

MUNICH BATTERY LABS

BATTERY CELL TESTING.



Cell ageing and performance tests

Special tests during development phase

In-depth data analysis

Customized Testing with Outstanding Expertise.

At the MUNICH BATTERY LABS, we test battery cells of all formats and chemistries, including lithium-ion, sodium-ion, and solid-state cells. Our primary focus lies in analysing cell ageing and performance under predefined environmental conditions.

Drawing on years of laboratory experience and outstanding expertise in electronic component testing, we successfully launched our first battery cell testing facility in 2022.

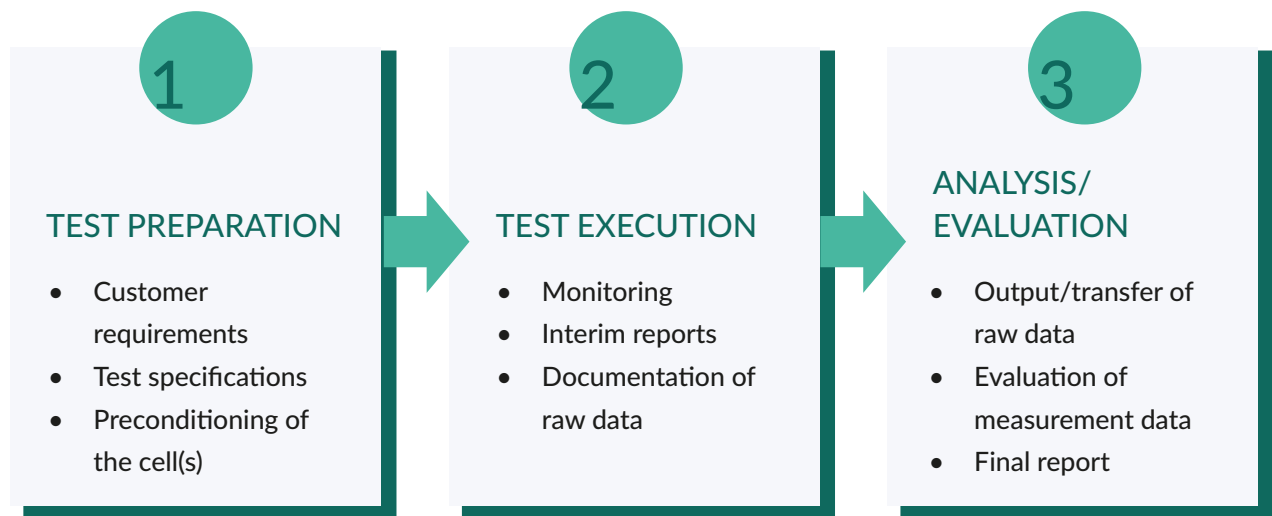
Since 2024, our MUNICH BATTERY LABS have offered extensive testing capabilities and state-of-the-art infrastructure across nearly 600 m² and 572 channels – ensuring comprehensive support for your cell testing requirements.

We are looking forward to receiving your test specifications.



Manuel Kroh
Director Business Development

Battery cell ageing and performance tests at our MUNICH BATTERY LABS.



Based on your requests, we analyze your requirements and determine a suitable test methodology, which is carried out in accordance with the applicable standards and with the help of an automated test plan.

Throughout the battery testing process in our state-of-the-art laboratories, you benefit from customized specifications, custom-designed cell adapters, continuous monitoring and a clear, coherent final report detailing the results.

With our cutting-edge equipment, we meticulously replicate the customers unique charge and discharge profiles, facilitating precise definition of multiple parameters including currents, voltages, temperatures, and beyond.

Cell Testing for Development and Validation

- Calendar & cyclic ageing tests
- OCV measurement for precise condition assessments
- Dynamic stress tests (DST) and internal resistance measurement (IR)
- Cyclic voltammetry (CV) and differential voltage analysis (DVA)
- Pulse load testing and fast-charging capability of up to 2,400 A per channel (parallelised)
- Tests under real drive cycle profile

In addition, we offer specialised tests for in-depth analysis and optimisation:

- Thermal measurements and (gas) pressure measurement
- Electrochemical impedance spectroscopy (EIS)
- High-Precision Coulometry (HPC)
- Ultrasound Imaging
- Solutions for active and passive cell cooling
- Model validation



Data analytics ensures precise and reproducible results.

Our Data Analytics team collaborates seamlessly with our battery laboratories to efficiently and accurately analyze extensive datasets, ensuring consistent quality.

Our experts work seamlessly with our battery labs to efficiently and accurately analyze large data sets. The insights gained from our analysis are coherently documented in a final report.

On request, we can provide you with an interactive dashboard on which you can view all measurement data and analyses. Meaning you always have an detailed overview to make well-founded decisions.



A Partnership Based on Trust.

With VISPIRON SYSTEMS at your side, you benefit from extensive expertise in the field of battery cell testing, a passion for quality and our constant striving for improvement.



Our Way to DIN EN ISO 17025 Accreditation.

In our pursuit for excellence in quality assurance and battery testing, we are working towards accreditation according to DIN EN ISO 17025. We aim to achieve this status by the end of 2026.

Focused on battery technology standards.

