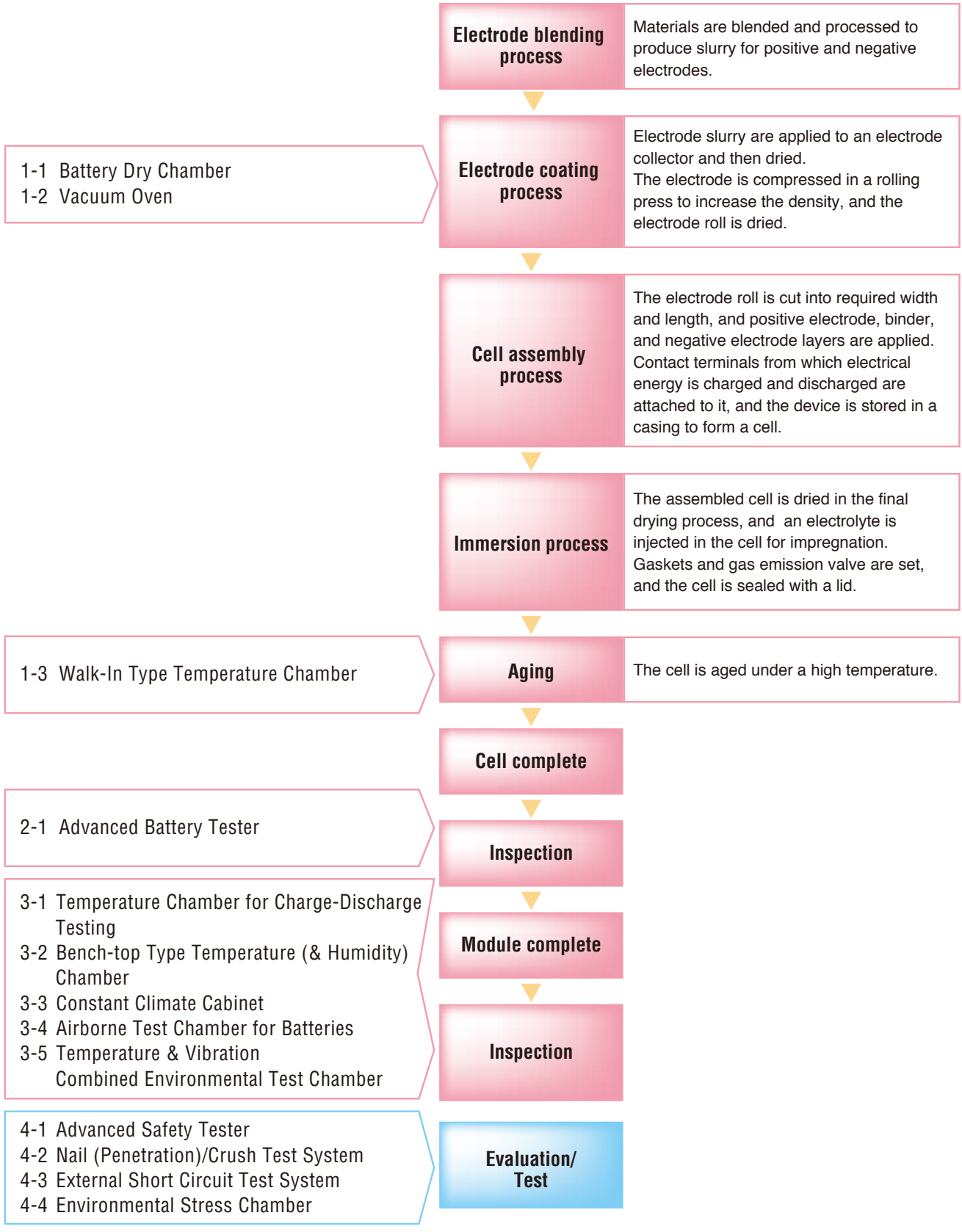
Quality is more than a word

ESPEC

Products for Secondary Battery Production and Testing

Secondary Battery Production Process



Test method for Secondary Battery

Test method	Standard	Conditions	Compliant product
Altitude (low-pressure) test	JIS8712 UN3480 UN3481 PSE	Pressure: 11.6 kPa or less Temperature: 20°C (±5°C) Duration: 6 hours	Vacuum Oven Airborne Test Chamber for Batteries
	UL1642	Pressure: 11.6 kPa or less Temperature: 20°C (±3°C) Duration: 6 hours	
Temperature test	UN3480 UN3481	Temperature: 6 hours at 75°C (±2°C), then temperature pull down to –40°C (±2°C) within 30 minutes. Hold the specimen for 6 hours. Repeat the cycle 10 times, then let the specimen hold for 24 hours at 20°C (±5°C).	Rapid-Rate Thermal Cycle Chamber Thermal Shock Chamber
	UL1642	Increase the temperature from 20°C (±5°C) to 130°C (±2°C) at 5°C/min. (±2°C) and hold for 10 minutes.	Temperature Chamber Environmental Stress Chamber Rapid-Rate Thermal Cycle Chamber
		Cycle: To 70°C (±3°C) within 30 minutes. Hold for 4 hours. Pull the temperature down to 20°C (±3°C) within 30 minutes, hold for 2 hours. Pull the temperature down to –40°C (±3°C) within 30 minutes, hold for 4 hours. Heat the temperature up to 20°C (±3°C) within 30 minutes hold for 4 hours. Repeat the above cycle 10 times, and then let the specimen hold for 24 hours.	Environmental Stress Chamber Rapid-Rate Thermal Cycle Chamber Thermal Shock Chamber
