ACS | TESTING FOR A BETTER PLANET

Angelantoni



# Battery test chambers

acstestchambers.com

ACS | Angelantoni TECHNOLOGY FOR LIFE

**Angelantoni Test Technologies**
stay ahead to meet the needs
of the Industry of the Future, where
**Internet Technology,**
**Remote Connections,**
**Communication & Networking**
are the keywords for success.




# Battery test chambers

**Greenhouse Gas (GHG)** emissions have been constantly increasing globally and reached 58,710 million tons of CO2 equivalent in 2016*, which were +62% compared to levels in 1990. Electrification is expected to help reduce CO2 emissions when electricity is generated via a balanced energy mix, which integrates a significant share of renewables. This enables the reduction of pollutant emissions and improves air quality, especially in urban areas.
In the Automotive sector, the development of more efficient Energy Storage, in terms of energy density, environmental impact and safety, is the biggest challenge of the current electrification phase. Of all the available technologies, the Li-Ion Battery is currently considered the most promising in the short and medium term.
All the solutions described below are related to Li-Ion Battery Testing and have been developed by **Angelantoni Test Technologies**, together with their valued partners, to give the Li-Ion Battery Test Lab the most comprehensive Test Package, scaled to different Cell, Module and Pack testing requirements.
Impressive research and development efforts are still underway around the world to improve available solutions and investigate various new technologies. The Vision and Values of Angelantoni Test Technologies are perfectly tuned to this challenge and the company is at the forefront, together with the rest of the e-mobility community, ready to play its part in the transition to a more Electrified World.

* according to the latest available data by the United Nations Framework Convention on Climate Change

# Battery test chambers Setting up your lab

**Li-Ion Battery Testing Labs** differ from “normal” Environmental Testing Labs in two main key factors:

1. The need for a very specific DUT electric and electronic interface (battery cyclers) to perform electric charge/discharge profiles

2. Safety issues with samples (batteries) that may generate dangerous situations under specific and normally undesirable conditions.

**Angelantoni Test Technologies** supports Test Lab Supervisors in managing both aspects, to continually improve the **ACS Battery Test Chamber Platform** in order to:

- enable easy integration with the selected battery cycler, by providing several available options and dedicated solutions to create customised Test Packages
- enable the essential chamber configuration to be selected in order to comply with the Risk Assessment of the whole Test Lab.



