



CTC | advanced
member of RWTÜV group

The logo features the text 'CTC' in a bold, white, sans-serif font. To its right are three vertical bars of varying heights and widths, colored in a light blue. Further right is the word 'advanced' in a lowercase, white, sans-serif font. Below 'advanced' is the text 'member of RWTÜV group' in a smaller, lowercase, white, sans-serif font. The background is dark with a pattern of light blue dots and lines.

Battery Lab Presentation

January 2019

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Tests on cell level

Nail	Altitude	Dust
Crush	Voltage Limit Cycling	Immersion
Overcharge	Normal Cycling	Cut Test
Over Discharge	Drop	High Temperature Crush
HC Plating	Temperature Cycling	Low Temperature Storage
Voltage Reversal	Temperature Stability	Fuel Fire
Short Circuit	High Temperature Storage	Crash
Fire	Blund Road	Shock
Vibration	Mechanical Shock	Temperature Humidity
Salt Fog	IPXX	Disposal



Tests on module/pack level

Nail	Altitude	Dust
Crush	Automated Cycling	Immersion
Overcharge	Drop	Fuel Fire
OverDischarge	Temperature Cycling	Rollover
Plating	High Temperature Storage	Load Profile Simulation
Propagation	Mechanical Shock	Chemical Resistance
Short Circuit	Low Temperature Storage	Leakage Test
Unplug	Crash	Temperature Humidity
Vibration	Shock	Customer Specific Test
Salt Fog	IPXX	Disposal




Standardized Tests – recent accreditations

- UNT-T 38.3
- ECE R 100
- ECE R 136
- IEC 62133
- Safety Guidelines (BVES) for home storage systems
- IEC 62619
- VDE-AR-E 2510-50
- Other standards on request



Test capabilities battery lab

NAIL PENETRATION TEST


Maximum Force:	18 kN	
Speed:	1-10 cm/s	
Max. penetration depth:	12 cm	
Accuracy:	+/- 1 mm	
Nail diameter	1-30 mm	
Test temperature:	Ambient temperature (higher temperatures by preheating)	
Number of measuring channels:	20 / <i>Standard: 6</i> (temperature, voltage, distance)	
Samplingrate (Measurement):	Max. 100 Hz / <i>Standard 10 Hz</i>	
Samplingrate (Control):	3 Hz	
Max. sample size:	60x80x100 cm (WxDxH)	

Additional: Preheating possible / HD video



Test capabilities battery lab

NAIL PENETRATION TEST according to IEC 62660

Maximum Force:	2 kN	
Speed:	0,1-80 mm/s	
Max. penetration depth:	100 mm	
Accuracy:	+/- 0,1 mm	
Nail diameter	1-3 mm (ceramic + steel)	
Test temperature:	Ambient temperature (higher temperatures by preheating)	
Number of measuring channels:	20 / <i>Standard: 6</i> (temperature, voltage, distance)	
Samplingrate (Measurement):	Max. 100 Hz / <i>Standard 10 Hz</i>	
Samplingrate (Control):	> 1 kHz	
Max. sample size:	60x60x50 cm (WxDxH)	

Additional: Preheating possible / HD video



Test capabilities battery lab

OVERCHARGE – without voltage limits

Max. Voltage + Current values:

0-40 V / 340 A (max. 4 kW)
40-80 V / 170 A (max. 4 kW)
20-600 V / 600 A
(max. 100 kW)
0-10 V / 1000 A (max. 10 kW)
from mid-2019: 50-1000 V / 1200 A (360 kW)



Test temperature:

25°C – 100°C

Number of measuring channels:

20 / *Standard: 6*
(temperature, voltage, electrolyte)

Samplingrate (Measurement):

Max. 100 Hz / *Standard 10 Hz*

Samplingrate (Control):

2 Hz

Max. sample size:

35x30x15 cm (WxDxH)
(at test temperature higher than ambient temperature)

Additional: HD video



Test capabilities battery lab

OVERDISCHARGE – Discharge to 0 V

Max. Voltage + Current values:

0 V / 390 A (max. 4 kW)
2 V / 600 A (max. 100 kW)
-8 V / 1000 A
(max. 10 kW) **new*

from mid-2019: 50-1000 V / -1200 A (360 kW)



