

Test systems for energy storage

Innovative safety test systems with perfect user protection



Safe testing

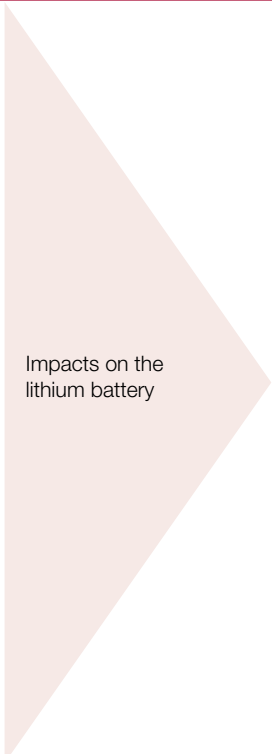
In the field of mobile systems, lithium batteries have successfully proved their importance as energy storage. Ever larger applications - such as electric vehicles - require storage systems, which not only offer a large volume of energy, but which also can produce large outputs. To test their reliability, lithium batteries are subjected to various tests in the field of environmental simulation. These tests are carried out in temperature change test cabinets or climatic test chambers.

During the temperature tests, overchargings or malfunctions of the batteries may occur. This can lead to the destruction of the batteries.

Increasing storage sizes cause increasing impacts of possible failures and potential risks during tests with lithium batteries. For this reason, safety in the laboratory, in particular the protection of the staff, during such tests has the highest priority.

To assure this safety in your laboratory during tests with lithium batteries in a temperature- or climatic test chamber, we can offer safety devices, which are adjusted to the EUCAR Hazard Level at an optimum. Of course, the safety equipment can be adapted individually, according to customer specifications. Please contact us for more detailed information.

● Tests under the influence of temperature

External influences, such as <ul style="list-style-type: none"> • External heating • Overcharging • Deep discharge • Excessive charging current • External short-circuit 		Hazard Level	Description	Classification Criteria & Effect
		Internal events, such as <ul style="list-style-type: none"> • Electrode-electrolyte reactions • Electrochemical reactions 	0	No effect
	1	Passive protection activated	No defect; no leakage; no venting, fire or flame; no rupture; no explosion; no exothermic reaction or thermal runaway. Cell reversibly damaged. Repair of protection device needed.	
	2	Defect / Damage	No leakage; no venting, fire or flame; no rupture; no explosion; no exothermic reaction or thermal runaway. Cell irreversibly damaged. Repair needed.	
	3	Leakage $\Delta \text{mass} < 50\%$	No venting, fire or flame*; no rupture; no explosion. Weight loss < 50% of electrolyte weight (electrolyte = solvent + salt).	
	4	Venting $\Delta \text{mass} \geq 50\%$	No fire or flame*, no rupture; no explosion. Weight loss $\geq 50\%$ of electrolyte weight (electrolyte = solvent + salt).	
	5	Fire or Flame	No rupture; no explosion (i.e., no flying parts).	
	6	Rupture	No explosion, but flying parts of the active mass.	
	7	Explosion	Explosion (i.e. disintegration of the cell)	

* The presence of flame requires the presence of an ignition source in combination with fuel and oxidizer in concentrations that will support combustion. A fire or flame will not be observed if any of these elements are absent. For this reason, we recommend that a spark source be used during tests that are likely to result in venting of cell(s). We believe that "credible abuse environments" would likely include a spark source. Thus, if a spark source were added to the test configuration and the gas or liquid expelled from the cell was flammable, the test sample would quickly progress from hazard level 3 or 4 to hazard level 5.

Possible safety equipment

Hazard Level 0-3	Hazard Level 4	Hazard Level 5-6		Hazard Level 7
<p>Status display</p> 	<p>Reversible pressure release flap</p> 	<p>Permanent inertization using nitrogen or argon</p> 	<p>Fire alarm system</p> 	<p>Tolerable residual risk without further safety test</p>
<p>Electrical door lock</p> 	<p>Mechanical door lock</p> 	<p>Oxygen measurement</p> 	<p>Fire detection via temperature measurement</p> 	
	<p>Sealing plug with retaining clamp</p> 	<p>Burst disc</p> 	<p>Flushing device for inertization in case of fire</p> 	

Safety options

Status display

The signal lamp can be positioned variably on the device due to an adjustable magnetic foot. The red signal lamp flashes when a fault occurs. In addition, an acoustic signal is possible.



