Scientific.

Dendrometer D1

The D1 Dendrometer is a simple tool that allows you to manually measure changes in the circumference of tree stems over time. The D1 is designed to be installed, left in place, and periodically visited to record changes in the circumference resulting from tree or stem growth.

The D1 is made by German manufacturer METER Ag with painstaking attention to detail.

The D1's measuring tape is made of low-friction, low thermal expansion Astralon plastic. It wraps around the trunk of a tree and fastens with a spring mechanism that allows the tape to expand as the tree grows. The researcher measures the change in diameter, typically at longer intervals (once a year). The measurement scale is in units of π so there is no need to convert circumference to diameter.

The D1 has a specially shaped frictionless Vernier scale to make it easier to take a precise reading. METER have additionally reduced friction by manufacturing the eyelets without burrs and eliminating printing on the bark-side surface of the tape.

The D1 measures trees with diameters from 10 to 66 cm. Two tapes can be connected to measure larger trunks. Stems less than 40 cm in diameter should use the short spring, and the longer spring should be used on stems > 40 cm in diameter.

Length: 2100 mm.

Width: 15 mm.

Thickness: 0.5 mm.

Thermal Elongation: 75×10^{-6} /K.

Tensile Strength: 64 N/mm².

Coefficient of Friction: 0.5 on dry bark.

Operating Temperature: -30 °C to 60 °C.

Weight of Band: 16g.

Weight of Spring: 7 g (short), 14 g (long).



ZL6

Data-logger



With the ZL6, you no longer have to be a specialist in every discipline. Using the ZL6 is like having a meteorologist, a soil physicist, and more at your disposal, allowing you more time to focus on your specialty. How? The ZL6 connects up to six different types of METER sensors, so you can monitor different parameters, such as weather, soil moisture, and soil water potential all at the same time, giving you deeper insight. We've also integrated barometric pressure to eliminate the need to install extra sensors. Because everything is plug and play, you don't have to be an expert at wiring or programming.

We engineered the ZL6 to be extremely robust and low maintenance, so you can almost forget about your data logger completely. The ZL6's integrated solar charging panel means there's hardly any power maintenance required. An IP56-rated enclosure designed for shedding rain makes sure water doesn't get in. More secure cable handling ensures sensor cables don't get yanked out. A hidden antenna limits breakage. And we've added fully round clasps and hinges that won't break.



Plus, the ZL6 requires little setup.

It self-recognizes what's plugged into each port (as long as they're digital sensors), and the new ZENTRA app uses Bluetooth to configure digital sensors on any device, so you can bring a cell phone to the field instead of a heavy laptop. You can even configure the sensors from your office using ZENTRA Cloud. We also added GPS, so it automatically keeps track of where data are collected. And new firmware-over-the-air capability means ZENTRA Cloud updates ZL6 firmware automatically, with no effort from you. .

The ZL6 features an in-built cellular modem that automatically uploads data to the internet. Using the ZENTRA Cloud you can log, store and download your data at any time, virtually anywhere in the world. The ZL6 uses ZENTRA Cloud to deliver near-real-time data wherever and whenever you need it. This means your grad students can spend less time downloading data in the field and more time generating research papers. Accessing data on ZENTRA Cloud speeds up your analysis by enabling you to correlate event factors, see important trends, or discover problems almost instantly, from the comfort of your own desk. And if there's no cell service at your site, you can still download your data via USB. Plus, data are now incredibly easy to distribute and share. Simply enter an email, and send an invitation. Your collaborators can instantly see what you see. The ZL6 and ZENTRA Cloud allow you and others to review data the way you want, whether it's in map format, short graphs, a list, or downloading to data-analysis packages.

Input ports Six, each supporting METER analogue, digital or pulse sensors.

Port type 3.5 mm "stereo jack" connector.

Logging interval 5 minutes to 12 hours.

Reporting interval Hourly.

