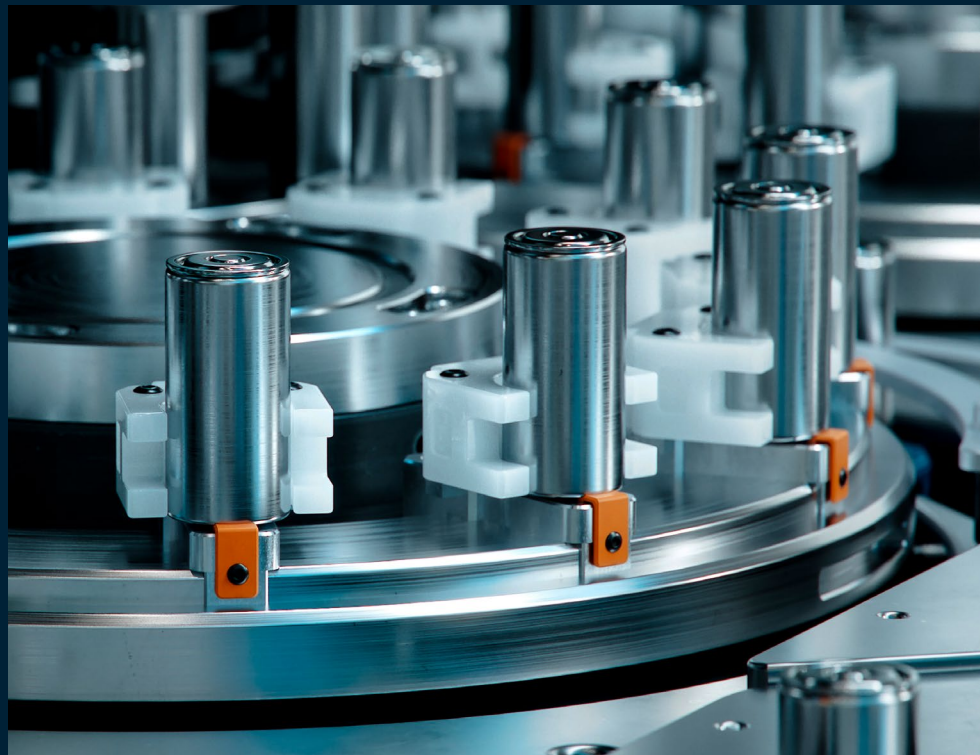


VAISALA

Accurate moisture and liquid
concentration measurements

produce high-
performance,