Test temperature:

25°C – 100°C

Number of measuring channels:

20 / *Standard: 6*
(temperature, voltage, electrolyte)

Samplingrate (Measurement):

Max. 100 Hz / *Standard 10 Hz*

Samplingrate (Control):

2 Hz

Max. sample size:

35x30x15 cm (WxDxH)
(at test temperature higher than ambient temperature)

Additional: HD video



Test capabilities battery lab

VOLTAGE LIMIT CYCLING – Cycling with overriding voltage limits

Max. Voltage + Current values:

0-40 V / 340 A
Charge (max. 4 kW)
0-40 V / 390 A
Discharge (max. 4 kW)
6-600 V / 600 A
Charge / Discharge (max. 100 kW)
-10 – 10 V / 1000 A
Charge / Discharge (10 kW)
from mid-2019: 50-1000 V / -1200 A (360 kW)



Test temperature:

25°C – 100°C

Number of measuring channels:

20 / *Standard: 6*
(temperature, voltage, current, electrolyte)

Samplingrate (Measurement):

Max. 100 Hz / *Standard 10 Hz*

Samplingrate (Control):

2 Hz

Max. sample size:

35x30x15 cm (WxDxH) (at test temperature higher than ambient temperature)

Additional: HD video



Test capabilities battery lab

REVERSAL CHARGE – Discharge to a negative voltage level

Max. Voltage + Current values:	+8 bis -8 V / 1000 A Discharge (max. 10 kW)
Test temperature:	25°C – 100°C
Number of measuring channels:	20 / <i>Standard: 6</i> (temperature, voltage, electrolyte)
Samplingrate (Measurement):	Max. 100 Hz / <i>Standard 10 Hz</i>
Samplingrate (Control):	2 Hz
Max. sample size:	35x30x15 cm (WxDxH) (at test temperature higher than ambient temperature)

The image shows a graph on the left with a red curve representing voltage over time (t). The y-axis is labeled +V and -V, and the x-axis is labeled t. The curve starts at a positive voltage, decreases, crosses the zero line, and continues into negative values. To the right of the graph is a photograph of a test setup. It features a grey electronic control unit with a blue display and several ports. Red and blue cables connect this unit to a large, rectangular battery pack. The battery pack is connected to a smaller, grey rectangular component, likely a temperature chamber or a specific test cell.

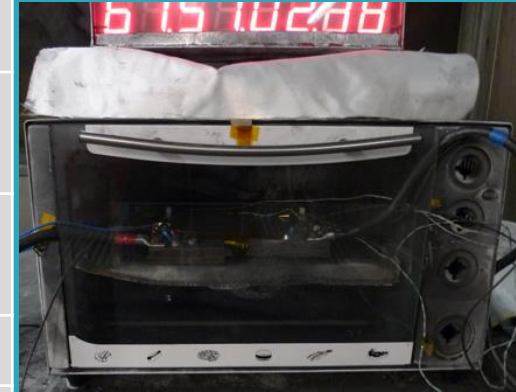
Additional: HD video



Test capabilities battery lab

THERMAL STABILITY

Test temperature:	25°C – 200°C
Number of measuring channels:	20 / <i>Standard: 6</i> (temperature, voltage, electrolyte)
Samplingrate (Measurement):	10 Hz
Samplingrate (Control):	1 Hz
Max. sample size:	35x30x15 cm (WxDxH)




Additional: HD video



Test capabilities battery lab

CRUSH	
Force:	8-850 kN
Speed:	0,02-2 mm/s
Max. crush depth:	20 cm
Accuracy:	+/- 0,2mm
Test temperature:	Ambient temperature (higher temperatures by preheating)
Number of measuring channels:	20 / <i>Standard: 6</i> (temperature, voltage, distance, force)
Samplingrate (Measurement):	100 Hz
Samplingrate (Control):	1 Hz
Max. sample size:	90x60x90 cm (WxDxH)




Additional: Preheating possible / HD video



Test capabilities battery lab

HIGH CURRENT PLATING – Cycling with high current at neg. temp.