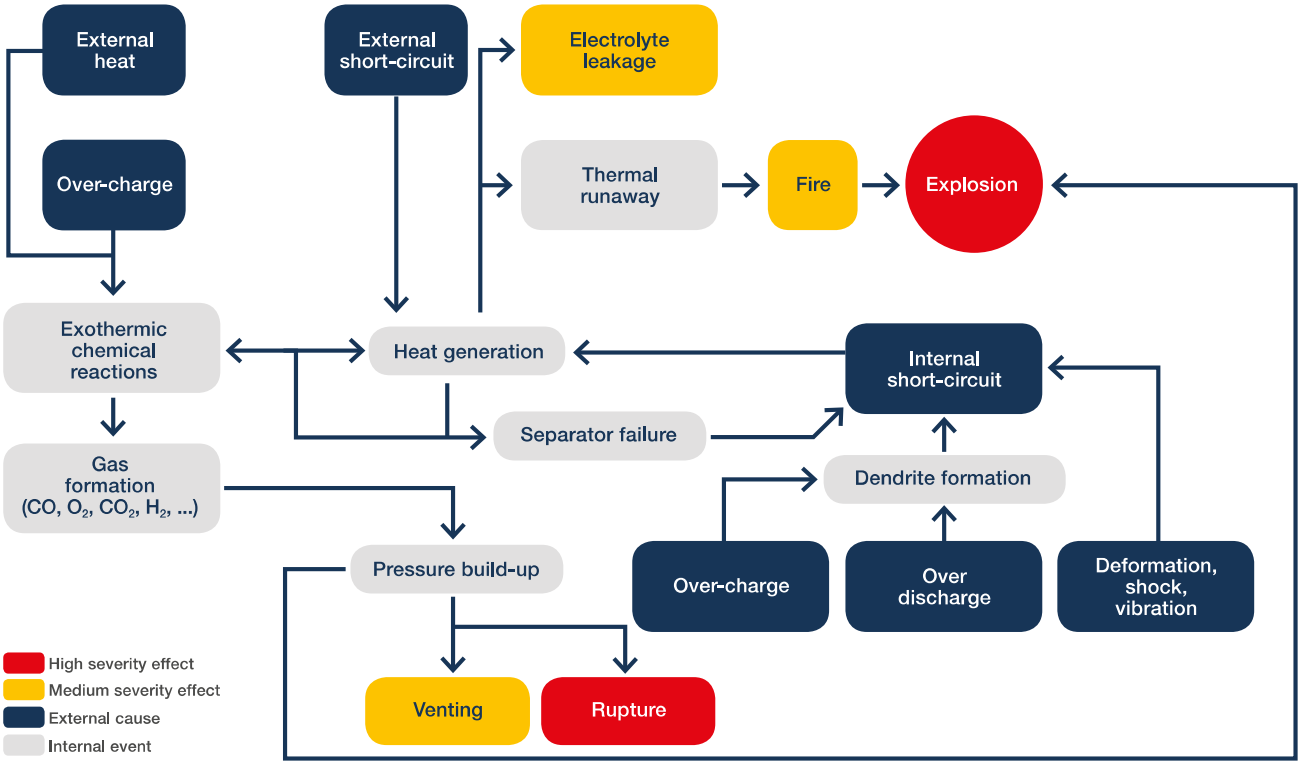
## Step 1 Select your standard

Angelantoni Test Technologies ensures environmental testing is performed in accordance with the main applicable standards, e.g.:

| Code | Title |
|---|---|
| SAE J2464 | Electric and hybrid electric vehicle rechargeable energy storage system (RESS) safety and abuse testing |
| SAE J2929 | Electric and hybrid vehicle propulsion battery system safety standard - lithium-based rechargeable cells |
| IEC 62133 | Safety requirements for portable sealed secondary lithium cells, and for batteries made from them, for use in portable applications - Part 2: Lithium systems |
| UL 2580 | Batteries for use in electric vehicles |
| UN 38.3 | Recommendations on the transport of dangerous goods - manual of tests and criteria |

Compliance with a wider range of test protocols, including customised tests, is possible thanks to the extensive experience of Angelantoni Test Technologies in this field.

## Step 2 Be aware of




## Step 3 Assess hazard levels

| Hazard level | Description | Criteria for Severity Classification & Effects |
|---|---|---|
| 0 | No effect | No effect. No loss of functionality |
| 1 | Reversible Loss of Function | No defect; no leakage; no venting, fire, or flame; no rupture; no explosion; no exothermic reaction or thermal runaway. Temporary loss of battery functionality. Resetting of protective device required. |
| 2 | Irreversible defect/damage | No leakage; no venting, fire, or flame; no rupture; no explosion; no exothermic reaction or thermal runaway. RESS irreversibly damaged. Repair required. |
| 3 | Leakage Δ mass < 50% | No venting, fire, or flame; no rupture; no explosion. Weight loss < 50% of electrolyte weight. Light smoke (electrolyte=solvent+salt). |
| 4 | Leakage Δ mass ≥ 50% | No fire or flame; no rupture; no explosion. Weight loss ≥ 50% of electrolyte weight. Heavy smoke (electrolyte=solvent+salt). |
| 5 | Fire or Flame | No rupture; no explosion (i.e. no flying parts) |
| 6 | Rupture | No explosion. RESS could disintegrate but slowly without flying parts of high thermal or kinetic energy. |
| 7 | Explosion | Explosion (i.e. disintegration of the RESS with externally damaging thermal & kinetic forces). Exposure to toxic substances in excess of OSHA limits. |

# Battery
# test chambers
# Setting up your lab

## Step 4 Our available options

| | Hazard level - No risk of explosive atmosphere in the chamber | | | | | | Risk of explosive atmosphere in the chamber |
|---|---|---|---|---|---|---|---|
| | 0...2 | | 3...4 | | 5...6 | | |
| Solutions | cell / module | pack | cell / module | pack | cell / module | pack | cell / module / pack |
| Optical/Acoustic alarm with supplementary PT100 Sensor | ● | ● | ● | ● | ● | ● | Custom-designed solutions |
| Door locking system | | | ● | ● | ● | ● | |
| Battery gas monitoring ($H_2$ and/or CO) | | | ● | ● | ● | ● | |
| Reversible overpressure valve with additional door locks | | | ● | ● | ● | ● | |
| Porthole with retaining clamps | | | ● | ● | ● | ● | |
| Compressed air or $GN_2$ washing | | | ● | ● | ● | ● | |
| Oxygen monitoring system (to optimize $N_2$ consumption) | | | ● | ● | ● | ● | |
| $CO_2$ protection system / Water mist predisposition | | | | | ● | ● | |

Note: count on our team to assist you in selecting the best options for your specific test needs.