Reversible pressure release flap

The venting duct is installed on the top of the cabinet. It is equipped with a mechanical, weighted pressure release flap. This can be dimensioned between 80 and 200 mm \varnothing , depending on the expected volume of escaping gas.



Electrical door lock

The test space door is locked via an electrical door lock during automatic and manual tests. In automatic mode the complete testing system can be switched off during a program interruption, in order to allow the unlocking of the test space door.





Mechanical door lock

Two fasteners which mechanically hold the door closed are attached to the test space door in addition to the reversible pressure release flap.



Sealing plug and retaining clamp

The entry ports are equipped with retaining clamps to secure the plug.



Fire detection via temperature measurement

Fire is detected by an independent, freely-movable PT 100 temperature sensor. The sensor records temperature increases which are possibly caused by fire inside the test cabinet.

Safety options

Permanent inerting using nitrogen or argon

The door lock is activated for permanent inerting of the test space with nitrogen (N_2) or argon (Ar). A major flushing quantity reduces the oxygen concentration to $\leq 5\%$. After the minimum flushing time has elapsed, testing is released and the system switches to a process-orientated small flushing quantity.



Oxygen measurement

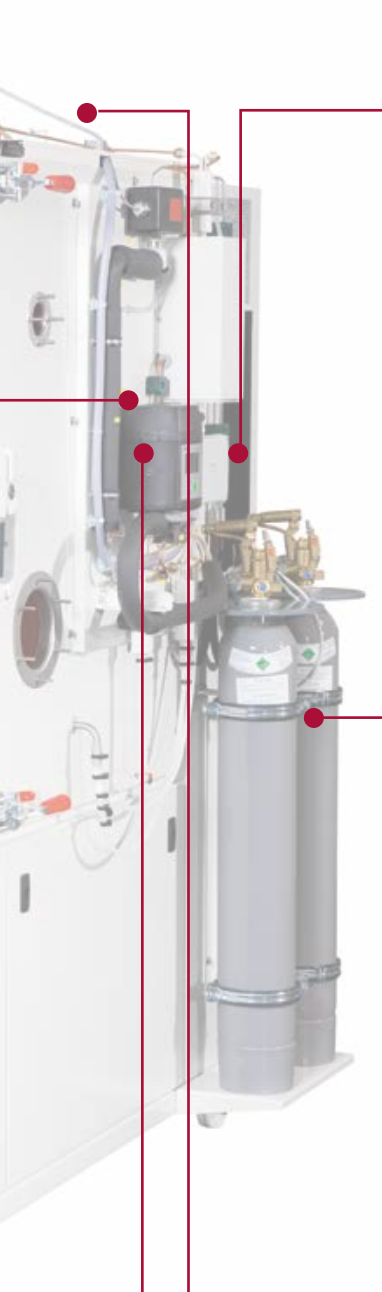
In combination with the permanent inertization using nitrogen or argon, the oxygen (O_2) measurement is used to monitor the O_2 -concentration in the test space. It allows a controlled infeed of nitrogen or argon.



Fire alarm system

Detection of fire using a carbon monoxide (CO) measurement. An electrochemical sensor is used to measure the CO in the air with the help of a gas measuring pump and tempering of the sample gas. Contacts for alarms are made available on the test cabinet. In conjunction with this option, hydrogen monitoring (H_2) is also possible.





Flushing device for inertization in case of fire

When a fire is detected, the test space can be flooded with nitrogen (N_2) or carbon dioxide (CO_2). This flooding inertizes the test space and with liquid CO_2 also has a slight cooling effect.