	JIS8712 PSE	Keep the product for 7 hours at 70°C (±2°C). Remove from the chamber, and leave in an environment of 20°C (±5°C).	Temperature Chamber Large Volume Temperature Chamber Constant Climate Cabinet
		Cycle: Hold for 4 hours at 75°C (±2°C). Pull the temperature down to 20°C (±5°C) within 30 minutes, hold for 2 hours. Pull the temperature down to -20°C (±2°C) within 30 minutes, hold for 4 hours. Heat the temperature up to 20°C (±5°C) within 30 minutes, hold for 2 hours. Repeat the above cycle 5 times, then let the specimen hold for 7 days.	Platinous Series Temperature Chamber Environmental Stress Chamber Bench-Top Type Temperature Chamber Rapid-Rate Thermal Cycle Chamber Thermal Shock Chamber
	JIS8712 JIS8714	Increase the temperature to 130°C (±2°C) at 5°C/min. (±2°C) and hold for 10 minutes.	Temperature Chamber Environmental Stress Chamber Rapid-Rate Thermal Cycle Chamber
Vibration test	UN3480 UN3481	Make the specimen vibrate within the frequency range from 7 to 200 Hz, 12 times in 3 hours. Vibration shall occur in 3 directions perpendicular to each other.	Temperature & Vibration Combined Environmental Test Chamber
	UL1642 UL2054 PSE	Vary the frequency within 10 to 55 Hz range, at a rate of 1 Hz/min. Vibration shall occur in 3 directions perpendicular to each other.	

According to in-house research as of December, 2014.