Max. Voltage + Current values:	0-40 V / 300 A Charge 0-40 V / 250 A Discharge (max. 4 kW)
Test temperature:	-40°C – 0°C
Number of measuring channels:	20 / Standard: 3 (temperature, voltage, current)
Samplingrate (Measurement):	Max. 10 Hz / Standard 1 Hz
Samplingrate (Control):	2 Hz
Max. sample size:	60x40x15 cm (WxDxH)
Channels:	2
Additional: NO Video	





Test capabilities battery lab

CYCLING / PLATING – Cycling with 1C at neg. temp.

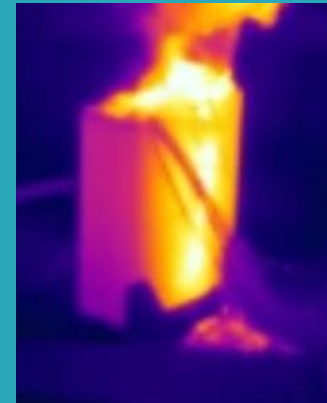
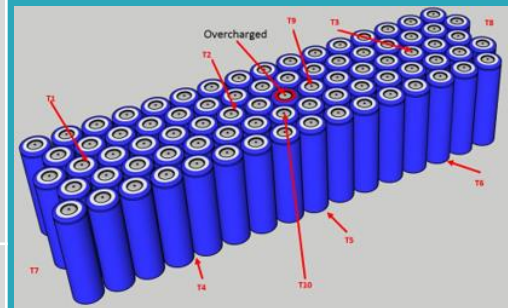
Voltage:	2-26 V
Charging Current:	0,05 – 20 A
Discharging Current:	0,05 – 20 A
Number of Cycles:	1-1000
Test temperature:	-30°C – +80°C
Number of measuring channels:	3 (temperature, voltage, current)
Samplingrate (Measurement):	1 Hz
Samplingrate (Control):	0,5 Hz
Max. sample size:	50x50x50 cm (WxDxH)
Number of Channels:	8 (16 with limited voltage + current)



Test capabilities battery lab

PROPAGATION - tests on module or system level up to 25kWh

Trigger:	Short Circuit Nail Penetration Overcharge (10 V / 1000 A) Reversal Charge (-8 V)
Number of measuring channels:	40 (temperature, voltage, current)
Samplingrate (Measurement):	10 Hz
Monitoring:	HD and IR Video
Max. sample size:	120x120x50 cm (WxDxH)





Test capabilities battery lab

THERMAL CYCLING


Test temperature:	-40°C – 100°C
Number of measuring channels:	20 / Standard 4 (temperature, voltage, 1 electrolyte)
Samplingrate (Measurement):	Max. 10 Hz / Standard 1 Hz
Monitoring:	SD Video (640x480 Fps)
Max. sample size:	120x100x100 cm (WxDxH)





Test capabilities battery lab

STORAGE – long term storage at high temperature

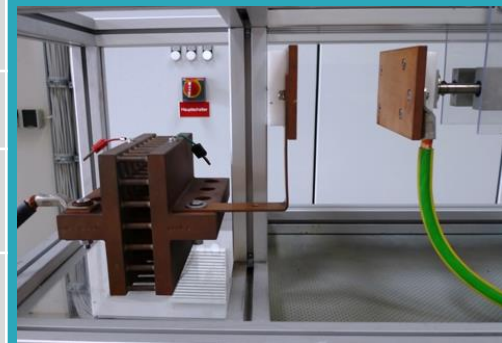
Test temperature:	20°C – 70°C	
Number of measuring channels:	20 (temperature, voltage, 1 electrolyte) (Standard 1 temp. each cell/pack)	
Samplingrate (Measurement):	Max. 10 Hz / Standard 1 Hz	
Monitoring:	SD Video (640x480 Fps)	
Max. sample size:	120x160x90 cm (WxDxH)	