CO_2 compressed gas bottles

As an addition to the flushing device for inertization in case of fire, a compressed gas bottle, filled with 7.5 kg CO_2 and an aromatic additive, is attached to the side of the test cabinet. The CO_2 is filled into the test space in a liquid state. When it expands, cold gas and CO_2 -snow is formed. Several bottles can be cascaded. Manual triggering is also possible.



Pressure reduction unit using certified burst disc

In case of damage to the battery, large volumes of gas can be released into the test space at a blow. To extract the gas rapidly, the chamber can be equipped with a pressure release system, connected to a waste air duct. For this, the test space container is manufactured in a pressure-resistant version and a rectangular burst disc is integrated into the ceiling.

Applications

● Temperature test cabinet for testing cells and packs

Example: 2xVT 4021/S

The temperature change cabinet 2xVT 4021/S was developed specially for testing cells and packs in laboratories. The superimposed test spaces, each with a capacity of 210 litres, permit simultaneous execution of two tests, but only require half of the laboratory space that two comparable single-chamber solutions would require. Of course, the entire VT series can be equipped with safety options for testing lithium batteries. This cabinet is optionally available as a series VC climatic test cabinet.

Technical data:

Test space volume:	2x 210 l
Temperature range:	-40 °C to +100 °C
Temperature rate of change in accordance with IEC 60068-3-5:	Cooling: 3.1 K/min Heating: 4.0 K/min
Heat compensation:	1000 W
Sound pressure level:	55 dB(A)



● Temperature and climatic test cabinet for testing cells, packs, modules and complete batteries

Example: VC³ 4018/S

The temperature and climatic test systems of the VT³ and VC³ series from Vötsch Industrietechnik set the standard in environmental simulation. They can offer test space volumes of 190 to 1540 litres, allowing tests in a temperature range of -72 °C to +180 °C. Climatic tests in a humidity range of 10% to 95% rel. humidity can be carried out at a temperature range of +10 °C to +95 °C. The test systems of the VT³ and VC³ series are suitable for testing cells, packs, modules and complete batteries. They can be equipped with any necessary safety equipment and can be specially adapted to meet your requirements.

Technical data:

Test space volume:	190–1540 l
Temperature range:	-72/-42 °C to +180 °C
Temperature rate of change in accordance with IEC 60068-3-5:	Cooling: approx. 3 K/min Heating: approx. 3 K/min
Humidity range:	10%–98% RH
Heat compensation:	1500–4500 W
Sound pressure level:	56–63 dB(A)



● Stress Screening systems for testing cells, packs, modules and complete batteries

Example: VCS³ 4034-5/S

The VTS³ and VCS³ temperature and climatic test systems fill the gap between the tried-and-trusted temperature and climatic test systems of the VT³ and VC³ series and our shock test systems. With test space sizes from 190 to 1540 litres and a temperature range from -70 °C to +180 °C, we are able to meet nearly all customer requirements. The VCS³ series implements common climatic testing standards. The preferred temperature change rates are 5 K/min, 10 K/min and 15 K/min. For special applications we can offer test systems with up to 30 K/min. The Stress Screening systems of the VTS³ and VCS³ series can be equipped with any safety equipment, specially adapted to your requirements.

Technical data:

Test space volume:	190–1540 l
Temperature range:	-70/-40 °C to +180 °C
Temperature rate of change in accordance with IEC 60068-3-5:	Cooling: 5–18 K/min Heating: 6–17 K/min
Humidity range:	10%–98% RH
Heat compensation:	3000–8000 W
Sound pressure level:	56–73 dB(A)



● XXL series for testing batteries

Example: VC³ 7250/S

The XXL range of the VT³ and VC³ series offers test space volumes of 2500 to 6000 litres. The entire test space is easily accessible through a double wing door, allowing the testing of whole modules and batteries. The modular design means that we can create individual sizes according to customer specifications.