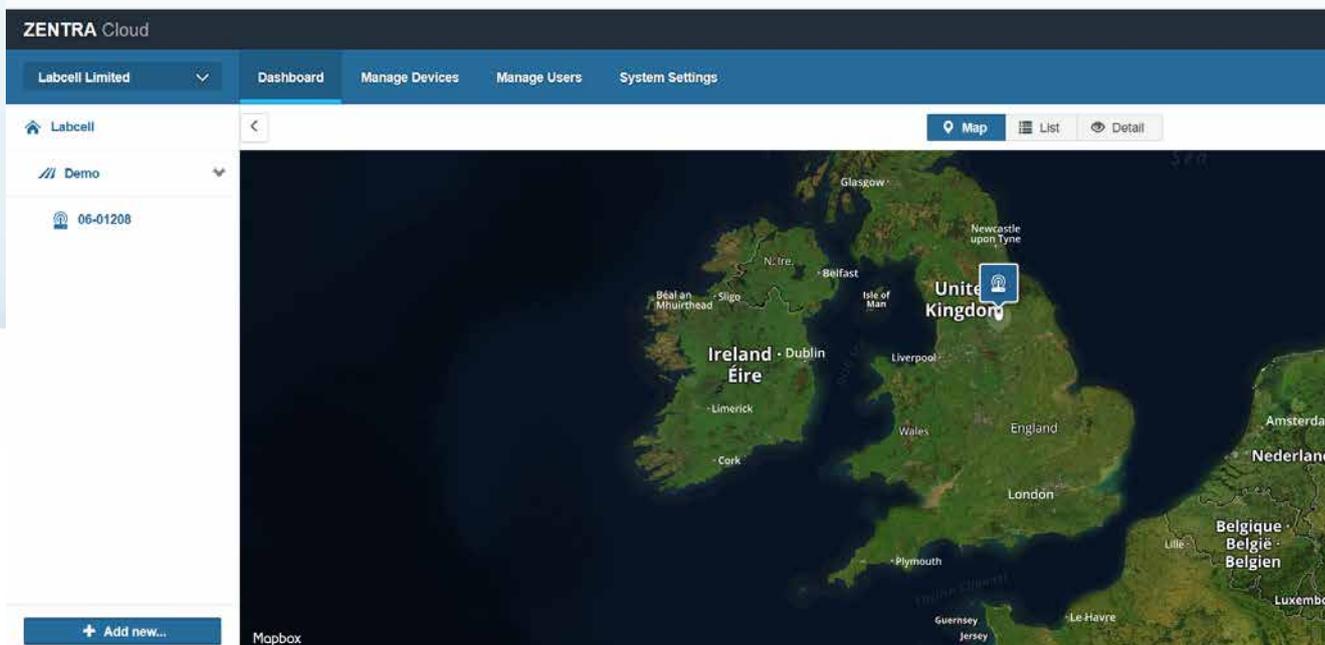
Data storage 8 MB (40,000 to 80,000+ records, depending on configuration).

Memory type Non-volatile flash, full data retention with loss of power.

Global position Integrated 56-channel GPS/QZSS receiver.

Battery life 3+ years with good view of sun.

PC communication Standard USB cable, USB A to Micro-B.



More data and fewer resources mean you need help to get your data to a place you can use. ZENTRA Cloud works together with the ZL6 to start the analysis process for you. It aggregates all your data in one easy place and automatically graphs it, in near-real time.



Now, see important trending information as it happens, instead of having to comb through imported spreadsheets. Near-real-time visualization of several different data streams means you can easily check on—and share—current site conditions, such as recharge from the last rain event or plant available water. Pull near-real-time data up at a conference to illustrate a point, or share current data with your students to teach them how to model evapotranspiration.

Remote data management means you can reconfigure sensors while sitting at your desk. Use the GPS mapping feature to illustrate to a colleague or a class how a site is configured. And simplified sharing of near-real-time data makes it easier for your colleagues or students to see exactly what you see, when you want to see it.