# Cell and module testing
# **Standard solution**

## Temperature and RH test chambers, DISCOVERY MY series

Angelantoni Test Technologies has developed and standardised a complete series of chambers for Temperature and Humidity tests, which are continually updated as technology evolves and made to increasingly adapt to the customer's needs.
The **Discovery My chambers**, ranging from a capacity of 340 to 1600 l, feature a brilliant, innovative design.
They are controlled by the powerful **MyKratos™ Control System**, which makes it possible to manage and monitor the chamber both from the 10 inch on-board display and from remote devices (PC, tablet, Smartphone) using Wi-Fi, Ethernet or mobile network connections.
The standard chamber can be equipped with one or more of the battery test options, depending on the customer's specific requirements.



Sample of standard battery test solution

# Cell and module testing **Custom-designed solutions**

- Optimised footprint for customer's laboratory
- Availability of fast gradients to minimise downtime
- Customised solutions to minimise electricity consumption
- Possibility of interfacing with any type of fire protection system supplied by the customer
- Protection against nitrogen leaks in the laboratory
- Fully welded chamber to ensure perfect gas sealing
- Optimised air flow to allow simultaneous testing of as many specimens as possible
- Possibility of air or water condensation






- 2 x 660 litre test vanes with independent cooling units
- 1 single electrical cabinet
- Battery management modules fully integrated with the chamber



- Temperature range: -40°C / +80°C
- Cooling rate: 0.5 K/min
- 4 x 200 litre test vanes with independent cooling units
- 1 single electrical cabinet
- Optimized vertical air flow with double floor
- Battery management modules fully integrated in the chamber





- Temperature range: -40°C / +80°C
- Cooling rate: 0.5 K/min
- 3 x 50 litre test vanes with independent cooling units
- 1 single electrical cabinet
- Optimized horizontal air flow
- Battery management modules fully integrated in the chamber

# Battery pack **Testing Lab**






**Voltavision Test Lab** - Germany






**Voltavision Test Lab** - Germany

# Battery pack testing
# **Walk-in chamber for battery pack testing**

When it comes to pack testing, Angelantoni Test Technologies can provide custom-designed, walk-in chambers to test one or more battery packs. Building on previous successful projects, **ACS** chambers can be specifically customised in terms of footprint, performance and additional safety equipment to meet the most demanding customer requirements.






- Useful internal volume: 9000 liters
- Temperature range: -60/+150°C
- RH range: between 10 and 95% in the +5/+90°C T range

Accessories to comply with Hazard Levels 0…6:

· Optical /acoustic alarm + no. 4 supplementary PT100
· Sampling system for test room monitoring
· GN2 or compressed air purging with flowmeter
· Oxygen, H2, CO monitoring sensors
· Pressure relief blow-out port