Test capabilities battery lab

SHORT CIRCUIT

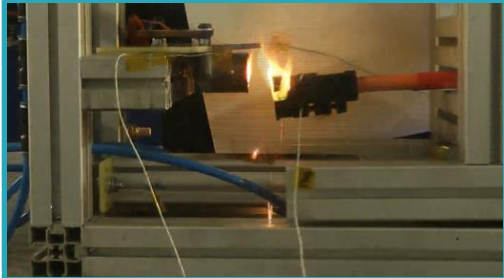
Max. switching current:	20 kA
Max. measuring current:	20 kA (+/- 25 A)
Resistance:	<5 mOhm to 100 mOhm (adjustable)
Test temperature:	Ambient temperature (higher temperatures by preheating)
Number of measuring channels:	6 (temperature, voltage, current)
Samplingrate (Measurement):	Max. 100 kHz / Standard 1 kHz
Monitoring:	HD Video and IR Video or HighSpeed
Max. sample size:	160x200x50 cm (WxDxH)





Test capabilities battery lab

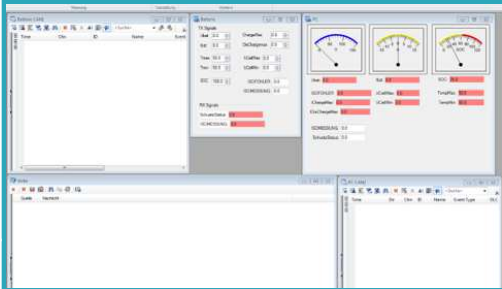
UNPLUG – Disconnect plug-in under load

Max. measuring current:	600 A	
Max. measuring voltage:	1 kV	
Speed:	1-80 mm/s	
Test temperature:	Ambient temperature (higher temperatures by preheating)	
Number of measuring channels:	6 (temperature, voltage, current)	
Samplingrate (Measurement):	Max. 100 kHz / Standard 1 kHz	
Monitoring:	HD Video and IR Video or HighSpeed	
Max. sample size:	100x100x50 cm (WxDxH)	



Test capabilities battery lab


AUTOMATED CYCLING – Cycling on the basis of recent data of BMS*

Max. Voltage + Current values:	10-600 V / 600 A Charge 10-600 V / 600 A Discharge (max. 100 kW) <i>from mid-2019: 50-1000 V / -1200 A (360 kW)</i>	
Test temperature:	25°C – 100°C	
Number of measuring channels:	20 / Standard: 6 (temperature, voltage, current, electrolyte)	
Connection:	4 CAN Busses / Ethernet	
Samplingrate (Measurement):	Max. 100 Hz / Standard 10 Hz	
Samplingrate (Control):	2 Hz	
Monitoring:	HD Video	
*(0-100% SOC / UCellmin – UCellmax / etc.)		



Test capabilities battery lab

VIBRATION – with climatical and electrical overlay (DRIVE CYCLE)

Max. charge + discharge current:	10-600 A script controlled	
Max. voltage:	10-600 V script controlled	
Test temperature:	-40°C – +80°C script controlled	
Vibration:	Sinus / Random / Shock 111 kN Sinus (pk) 102 kN Random (rms)	
Cooling:	water glycol / water / silicone oil	



Test capabilities battery lab

VIBRATION – with climatical and electrical overlay (DRIVE CYCLE)


Number of measuring channels:	6 (temperature, voltage, current) 12 acceleration sensors
Connection:	4 CAN Busses / Ethernet
Samplingrate (Measurement):	Max. 100 Hz / Standard 10 Hz
Max. sample size:	120x120x120 cm (WxDxH)
Monitoring:	HD / HS Video





Test capabilities battery lab

ROLL OVER	
Max. rotation angle:	2 x 360°
Max. rotation speed:	360° each 20 s
Test temperature:	Ambient temperature
Number of measuring channels:	20 (temperature, voltage, current)
Connection:	4 CAN Busses / Ethernet
Samplingrate (Measurement):	Max. 100 Hz / Standard 10 Hz
Monitoring:	HD Video
Max. sample size:	140x120x120 cm (WxDxH)





Test capabilities battery lab

CRASH	
Payload:	Up to 500 kg
Payload at ECE R100:	Up to 150 kg
Test temperature:	Ambient temperature
Number of measuring channels:	16 (temperature, voltage, acceleration)
Connection:	4 CAN Busses / Ethernet
Samplingrate (Measurement):	Max. 10 kHz / Standard 100 Hz
Monitoring:	HS Video
Max. sample size:	120x120x40 cm (WxDxH)