ZSC Bluetooth Interface

During sensor installations, the ZSC lets you monitor a sensor reading as it is installed.

Get real-time, wireless readings via Bluetooth on your smartphone with the push of a single button. Readout values are displayed in ZENTRA Utility Mobile to help you detect installation problems (poor sensor-to-soil contact, air pockets, rocks etc.) before you repack the hole or trench. The ZSC is often used to spot-check soil moisture, but it can also instantaneously read any other environmental sensor and it's powered by only two AA alkaline batteries.



SDI-12 sensor networks using a common data line are like Christmas tree lights. One shorted sensor interferes with communications over the entire network. It's imperative to find that sensor and get it off the data line. With the ZSC, there's no more unplugging every sensor, hoping the network will fire up. Use it to find out exactly where problem sensors are. Plus the ZSC allows the user to assign SDI-12 addresses to digital sensors for easier SDI-12 programming.

ProCheck Hand-held readout

Plug in the hand-held ProCheck to get a real-time reading from any of our sensors.

Readout values help you detect installation problems (poor sensor to soil contact, air pockets, rocks, etc.) before you repack the hole or trench.

ProCheck can be used to assign SDI-12 addresses to digital sensors for easier SDI-12 programming.

ProCheck is often used to spot check soil moisture, but it can instantaneously read any soil moisture or environmental sensor. Press a button to save up to 5,000 individual readings. Each reading includes sensor type, date, time, raw value, calibrated value and calibration coefficients.



Hydrology-Field

Remote Ground Water Monitoring

The HYDROS sensor combined with a METER data logger are the perfect pair for remote groundwater monitoring. Our ZL6 logger can send your water depth, temperature and electrical conductivity data to your computer up to six times daily by cellular transmission worldwide.



HYDROS 21

Water depth, temperature and electrical conductivity

Continuously monitor groundwater and surface water level changes along with electrical conductivity and temperature.

Water Depth

Range: CTD-10 (0 to 10 m).

Electrical Conductivity

Range: 0 to 120 dS/m (mS/cm).
Accuracy: ±0.01 dS/m or ±10%.
Resolution: 0.001 dS/m.

Temperature

Range: 0 to +50 °C.
Accuracy: ±1 °C.
Resolution: 0.1 °C.

Data Logger Compatibility

METER ZL6 and Campbell Scientific Data-loggers.

*Operating temperature 0 to 50°C (Pressure transducer cannot be allowed to freeze while submerged).

Infiltrometer

Portable Measurement of Hydraulic Conductivity and Infiltration

Adjustable suction and porous stainless steel contact plate ensures good contact and minimizes surface disturbance for a quick and accurate measurement.

Total Length: 32.7 cm.
Suction Range: 0.5 to 7 cm of suction.
Water Volume for Operation: 135 mL.
Diameter of Sintered Stainless Steel Disc: 4.5 cm diameter, 3 mm thick.



Drain Gauge G3

Water movement below the root zone

Use the Drain Gauge G3 to collect, monitor and analyze water moving below the root zone. The Drain Gauge G3 collects water moving through the vadose zone and sends drainage rate measurements to a surface data logger. The Drain Gauge G3 is built to be buried and stay buried.

Measurement Surface Area: 507 cm².
Sampling Reservoir Volume: 3 L.
Accuracy: ±1.4 mm drainage.
Resolution: 0.2 mm drainage.
Suction at Intake: 110 cm (11 kPa).
Total Length: 147 cm.
Divergence Control Tube (DCT) Length: 60 cm.
Measurement Time: 150 ms.



SATURO

Automated Infiltration Calculation

The SATURO Infiltrometer does almost everything for you. It's fully automated and doesn't require post-processing of data. Install the ring, connect the hoses, and push "start".



Infiltration Rate Range: 0.0038 cm/hr to 115 cm/hr.
Infiltration Rate Resolution: 0.0038 cm/hr.
Infiltration Rate Accuracy: ±5 % of reading.