Test method for Secondary Battery

Test method	Standard	Conditions	Compliant product
External short circuit	UN3480 UN3481	Connect the specimen at 55°C (±2°C) with a resistance of 0.1 Ω to make a short circuit.	Advanced Safety Tester External Short Circuit Test System
	JIS8712 UL1642 UL2054	Connect the specimen at 20°C (±5°C) and 55°C (±5°C) with a resistance of 80 mΩ (±20 mΩ) to make a short circuit.	
	JIS8714 PSE	Electrical cell: Connect the specimen at 55°C (±5°C) with a resistance of 80 mΩ (±20 mΩ) to make a short circuit.	
		Battery pack: Connect the specimen at 20°C (±5°C) with a resistance of 80 mΩ (±20 mΩ) to make a short circuit.	
Crush test	UL1642 UL2054 JIS8712 JIS8714 PSE	Between 2 flat plates, apply pressure at 13kN (±1KN).	Advanced Safety Tester Crush Test System
	UN3480 UN3481	Between 2 flat plates, apply pressure at 13kN (±0.78KN) .	
Forced internal short circuit test	JIS8714 PSE	Implant a nickel platelet into a battery. Apply pressure to the embedded area at 10°C and 45°C (±2°C). (Upper limit value: 800 N or 400 N).	
Overcharge test	UL1642 UL2054	At 20°C (±5°C), charge (3C) the specimen with three-times the rated current and power for a minimum of seven hours.	Advanced Safety Tester
	JIS8712 PSE	At 20°C (±5°C), power the specimen until it reaches 250% of the rated capacity or the test voltage.	
Over discharge test	UL1642 UL2054	Connect a cell after being discharged and a cell after being charged in a series and short circuit by connecting 80 mΩ (±20 mΩ) of resistance	
	JIS8712 PSE	At 20°C (±5°C), reverse charge the specimen for 90 minutes.	
High-rate charge test	JIS8712 PSE	Temperature: at 20°C (±5°C). Charge the product with a current 3 times higher than the maximum charging current.	
Continuous and stable voltage charge test	JIS8712 PSE	Charge the product at 20°C (±5°C) for 28 days under designed constant-voltage charge condition.	Advanced Safety Tester
Overcharge protection function test	JIS8712 PSE	Perform the test at 20°C (±5°C) according to stipulated method.	

According to in-house research as of December, 2014.

Test method for Vehicle Secondary Battery

Test method	Standard	Conditions	Compliant product
High temperature test	IEC62660-2	130°C, 30 minutes (heat-up 5°C/min)	Temperature Chamber Environmental Stress Chamber Rapid-Rate Thermal Cycle Chamber
Thermal cycle	ISO12405-1,-2 IEC62660-2 UN ECE R100.02 PartⅡ	–40°C/85°C (temperature change within 30 min), 5 cycles –40°C/85°C, 30 cycles –40°C/60°C (temperature change within 30 min), 5 cycles	Environmental Stress Chamber Thermal Shock Chamber
Storage test	ISO12405-1,-2 IEC62660-1	45°C, 28 or 42 days	Platinous Series Temperature Chamber Bench-Top Type Temperature Chamber Compact Ultra Low Temperature Chamber
Dew condensation test	ISO12405-1,-2	Run the temperature and humidity test pattern that conforms to IEC 60068-2-30 for 5 cycles	Platinous Series Temperature Chamber Environmental Stress Chamber
Cycle life test	IEC62660-1 ISO12405-1 ISO12405-2	45°C charge/discharge cycle Room temperature charge/discharge cycle –10°C charge/discharge cycle	Advanced Battery Tester Advanced Safety Tester
Performance test	ISO12405-1,-2	Run the charging/discharging test by various methods between –18°C to 45°C. Measure the power at high and low temperatures and calculate the internal resistance and energy efficiency. Also includes cycle life tests.	
Output test	IEC62660-1	–20°C, 0°C, 25°C, 40°C Voltage measurements after specified charge/discharge	
Overcharge test	UL2580 ISO12405-1 ISO12405-2 IEC62660-2 UN ECE R100.02 PartⅡ	25°C, Maximum charging current 25°C, 5C 25°C, 2C 25°C, 1C(BEV), 5C(HEV) 20°C, 1/3 C or greater, standard charging current or less	
Forced discharge test	UL2580 ISO12405-1 ISO12405-2 IEC62660-2 UN ECE R100.02 PartⅡ	95% of the current value that will cause the protection function to activate After full charge, 1 C, maximum 90 minutes After full charge, 1/3 C, maximum 90 minutes After full discharge, 1 C, 90 minutes 20°C, 1/3 C or greater, standard discharging current or less	
External short circuit test	UL2580 ISO12405-1 ISO12405-2 IEC62660-2 UN ECE R100.02 PartⅡ	25°C, 20 mΩ or less Room temperature, 60 to 100 mΩ Room temperature, 10 to 20 mΩ Room temperature, 5 mΩ or less 20°C, 5 mΩ or less	Advanced Safety Tester External Short Circuit Test System
Vibration test	UL2580 ISO12405-1,-2 IEC62660-2 UN ECE R100.02 PartⅡ	Conforms to SAE J2380 Maximum 200 Hz, 12 to 21 h, –40°C, 25°C, 75°C Maximum 2 kHz, 27.8 m/s^2, 8 h, 25°C 7 to 50 Hz, 20°C	Temperature & Vibration Combined Environmental Test Chamber
Impact test	UL2580 ISO12405-1,-2 IEC62660-2	25 G, 18 times, conforms to SAE J2464 50 G, 10 times/direction, 25°C	
Nail penetration test	SAND2005-3123 SAE J2464	Nail diameter ø3 mm (cell), ø20 mm (pack), 80 mm/s	Advanced Safety Tester Nail (Penetration) Test System
Crush test	UL2580 UN ECE R100.02 PartⅡ IEC62660-2 SAND2005-3123	Corrugated plate jig, maximum 100±6kN Corrugated plate jig, 100 to 105kN (to 100kN within 3 minutes) ø150 mm circular (semicircular) jig, pressure 1000-times the cell weight	Advanced Safety Tester Crush Test System