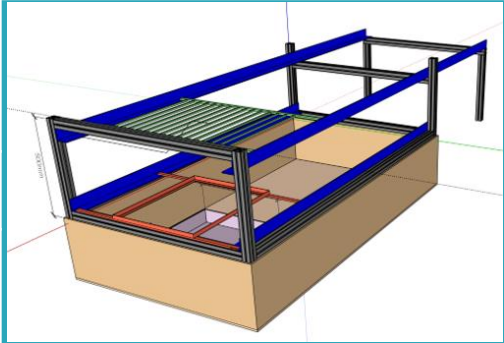
Theoretical max RAM-SLED acceleration, p. Air = 200 bar, 3 brake blocks, 6 MOOG valves

Displacement (mm)	1_MIT_max_200 kg Payload (g)	1_MIT_max_150 kg Payload (g)	1_MIT_max_100 kg Payload (g)
0	70	55	40
100	65	50	38
200	60	48	36
300	58	46	35
400	56	45	34
500	54	44	33
600	52	43	32
700	50	42	31
800	48	41	30
900	46	40	29
1000	45	39	28



Test capabilities battery lab

FUEL FIRE	
Fuel:	Gas or petrol
Test temperature:	Up to 850°C
Number of measuring channels:	20 (temperature, voltage, current)
Connection:	4 CAN Busses / Ethernet
Samplingrate (Measurement):	Max. 100 Hz / Standard 10 Hz
Monitoring:	HD Video
Max. sample size:	60x60x50 cm (WxDxH) <i>Larger samples on demand!</i>





Test capabilities battery lab

IMMERSION


Water depth:	1 m	
Test temperature:	ca. 0 °C up to ambient temperature	
Number of measuring channels:	10 (temperature, voltage)	
Connection:	4 CAN Busses / Ethernet	
Samplingrate (Measurement):	Max. 100 Hz / Standard 10 Hz	
Monitoring:	HD Video	
Max. sample size:	90x120x60 cm (WxDxH)	

Additional: Electrical overlay during the test possible



Test capabilities battery lab

ALTITUDE	
Altitude:	- 950 mbar
Test temperature:	Ambient temperature
Number of measuring channels:	1 (pressure)
Max. sample size:	200x100x80 cm (WxDxH)
Max. sample weight:	500 kg





Test capabilities battery lab

GUIDED DROP

4000 mm guided free drop

Max. sample weight:

250 kg





Test capabilities battery lab

CLIMA (TEMPERATURE / HUMIDITY)

Temperature change: up to 10 k / Min

Several cabinets: up to 160x213x210cm

Temperature range: -70°C to +300°C

Humidity: 10-95%

Additional: Shock Temperature Chambers





Test capabilities battery lab

SALT MIST

Max. sample weight:	1000 kg/m ²
Max. sample size:	300x220x165 cm

Additional: Several temperature ranges





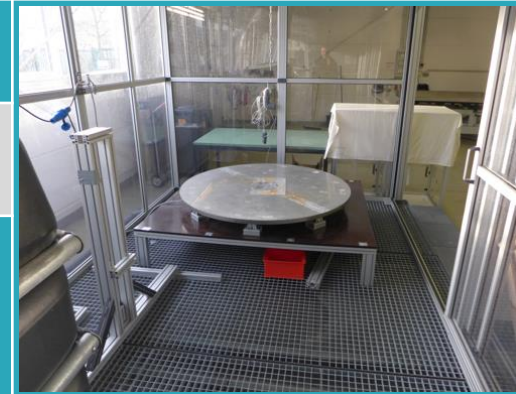
Test capabilities battery lab

IP Protection Classes IP XX

IP X 1-9 k

Max. sample size: app. 120x120x80cm

Additional: Several temperature ranges



IP Protection Classes IP XX

IP 1-5 k X

Max. sample size: 100x100x60cm





OUR SERVICES FOR YOU

- Development and Realisation of specific test requirements on customer demand
- Adjustment of measuring and test systems according to customer requirements
- Development and adjustment of rest bus simulation
- Consulting in the field of test realisation
- Design and manufacturing of fixtures for vibration, shock and crush test



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