Smart Field Lysimeter

TEROS 32 Tensiometer

Tensiometers simplified

Tensiometers are indisputably, the most accurate way to directly measure water potential in the wet range. But measuring with a tensiometer is complicated. Most tensiometers require sophisticated wiring and complex data logger programming skills to even get them up and running, not to mention the constant maintenance, checking and refilling. Now there's a new way. Introducing the TEROS 32. Now, sit back, and relax.

At METER, we know tensiometers. We've sold over 10,000 across the span of a quarter century, so we're confident that if you need a precise, easy-to-use, reliable field tensiometer with outstanding year-round performance, you can rely on the TEROS 32. More usable, robust, and precise than other tensiometers, it provides superior quality data in near-real time and remains one of the most reliable instruments in the world for year-round outdoor monitoring.

TEROS 32 is a simple, plug and play tensiometer that combines METER's legendary German precision engineering with the power of ZENTRA cloud, giving you easier, faster, more accurate water potential data in near-real time. Just install it and plug it in, it's that easy. With ZENTRA Cloud software, you can review data as it happens from the comfort of your office, ensuring every tensiometer is working as expected. No more worrying if your tensiometer has cavitated. Combine the TEROS 32 with the TEROS 12 and you'll know the best time to go out and refill. Plus, you can use both sensors to generate in situ moisture release curves. Accuracy has never been this easy.

Water potential:

Range: -85 to +50 kPa.
Resolution: 0.0012 kPa.
Accuracy: ± 0.15 kPa.

Temperature:

Range: -30 to +60 °C.
Resolution: ± 0.01 °C.
Accuracy: ± 0.1 °C between -20 and +40 °C.
(± 1 °C outside of this range).

Data logger compatibility:

METER ZL6 Data-logger or any data acquisition system capable of 3.6- to 28.0-VDC power and SDI-12.

Dimensions:

Length: 40.0 cm (15.75 in).
80.0 cm (31.50 in).
120.0 cm (47.24 in).
Diameter: 2.5 cm (0.98 in).



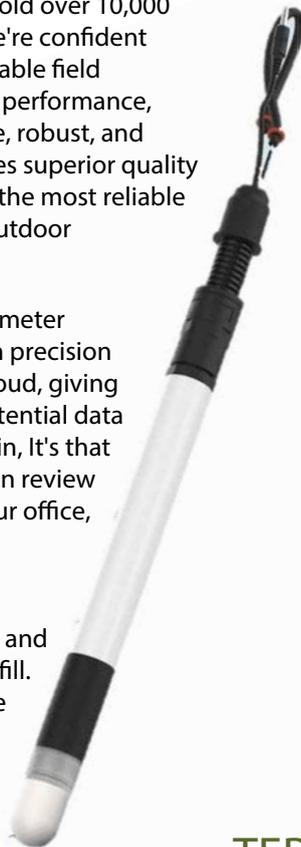
Go deep. Really deep.

The Smart Field Lysimeter delivers high-resolution data on water, water flux and mass transport with a depth and field precision no other instrument has. The Smart Field Lysimeter, the only small system in the world that directly and accurately measures the actual evaporation, leachate and precipitation at your site.

- A complete small, weighable, tension-controlled lysimeter combined with tensiometers, soil moisture sensors, data logger and optional GPRS modem.
- Field identical water conditions and temperature dynamics.
- Accurate ET.
- Direct measurement of the water balance.
- Depth flexibility.
- Lightning protection.
- Powered by solar panels.
- More economical and easier to install than large lysimeters.

Included sensors:

1 x T8 field reference tensiometer.
3 x 5TM probes for soil moisture.
3 x TEROS 21 probes for matric potential.



TEROS 21

Maintenance-free water potential and temperature.

Measurements do not drift over time.

SDI-12 compatible

- Highly accurate due to 6 point factory calibration.
- Tough overmoulded epoxy body to withstand tough conditions.
- Range of good accuracy extends to at least permanent wilting point.
- Accurate in a variety of soils and impervious to salts.