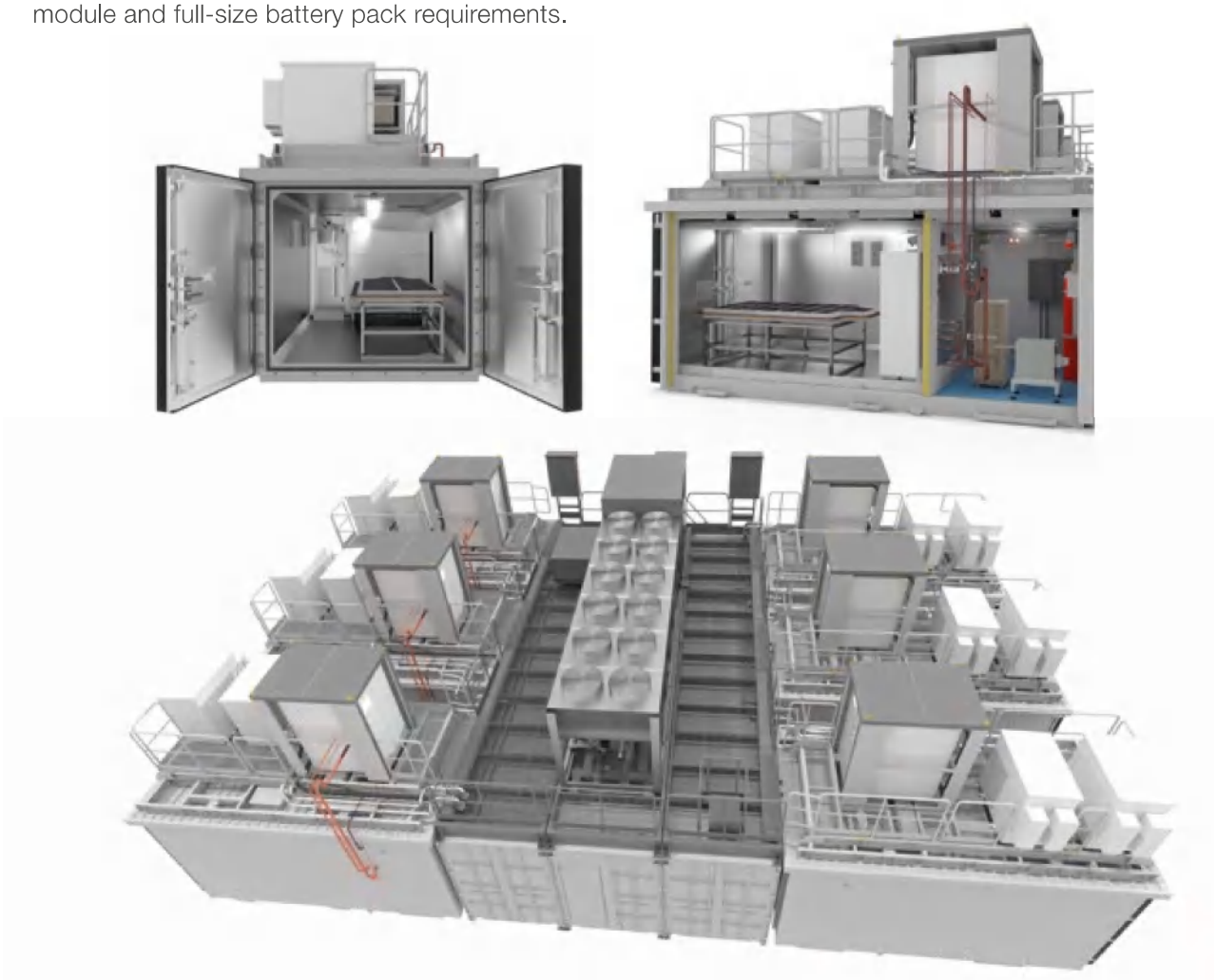
Application:

- Functional tests
- R&D tests
- Characterization tests

**Angelantoni Test Technologies** can also supply OEM with a series of components to be integrated to build battery test climatic chambers.
- Refrigeration units
- RH control systems
- Air treatments
- Control systems
- Gas sampling and analysis systems

# Proventia Case History

In the case of Proventia - offering products and services for emission control and for the electrifying vehicle industry - ACS components were used to build a complete Laboratory.
ACS contributed to the innovative design of the Proventia Electric Vehicle Battery Test Laboratory in Finland by supplying the air conditioning system for their battery test climatic chambers.
Proventia's modular EV battery test laboratory is a new solution for developing and testing electric vehicle battery packs and modules used in hybrid (HEV), plug-in hybrid (PHEV) and battery electric vehicles (BEV). The Proventia climatic battery test chamber is designed for both module and full-size battery pack requirements.