safe, and reliable
rechargeable
batteries

Brochure

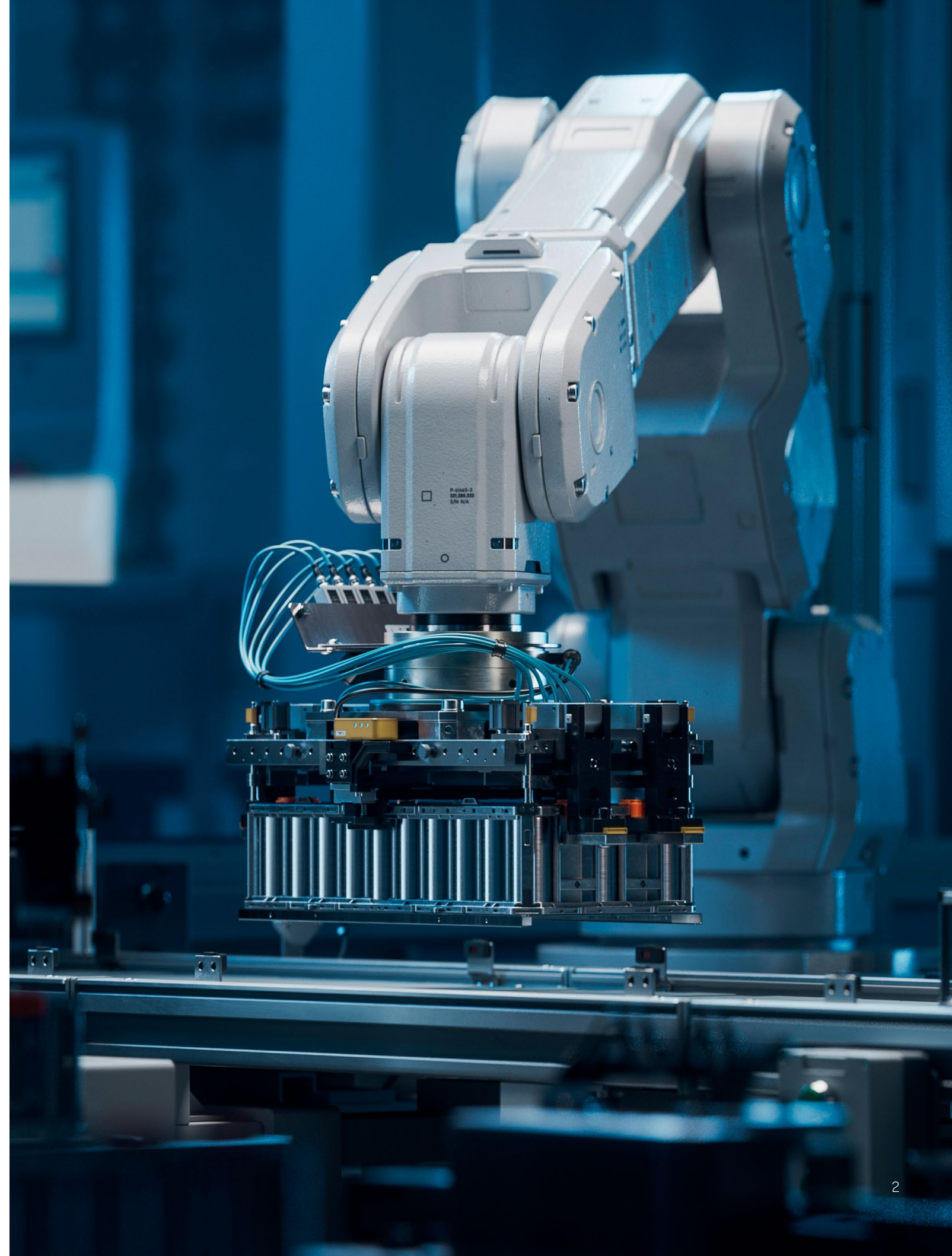
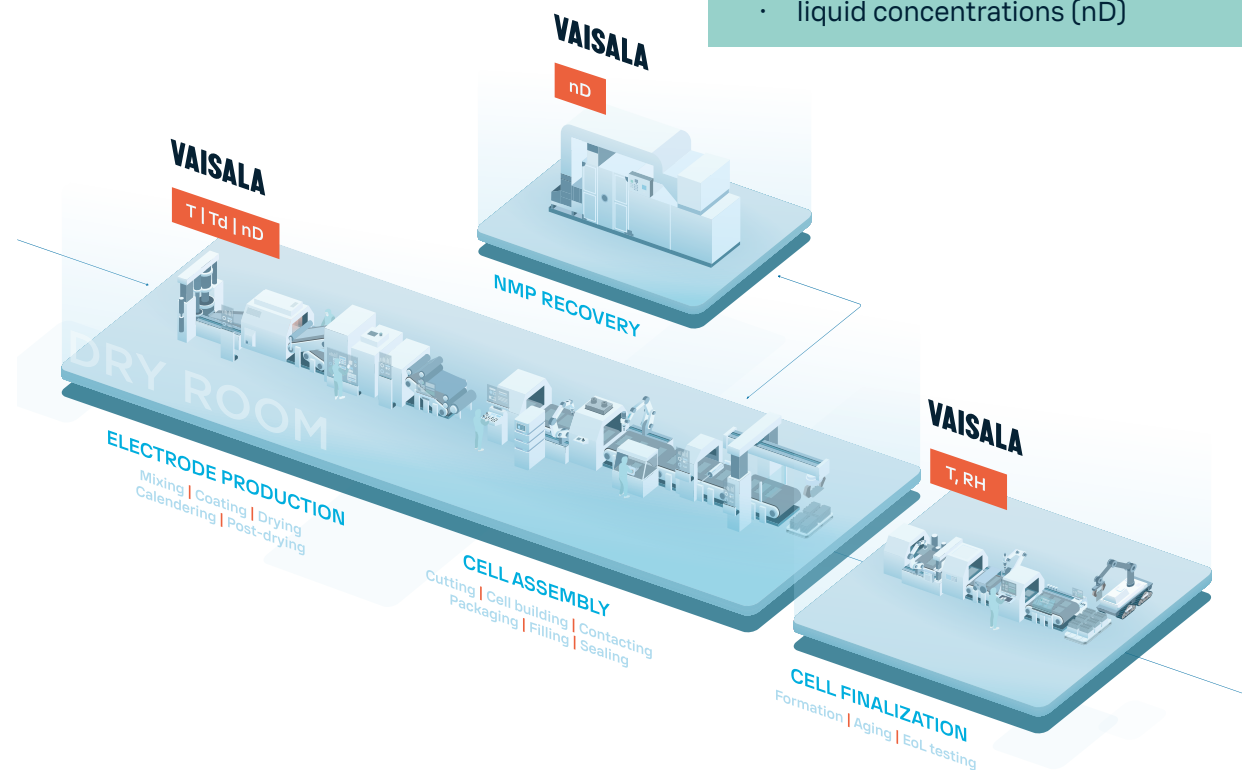