Soil Water Potential Range -9 to -100,000 kPa (pF 1.96 to pF 6.01).

Accuracy: $\pm 10\%$ of reading +2 kPa (from -9 to -100 kPa).

Temperature Range: -40 to 60 °C.

Temperature Accuracy: ± 1 °C.

Hydrology Lab

HYPROP

Automated Soil Water Potential



As soil scientists who have made hundreds of moisture release curves, we wanted an instrument that delivered greater accuracy. And we demanded an instrument that was automated. The HYPROP2 takes only days vs. months to generate a soil water characteristic curve in the wet range and it does this automatically. Use it together with the WP4C (which measures the dry range) and you can create full, high-resolution moisture release curves.

On top of all that, we designed the HYPROP2 to determine unsaturated hydraulic conductivity on undisturbed soil samples placed inside a standard 250 mL sampling ring. Used in tandem with the KSAT, it can measure the full unsaturated hydraulic conductivity curve. The resulting instrument winds up saving you time, hassle and worry.

Accuracy: 1.5 hPa (0 hPa to 820 hPa).

Resolution: 0.01 hPa.

Tensiometer Measurement range: +20 hPa to -1200 hPa / -2500 hPa.

Interface: RS485 tensioLINK.

T5 Tensiometer

Small footprint Water potential



With the T5 Tensiometer, we put our 25 years of expertise to work in the smallest space possible: a ceramic tip with a surface area of only 0.5 cm². The T5's minor footprint allows major advantages over larger tensiometers such as very little soil disturbance and an incredibly fast response time. Not only that, because of its small size, it's the only tensiometer in the world that can extend its measuring range.

No more trying to handle selective measurements in the field or small samples with oversized tensiometers. The T5 is small enough and precise enough to perform excellent point to point measurement of water potential in even the tightest spaces.

Not faster than a speeding bullet, but almost

The T5 Tensiometer has a super heroic response time of only 5 seconds for a pressure change of 0 to -85 kPa. It reacts much faster to changing soil conditions because of its small water volume, enabling you to measure even the most minute changes in water potential—something lower-quality tensiometers cannot do. It measures matric potential exactly within the range of most water movement, helping you understand whether water will move and where it will go.

KSAT

Saturated hydraulic conductivity in the lab



The KSAT is the only automated setup for taking saturated hydraulic conductivity measurements in the lab. In its simplest form, it's an instrument that uses both the falling and constant head methods on a soil core. Best of all, it's completely integrated, so you're also assured of software-controlled engineering that's fully tested.

Unlike typical contraptions, the KSAT comes with everything you need to make a measurement, meaning you can set it up right out of the box. This type of integration also allows the KSAT to take up minimal bench space. But perhaps its biggest benefit is how it complements the HYPROP. Both the HYPROP and the KSAT can use the same soil core because they share compatible sampling rings. This allows you to take saturated and unsaturated hydraulic conductivity measurements and generate a soil moisture characteristic curve to get a complete picture of a sample's properties, simplifying both processes.

Measureable Ksat values (min.): 0.01 cm/d (0.004 in/d).

Measureable Ksat values (max.): 10000 cm/d (3937 in/d).

Hydraulic conductivity (Ks) of the porous plate:

$K_s = 20000 \text{ cm/d (10000 in/d)}$.

Pressure sensor accuracy: 1 Pa (0.01 cm WC or 0.0001 psi).

Temperature sensor accuracy: 0.2 C (0.4 F).

Sampling ring (also fits with HYPROP):

Volume: 250 ml (0.066 gal).

Height: 50 mm (2 in).

Inside diameter: 80 mm (3.15 in).

Easy does it

To save you time and effort, the T5 can be installed in any position and orientation, plus it comes with a miniature auger to ensure as little soil disturbance as possible. For spot measurements in the field, just auger a 5 mm hole and insert the tensiometer. It's that easy.