Technical data:

Test space volume:	2500–6000 l
Temperature range:	-70/-40 °C to +180 °C
Temperature rate of change in accordance with IEC 60068-3-5:	Cooling: 1–5 K/min Heating: 1–5 K/min
Humidity range:	10%–98% RH
Heat compensation:	5000–8000 W
Sound pressure level:	68–75 dB(A)



Applications

Temperature and climatic test chambers for vibration tests

Example: VCV³ 7220-15/S

Our temperature and climatic test chambers of the VTV³ and VCV³ series are designed for the temperature and climatic overlaying of a dynamic vibration system. The impact of vibration tests can be investigated on products from cells to batteries under different climatic conditions. The test chambers, based on the tried-and-trusted modules of the Stress Screening system, are available with increased performance of heating, cooling and circulating air and with test space volumes between 600 to 2.200 litres. The VCV³ series also allows the implementation of current climatic testing standards.

Technical data:

Test space volume:	600–2160 l
Temperature range:	-70/-40 °C to +180 °C
Temperature rate of change in accordance with IEC 60068-3-5:	Cooling: 4.5–17.5 K/min Heating: 5.0–16.5 K/min
Humidity range:	10%–98% RH
Heat compensation:	3000–8000 W
Sound pressure level:	68–77 dB(A)



Walk-In and Drive-In Climatic Chambers for testing vehicle batteries

Example: VCZ 60012/S

Especially for testing of traction batteries, we can offer climatic test chambers in which you can walk or drive in. Due to the free accessibility the batteries can be perfectly cabled. Complete electric or hybrid vehicals can be tested under different climatic conditions in our Drive-In Chambers. The Drive-In chambers for hybrid vehicles can be equipped with additional safety options. Please contact us for more detailed information.

Technical data:

Test space volume:	8–50 m ³
Temperature range:	-60 °C to +120 °C
Temperature rate of change in accordance with IEC 60068-3-5:	Cooling: 1–3 K/min Heating: 1–3 K/min
Humidity range:	10%–98% RH



Systematic Communication

● More control in shorter times

Our test systems equipped with safety devices for testing of energy storage systems can be integrated perfectly into your existing testing area, just like any other test system made by Vötsch. Our test systems are equipped with a colour touchpanel as standard. The menu-guided desktop means that the tasks of the single performance components can be co-ordinated and monitored. Process sequences, system conditions and other process images are presented as graphical, self-explanatory pictograms. This makes use even more intuitive. Up to 100 testing programs can be easily and securely created, stored and reactivated. The desired functions are initiated with one touch. The system is compatible with the **SIMPATI*** simulation management software.



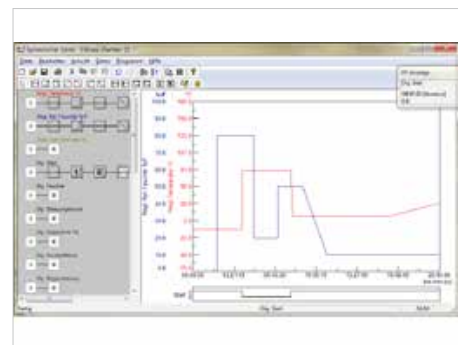
The removable 8" colour touchpanel

● **SIMPATI*** – sophisticated simplicity (option)

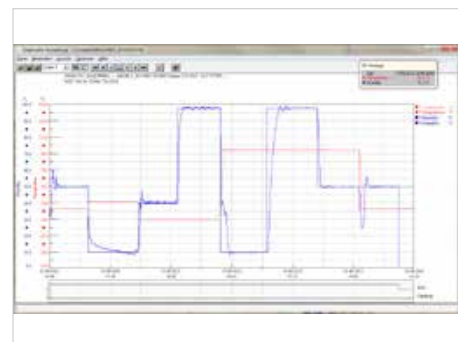
The **SIMPATI*** computer-assisted simulation management software is the optimal system for using and controlling testing and production systems. Your data is seamlessly documented and graphically evaluated.

With **SIMPATI*** you can:

- control test and process flows more easily
- store and evaluate measurement and process data with clearly presented graphics
- easily create convenient test programs with a graphical editor
- link up to 99 systems to one another
- optimally utilize laboratory capacities due to a clear time management



Comfortable programming:
The icon-driven editor



Clear illustration:
The evaluation of measurement and process data



Subject to technical alterations. Pictures contain optional extras.