Reliability and simplicity in your critical battery manufacturing measurement points

Vaisala's measurement solutions help to produce higher quality batteries in a more sustainable and cost-effective way, and reduce costs in energy-intensive operations, such as drying and dry room operations.

Measure accurately and in real time:

- temperature (T)
- dew point (Td)
- relative humidity (RH)
- liquid concentrations (nD)



Modular Indigo platform for easy-to-use measurement ecosystem

World-class measurements with technologically best-suited products for ultra-dry conditions and critical process operations, such as filling and sealing, are only available from Vaisala.

Dew point temperature with Indigo transmitters and compatible probes



INDIGO500 / INDIGO300



DMP 7



INDIGO80 WITH DMP80

Chemical concentrations with Polaris™ process refractometers



PR53GP



PR53M



PR53GC



Applications

MIDSTREAM: dry room, dryer in air handling unit, glovebox, laser notching, electrolyte filling and sealing, solvents in electrode coating.

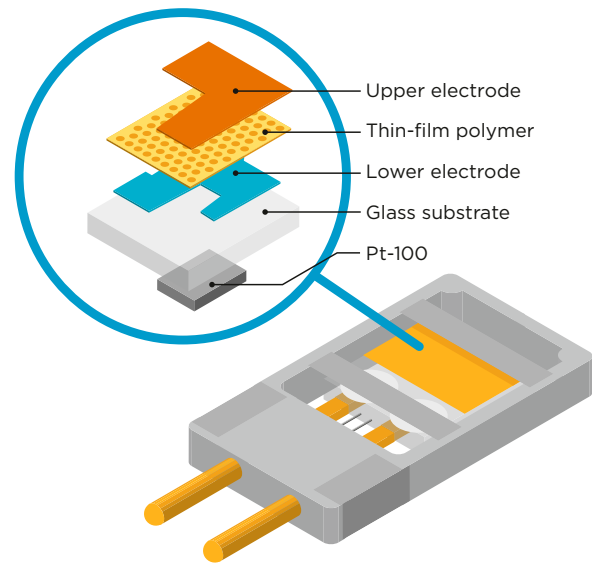
Benefits

- **Simple to use, solidly built**
Optimize energy-intensive processes with smart measurement probes embracing hot and dry conditions as well as processes with aggressive chemicals.
- **Meet sustainability goals while operating cost-effectively and always producing quality**
Say goodbye to scrap. Produce more high-quality batteries sustainably and more cost-effectively with Vaisala's accurate measurement solutions. With the help of our measurement, you can meet your sustainability goals.
- **Future-proof**
Your partner for the long-term; Vaisala probes are already fitted for the requirements of tomorrow.

» Read more: vaisala.com/battery

Protect your process from humidity with

Vaisala DRYCAP® innovation



DRYCAP achieves unmatched performance through 2 key innovations:

- the reliable capacitive thin-film polymer sensor
- the automated calibration feature

The sensor's thin-film polymer adjusts to water vapor changes in the surrounding humidity, altering the dielectric properties and capacitance. This capacitance is then translated into a humidity reading. Coupled with a temperature sensor, the capacitive polymer sensor calculates the dew point from humidity and temperature data.