Range: -100 to 0 to 85 kPa (ca. pF 2.9).

Accuracy: + 0.5 kPa.

Temperature shift: Typical shift 0.5% FS over 25 K.

Stability: Typical shift < 0.5% p.a.

Diameter: 5mm.

WP4C



Essential Water Potential Data

The WP4C measures water potential by determining the relative humidity of the air above a sample in a sealed chamber (conforms to ASTM 6836). Once the sample comes into equilibrium with the vapor, relative humidity is determined using the chilled mirror method. This involves chilling a tiny mirror until dew starts to form. At the dew point, the WP4C measures both mirror and sample temperature within 0.001 °C. This allows for unparalleled accuracy in the -0.1 MPa to -300 MPa range so you can have full confidence in sample readings.

The WP4C is a complex instrument due to its versatility, but extremely easy to use with sample sizes up to 15 ml. Simply fill the cup with soil, leaves or seeds and then equilibrate the sample. There's absolutely no change in the measurement for whatever you're analyzing. You can even plug WP4C data into HYPROP Data Evaluation Software in order to make a Moisture Release Curve or Soil Water Characteristic Curve.

WP4C Features:

- Precise mode
- Chilled mirror dew point technique
- Fast equilibration
- Unparalleled accuracy in the -0.1 MPa to -300 MPa range
- Durable and easy to clean
- Easy to calibrate with saturated salt solutions
- Conforms to ASTM 6836
- Use with HYPROP to create a full soil moisture release curve

WP4C Specifications:

Operating Environment: 5 to 40 °C (41 to 104 °F).

Temperature Control: 15 to 40 °C ±0.2 °C.

Sensors: 1. Infrared temperature 2. Chilled-mirror dewpoint.

Range: 0 to -300 MPa*.

Accuracy: ±0.05 MPa from 0 to -5 MPa, ±1% from -5 to -300 MPa.

Read Time: Typically 5 to 10 minutes.

Interface Cable: Serial cable (included).

Data Communications: RS232 compatible, 8-bit ASCII code, 9600 baud, no parity, 1 stop bit.

Weight: 3.2 kg (5.2 kg shipping weight).

Universal Power: 110-220 V AC, 50/60Hz.

Sample Size: 7 mL.

Calibration Standard: 0.5 molal KCl (-2.22MPa).

* WP4C will read to 0 MPa, but readings of samples wetter than -0.1 MPa will have an increasing and typically unacceptable percentage of error. Users may be able to make useful measurements in samples wetter than -0.1 MPa using special techniques.



Vapour Sorption Analyzer

VSA also stands for very simple and highly accurate

If you want to know something about your soil-how it behaves, how much clay there is, or if there are crystalline structures that may expand when water is present, the VAPOR SORPTION ANALYZER (VSA) is your simplest and most accurate option. It automates the entire process of moisture release curve construction in the dry region (-10 to -475 MPa) by accurately measuring simultaneously, at regular intervals, the water potential and the moisture content of a sample. The result is relief from a time-consuming, expensive and complicated process.

Set up a test, and walk away

With the VSA, it takes about five minutes to set up a test. Simply tell the instrument the humidity levels and times you'd like to use, put the sample into the instrument and move on to other tasks. The data from your test are automatically recorded and sent to your computer. In just 24 to 48 hours, the VSA generates curves with up to 200 data points (water potential vs. water content) for both adsorption and desorption. Powerful automation adds up to powerful time savings.

VSA Specifications:

Range: -10 to -475 MPa.

Accuracy: ±1 MPa or ±1%.

Temp Operating Range: 15 to 40 °C.

Size: 25.4 x 38.1 x 30.5 cm (10 x 15 x 12 in).

Weight: 19 kg.

Particle Size Analysis Automated

Reduce operation time to particle size

PARIO

The times are changing

Conventional soil particle size analysis operation takes a lot of time and energy. Readings or samplings have to be done by hand, at regular intervals and for up to 24 hours. Because the procedure is manual, it's prone to errors—which can easily lead to wasted time and effort.