The ACS system consists of three main units:
- Air treatment unit located inside the test room
- Machine unit located outside the test room on the top of the roof
- PLC control system on board of the machine unit





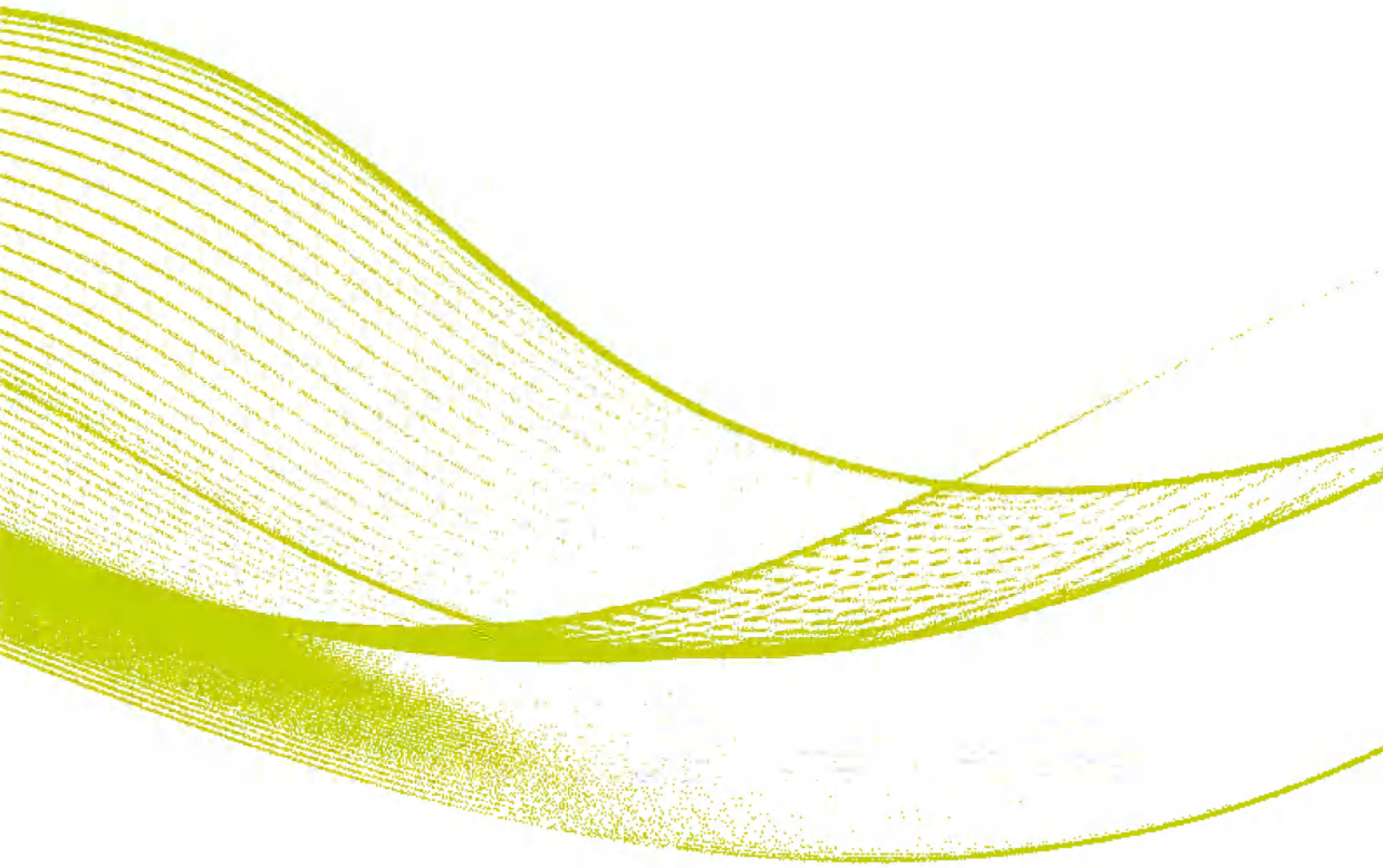
**Angelantoni Test Technologies**, owned by the **Angelantoni Group**, is the only company capable of offering a comprehensive range of environmental test chambers - **ACS** branded - for a great variety of applications, thanks to the expertise and technical know-how of its teams of experts. Innovation, flexibility and organization have always been the keys to success for ACS, world-famous since 1952 also for its high-tech test equipment such as Thermal High Vacuum Chambers for Aerospace applications and Calorimeters.

ENVIROMENTAL SYSTEM CERTIFICATION DNV·GL ISO 14001

QUALITY SYSTEM CERTIFICATION DNV·GL ISO 9001

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