Vaisala's patented auto-calibration function enhances measurement stability in dry conditions by periodically heating the sensor during the automated procedure. As the sensor cools to ambient temperature, monitoring humidity and temperature readings, offset correction compensates for potential drift. This sophisticated process ensures the DRYCAP sensor provides accurate long-term measurements, significantly reducing the need for maintenance.

About 80% of the energy used in manufacturing is attributed to dry room and dryer operations. The DRYCAP innovation will significantly help to manage and reduce energy usage and improve production efficiency.

Unlike conventional dew point instruments, DRYCAP excels in condensing environments, doesn't mind getting wet, and it is immune to contamination, including volatile organics, thanks to its sensor chemical purge functionality.

DRYCAP is the perfect aid for battery manufacturing – the exact solution manufacturers have been looking for.



DRYCAP Benefits

- Simple to use
- High chemical tolerance
- Withstands saturation
- Fast response time
- Sensor purge and warming
- Minimal drift
- Excellent accuracy and stability with very small hysteresis: Accuracy up to +2°C (+3.6°F) Td/f
- Vaisala quality with ISO9001 factory calibration



Dry room/ dry booth

Stable dry room conditions are crucial to battery production and product quality, such as capacity, reliability, and safety as well as for production yield, consistency and reliability. The sealed, temperature-controlled environment has tight specifications for low humidity and moisture in the air, and operations rely on accurate measurement instruments gathering data on the environment and feeding to SCADA Supervisory Control and Data Acquisition. Another option is to build a network of local screens conveniently visualizing the measurement readings with Indigo transmitters and using alarms limits feature for safe processing.

» Read more: vaisala.com/battery

Typical dry room
target levels:

Dew point -60...-40 °C Td

Match ultra-dry
conditions with the
best measurement
devices

Products



DMP5



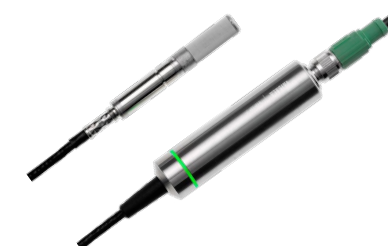
DMT143L



DMP7



HMT370EX



HMP7



INDIGO TRANSMITTERS

Glove boxes

Maintain desired low humidity levels and keep humidity strictly controlled during glove box operations and electrolytes safe from decomposing, while ensuring quality, safety, and performance of battery components with Vaisala's small-in-size and integrable measurement probes.

Direct installation in the glove box combined with the probe's chemical tolerance and fast reaction time enables extremely fast sequence control.