Our goal at METER is to give you the tools and services that allow you to get precise results and focus on your research. That's why we developed a revolutionary new way to reduce the time and effort needed for soil particle size analysis.

Particle size analysis, automated

PARIO calculates the particle size distribution by Stokes' law, with the range of particle sizes spanning from 63 μm to 1 μm . It allows for unattended, automated operation, with no interference by lab personnel. Just set it up and come back 6 hours later to a finished measurement with all the data you need.



Measure more. Worry less.

PARIO reduces errors, because it does not require the insertion of a hydrometer or sampling of suspension volume with a pipette, which disturbs the sedimentation process. Being automatic, it also avoids manual reading or calculating errors. This results in an overall error rate of just 3%—lower than any conventional particle size analysis method.

PARIO automatically measures at an interval of 10 seconds and continuously records the change of suspension pressure as well as the temperature. This results in highly—accurate and continuous particle size distribution curves. The data are automatically evaluated by our new data processing algorithm called “Integral Suspension Pressure Method” (ISP).

The PARIO measuring method is based on the well-established hydrometer or pipette method. That means there is no need for soil-specific corrections with transfer functions as required for almost any other automated measurement method, such as laser diffraction or image analysis.

Complete convenience.

To save you even more time, PARIO comes with an easy-to-use, all-in-one software solution for automated data inquiry, visualization, evaluation and export. All of this serves one goal—to reduce the operating time you spend for particle size analysis, while at the same time improving accuracy. So you can focus on your research, not operating machines.

The PARIO soil texture analyzer. Reducing operation time to particle size.

Range of particle sizes: 63 μm to 1 μm^* (eff. hydrodynamic diameter).

Approximate error in mass fraction detection

Typical particle mass: 25 to 40 g/L suspension $\pm 3\%$.

Typical duration of measurement: 8 hours.

Measuring interval: 10 s.

Operating temperature range: 15 $^{\circ}\text{C}$ to 35 $^{\circ}\text{C}$ μm to 1 μm^*
(eff. hydrodynamic diameter).

Max. tolerable temperature change during measurement: 3 $^{\circ}\text{C}$.

Note*

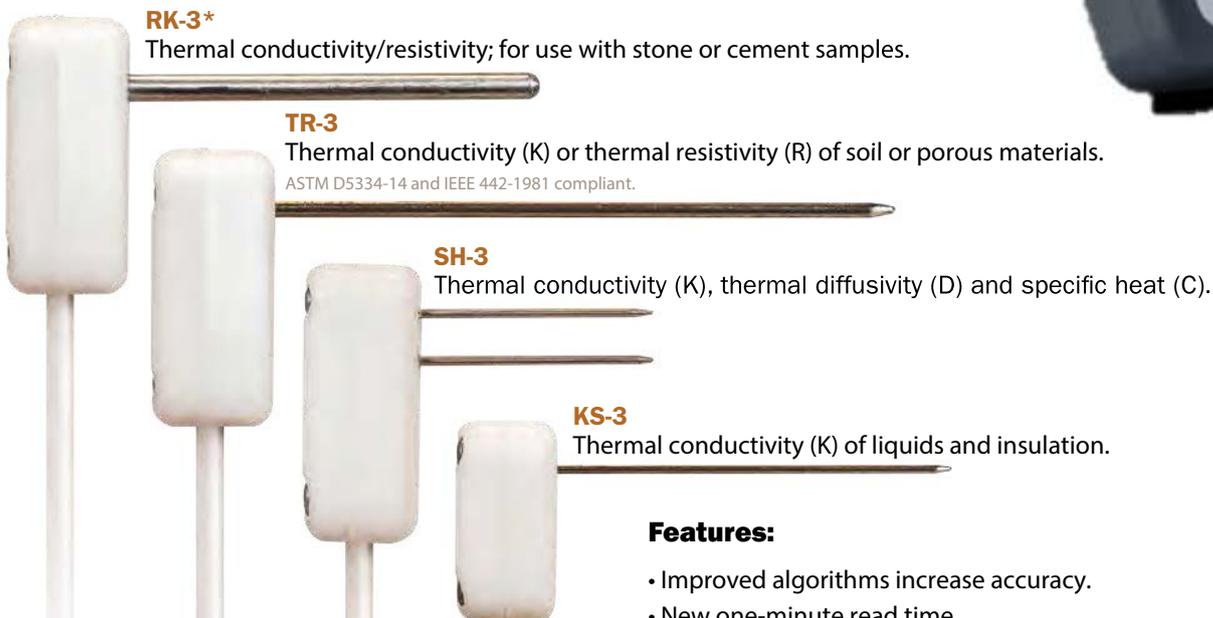
63 μm to 1 μm with 24 hours measuring period.