Our efforts focus on key standards vital for the future of battery cell testing, especially for lithium-ion secondary cells. These standards include:

DIN EN IEC 62660-1:2020-07: For testing the performance of lithium-ion secondary cells in electric vehicles | Teil 1: Prüfung des Leistungsverhaltens (IEC 62660-1:2018); Deutsche Fassung EN IEC 62660-1:2019

DIN EN 60068-2-1:2008-01: Focused on cold tests | Teil 2-1: Prüfverfahren - Prüfung A: Kälte (IEC 60068-2-1:2007); Deutsche Fassung EN 60068-2-1:2007

DIN EN 60068-2-2:2008-05: For dry heat tests | Teil 2-2: Prüfverfahren - Prüfung B: Trockene Wärme (IEC 60068-2-2:2007); Deutsche Fassung EN 60068-2-2:2007

DIN EN 60068-2-14:2010-04: Covers temperature variation tests | Teil 2-14: Prüfverfahren - Prüfung N: Temperaturwechsel (IEC 60068-2-14:2009); Deutsche Fassung EN 60068-2-14:2009

DIN EN 62620:2023-12: Secondary cells and batteries containing alkaline or other non-acid electrolytes – Secondary lithium cells and batteries for use in industrial applications

| Akkumulatoren und Batterien mit alkalischen oder anderen nichtsäurehaltigen Elektrolyten – Lithium-Akkumulatoren und -batterien für industrielle Anwendungen (IEC 62620:2014 + AMD1:2023); Deutsche Fassung EN 62620:2015 + A1:2023

Our dedication to quality.

Our preparation for the accreditation according to DIN EN ISO 17025 and our focus on said standards reflect our commitment to deliver quality, precision, and reliable results.

By adhering to and exceeding these standards, we ensure that our customers can always trust in the outstanding quality of our test results.

Available Channels and Specifications.

The measuring channels can be set parallel to ensure the usage of higher currents. This results in a maximum current of 2,400 A per channel.

Cell testing systems used:

- 12x Keysight/ Scienlab SL 1007 A, 100 A
- 1x Keysight/ Scienlab SL 1007 A, 300 A
- 3x Battery Dynamics / HRT-L, 300A
- 1x Sention Senturion Discovery Gen2 (Ultrasonic)

Number of channels	Max. power per channel (A)	Max. Voltage per channel (V)
560	100	6
12	300	6
24 (HPC)	300	6



Climate Control and Specifications.

Climate chambers used:

- 23x Binder MK 720
- 7x Binder MK 1020
- 5x Binder MKF 720

Temperature range	-40 °C to +120 °C
Spatial temperature deviation depending on the setpoint [+-K]	0,3 - 2
Temperature deviation over time depending on the setpoint [+-K]	0,1 - 0,5
Average heating rate according to IEC 60068-3-5 [K/min]	4
Average cooling rate according to IEC 60068-3-5 [K/min]	4,5

Technical Information on the Existing Sensors.

Used cell testing systems from Keysight:

Measured variable	Precision	Measurement type/information	Sensing frequency
Temperature	± 1 K	4-wire, PT 1000	1 kHz
Voltage	$< \pm 1$ mV (typ. 0,5 mV)	2-wire, DC	1 kHz
Power und power dynamics	$\pm 0,05\%$ (Measured variable) $\pm 0,01\%$ (Scale end value offset), depending on measuered variable	Dynamic: 3 ms (10% - 90% of total power)	1 kHz
Electro-chemical impedance spectroscopy (EIS)	Cell impedance: 10 $\mu\Omega$ - 1 Ω Excitation amplitude: < 10 A and 1 V Absolute error Z : (200 $\mu\Omega$) Relative error Z : 1% Absolute error Phi : 2 degrees	Galvanostatic, potentiostatic, multisine for frequencies <= 1 Hz AC current amplitude: max. 0.5 A, parallel connection of multiple channels possible	1 mHz to 10 kHz

Tester for High Precision Coulometry from Battery Dynamics:

Measurement	Accuracy	Measurement Methode/ -information	Sampling- frequency
Voltage	1 μ V resolution; typical noise: < 20 μ V p-p (< 5 μ V in slow mode), < 4 μ V RMS (< 1 μ V in slow mode)	temperature-stabilized measurement, 24-bit ADC; measurement range -5...6 V; operational range 0.5...5 V	internal sampling intervals < 1.0 ms (optional 0.1 ms)
Current	resolution 0.1 mA (measurement) / 2 mA (control); typical noise: < 3 mA p-p, < 1 mA RMS; FSR -100...+100 A	temperature-stabilized shunt measurement, 24-bit ADC	internal sampling intervals < 1.0 ms (optional 0.1 ms)
Sampling	time precision 0.0003%	time resolution 1 μ s; data logging $\geq$ 10 ms (optional $\geq$ 1 ms)	internal sampling intervals < 1.0 ms (optional 0.1 ms)

Additional measurement systems from Gantner Instruments:

Measured variable	Precision	Measurement type/information	Sensing frequency
Pressure	± 1 kPa/ 0,5%, depending on measured variable	Bridge circuit, depending on requirements	20 kHz
Rotation	2% to 5%, depending on measured variable	Depending on requirements	1 kHz
Voltage, redundant	$\pm 0,001\%$ to $\pm 0,006\%$, depending on measured variable	2-wire, DC	1 kHz
Temperature, in addition	± 1 K	4-wire PT100/ PT1000	1 kHz
Resistance	$\pm 0,002\%$ to $\pm 2\%$, depending on measured variable	2-wire/ 4-wire	1 kHz



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Get in touch with us for a personal consultation and be successful in your projects using our customized solutions.

We look forward to working with you to set new benchmarks in battery technology.