Products



Highest accuracy, lowest range
DEW POINT TRANSMITTER DMT152

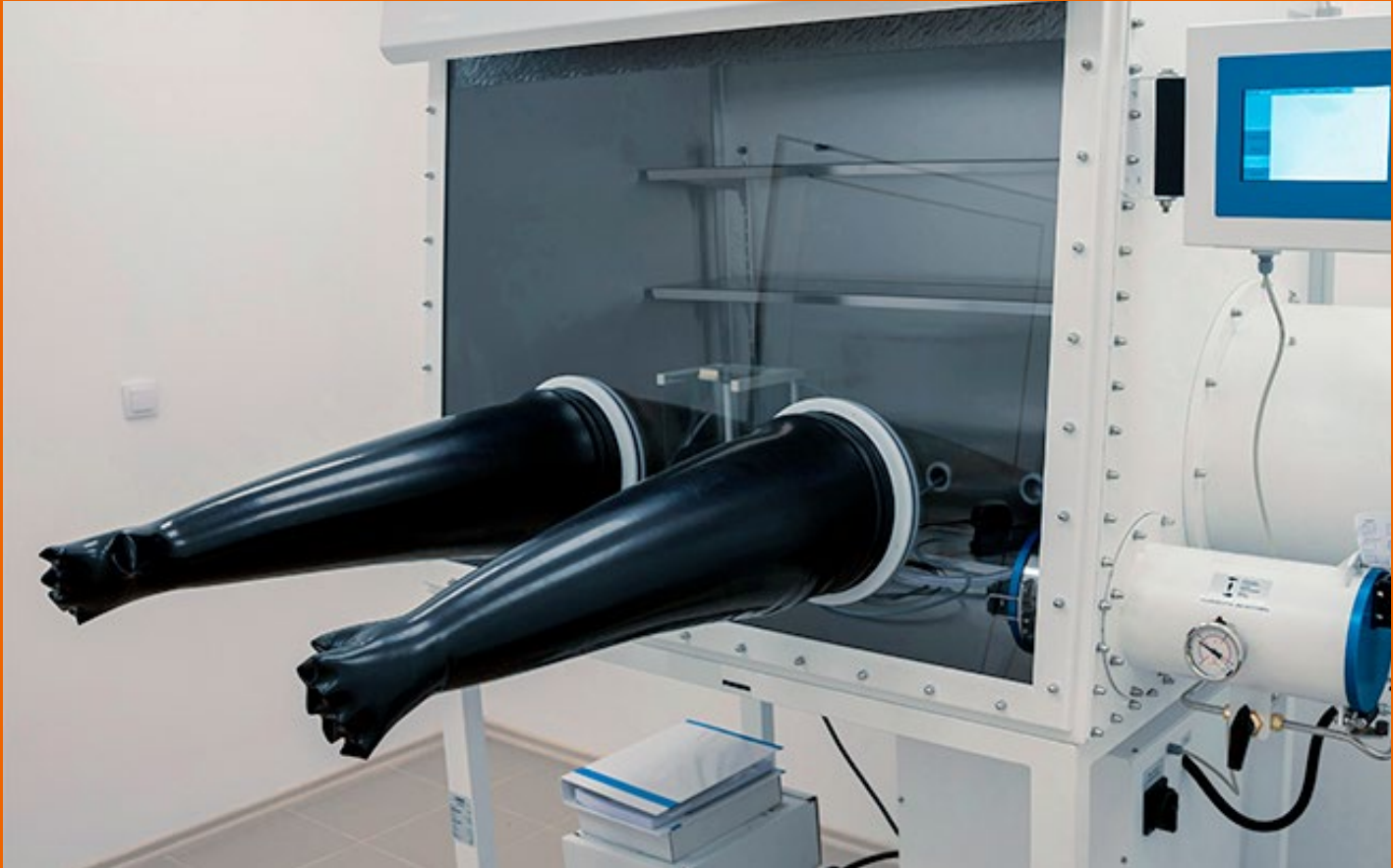
For very dry environments
Direct installation inside the glove boxes
Measures dew point down to -80°C [-112 °F]



Excellent chemical tolerance
**MINIATURE DEW POINT TRANSMITTERS
DMT143 & DMT143L**

Excellent chemical tolerance by Vaisala design
Patented auto-calibration function
Measures dew point down to -70°C [-94 °F]

Featuring the DRYCAP® innovation by Vaisala.



Turn on fast
sequence control
with Vaisala

Dryer in the air handling unit

Monitor, control, and improve dryer performance with Vaisala's dew point measurements. For production safety and efficiency, the dryer in the air handling unit should supply dryer air into the dry room than the existing conditions in the room.

Vaisala's instruments react rapidly, enabling precise dryer control and a much more stable dry room dew point temperature, saving energy.

» Read more: vaisala.com/battery

Products



DMT143 FOR OEM

Direct installation in the dryer for correct dryness and energy-efficient process.



INDIGO80 HANDHELD COMPATIBLE

Indigo80 with DMP80. Use as a screen on the go, for spot checking and data logging.



Dry room drying operations takes up about 40% of energy consumption. Save energy with Vaisala's rapidly reacting probes.

Critical processing steps with inert atmosphere

such as laser notching, electrolyte filling, and sealing

Even the smallest impurities or moisture can compromise the performance of the battery by interfering with the electrochemical processes. Maintain the integrity of the battery by controlling

the humidity levels in inert atmospheres and ensuring long-term safety and performance.