63 μm to 2 μm with 6 hours measuring period.

For particle size distribution analysis, manual sieving and recording the sand fraction is required.

Model Heat Movement

Measure heat transfer in the soil-plant-atmosphere continuum with the TEMPOS Thermal Properties Analyzer. The TEMPOS has four interchangeable sensors that measure thermal conductivity, thermal diffusivity and specific heat (heat capacity) with onboard data storage and downloadable capabilities and an automatic data collection mode. Forty years of expertise on heat and mass transfer have enabled us to engineer the most simple, easy-to-use instrument possible. Unlike competitor instruments, which use a one-sensor-fits-all type system, the TEMPOS automatically optimizes the reading for your material at the push of a button. It's ready to use, straight out of the box. Just insert the needle, select your material type and start measuring. It's that easy.



RK-3*
Thermal conductivity/resistivity; for use with stone or cement samples.

TR-3
Thermal conductivity (K) or thermal resistivity (R) of soil or porous materials.
ASTM D5334-14 and IEEE 442-1981 compliant.

SH-3
Thermal conductivity (K), thermal diffusivity (D) and specific heat (C).

KS-3
Thermal conductivity (K) of liquids and insulation.

Features:

- Improved algorithms increase accuracy.
- New one-minute read time.
- Measure thermal diffusivity and specific heat at a fraction of the cost.
- ASTM 5334- and IEEE 442-compliant.
- Measures thermal conductivity of many fluids.
- Automatically corrects for linear temperature drift.
- Interactive color screen automatically identifies the sensor you have plugged in and illustrates heating.

- Read modes:** Manual and unattended.
- Power:** 5 AA Batteries.
- Battery life:** More than 250 high-power measurements.
- Sensor interface:** DB-15 connector.
- Display size:** 5.5 x 4 cm.
- Data Storage:** 2,048 measurements in flash memory.
- Sensor Environment:** -50 to 150 °C.
- Case Size:** 18.5 x 10 x 3.5 cm.
- Power:** 5 AA Batteries.
- Cable:** 1 m.

RK-3 (*sold separately) Optional Sensor

6 cm needle length 

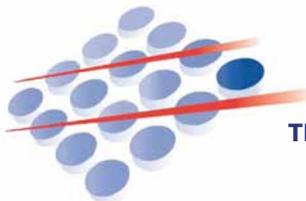
Thermal conductivity/resistivity; for use with stone or cement samples. The optional RK-3 sensor kit measures rock, concrete and other materials where drilling a pilot hole is required.



We made nearly 100,000 soil and environmental sensors last year. Every one of them was manufactured and calibrated right here, just steps away from my office. At METER, production staff, research scientists, lab techs, engineers and programmers talk to each other every day. We play soccer together, eat lunch together and communicate in casual and formal situations about our work and the little things that make a big difference in a sensor. We bring in scientists-our customers-to talk about their research so we know who we're working for. It's an approach that helps us as we try to build the best possible sensors for environmental research.

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