» Read more: vaisala.com/battery

Products



INDIGO300



INDIGO500



DMP5



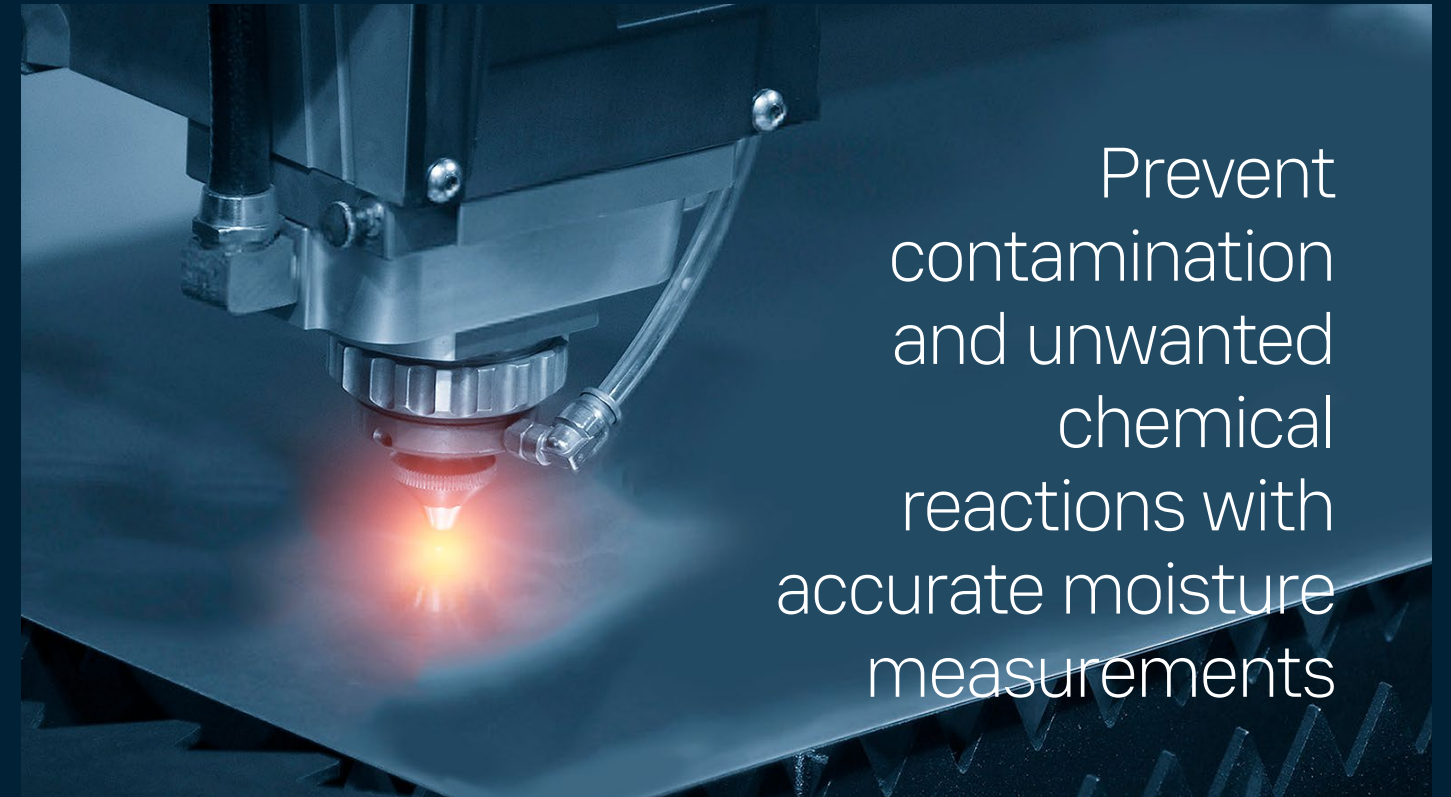
DMP6



DMP7



DMP8



Prevent contamination and unwanted chemical reactions with accurate moisture measurements

Probe with **rapid response time**

Manage dryer precisely with **immediate adjustments**

SAVE ENERGY

Equip dry room with local screens

Gather and feed data to the supervisory control and data acquisition system (SCADA) to enable immediate adjustments

ADJUSTMENTS BASED ON REAL-TIME DATA ENABLE SAFE PROCESSING

High-performance low dew point compatible Vaisala products

Ensure **consistent and on-target operations** for both standard and specialized conditions

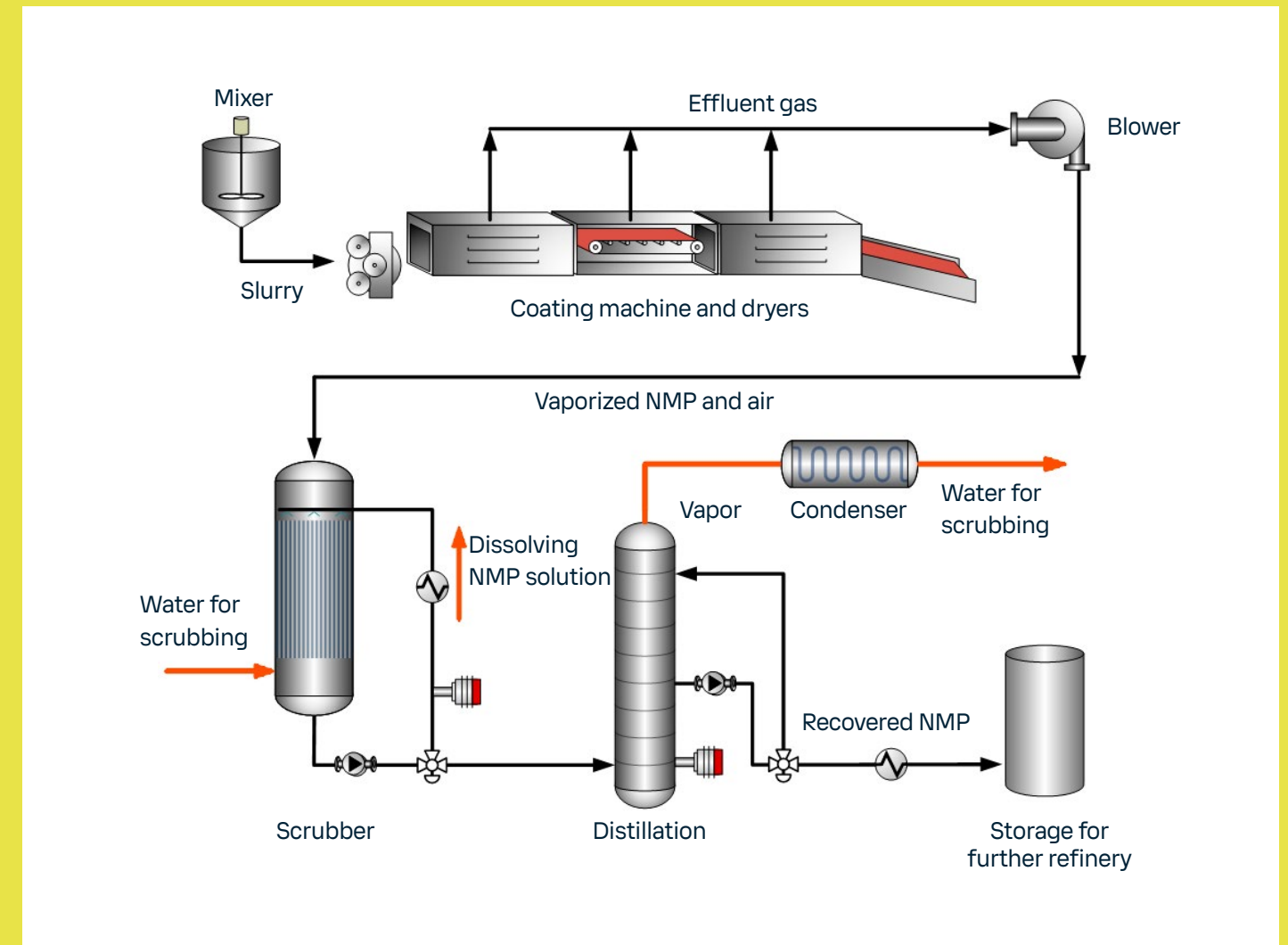
CONSISTENT QUALITY BATTERIES NOW AND IN THE FUTURE

Solvents in electrode coating

The electrode slurry is created by mixing electrode materials, which are often in powder or suspended particles form with (organic) solvents. Solvents dissolve or disperse the electrode materials, creating a viscous mixture suitable for coating onto the current collector. As the solvents influence the viscosity and rheological properties of the slurry, and therefore how the slurry applies to the current collector surface, it is important to measure the concentration of the solvent to create a uniform slurry for high battery performance.

NMP concentration

Measure quality, purity, and real-time concentration of N-methyl pyrrolidone (NMP) with inline measurement based on refractive index.



Effluent gas line accounts for about 40% energy consumption. Measure dry directly from the line and save energy. Always produce even quality slurry.

Dew point measurements in hot ambient environments such as effluent gas line

Vaisala offers specific products for measuring dew point in hot ambient environments. Measure dew point directly in the effluent gas line and get real-time data for process control. For hot ambient environments, select either direct or sample-based

measurement with probes that have excellent chemical and extreme temperature tolerance.

» Read more: vaisala.com/battery

Products



DMT143L



DMP6



DMP7



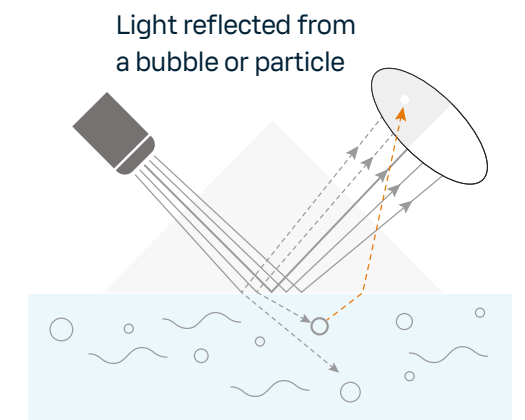
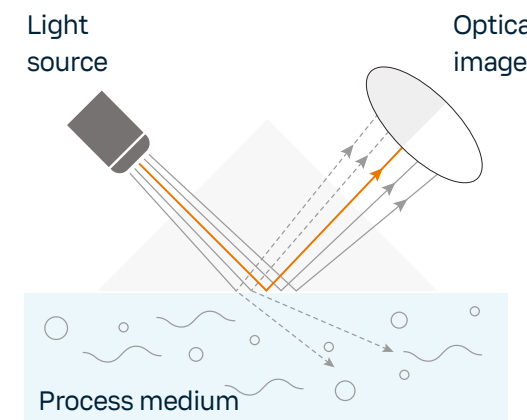
DMP8

RI principle

A process refractometer is based on refractive index (RI), which is a highly accurate measurement of the dissolved components in a liquid. There are three main components in the refractometer: a light source, a prism, and an image detector. The light source sends light rays at different angles to the prism and process interface. Rays with a steep angle are partly reflected to the image detector and partly refracted to the process. Rays with a low angle are totally reflected to the detector. The angle from which total reflection starts is called the critical

angle, which is a function of the refractive index – and therefore correlates with the concentration of the solution.

A built-in temperature sensor measures the temperature on the interface of the process liquid. The sensor converts the refractive index and temperature into concentration units indicated in different scales. The diagnostics program ensures that the measurement is reliable.



No influence by particles, bubbles or color

Chemical concentrations with Polaris™ process refractometers.



PR53GP



PR53M



PR53GC

Lithium-ion batteries, lithium-sulfur batteries, sodium-ion batteries, and solid-state batteries

researching solid-state and beyond


Battery technology is evolving at an unprecedented speed in the quest to find more powerful, safer, and smaller products to satisfy the ever-growing demand. Despite the new advances, these new technologies are even more sensitive to humidity and require accurate control and monitoring.

Vaisala has solutions for R&D, laboratory, and scaling-up manufacturing. In cases where a

measurement need is identified but lacks a suitable instrument, we find solutions. Partner with the most trustworthy measurement provider for reliable results and safe experiments, and prepare future developments with the best-in-class humidity and dew point probes.



Partner with the most trustworthy measurement provider for reliable results and safe experiments, and prepare future developments with the best-in-class humidity and dew point probes.



Supercharge your battery manufacturing success by selecting Vaisala as your go-to measurement partner for the most critical measurement points.

» Interested to hear more? [Contact us!](#)

Did you know?

Did you know that Vaisala's measurement probes have been measuring on planet Mars for years?

We consider this to be the highest honor and a symbol of our record of producing high-quality products with long-term stability. You simply cannot venture out into these conditions with just any instrumentation. The unforgiving conditions in space pose strict demands on technology, requiring the most reliable sensors that can be trusted to endure without need of maintenance or repair. After all, there are no routine maintenance trips to Mars, and technicians don't get to calibrate sensors on the Red Planet, no matter how much they would want to.

VAISALA

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