According to in-house research as of December, 2014.

China GB Standards — Safety Testing and Related Products

Test method	Standard	Conditions	Compliant product
GB/T 31485-2015 Safety Requirements and Test Methods for Traction Batteries for Electric Vehicles 6.2: Cell 6.3: Module	6.2.2/6.3.2 Over discharge	After charging, 1 C discharge, 90 minutes	Advanced Safety Tester
	6.2.3/6.3.3 Overcharge	After charging, 1 C charge, Cell: Rated upper voltage limit / Module: 1.5 times the rated upper voltage limit of any cell or 1 hr	
	6.2.4/6.3.4 External short circuit	After charging, Short circuit at 5 mΩ or less short-circuit resistance, 10 minutes	
	6.2.6/6.3.6 Heating	After charging, Heat to 130°C at 5°C per minute, Hold for 30 minutes	Temperature Chamber Environmental Stress Chamber Rapid-Rate Thermal Cycle Chamber
	6.2.7/6.3.7 Crush	After charging, Crush using ø75mm semi-cylindrical jig, Crush speed: 5 ±1 mm/s, Cell: Crush to 100 kN or up to 30% Module: Crush pressure of 1000 times the battery weight	Advanced Safety Tester
	6.2.10/6.3.10 Thermal cycle	After charging, 25°C → −40°C → 25°C → 85°C → 25°C, 5 cycles	Platinous Series Temperature Chamber Walk-In Type Temperature Chamber
	6.2.11/6.3.11 Low pressure	After charging, Hold below room temperature at 11.6 kPa or less for 6 hours	Low Pressure Low Temperature Chamber
GB/T 31467.3-2015 Lithium-ion battery pack and system for electric vehicles Third part: Safety Requirements and Testing Methods	7.1 Vibration	Three directions, 5 to 200 Hz, 21 hours in each direction	Temperature & Vibration Combined Environmental Test Chamber
	7.6 Crush	After charging, Crush using ø75mm semi-cylindrical jig, Crush to 100 kN or up to 30%	Advanced Safety Tester
	7.7 Temperature shock	After charging, −40 ±2°C ⇔ 85 ±2°C for 5 cycles, Temperature change within 30 minutes	Large Capacity Thermal Shock Chamber
	7.8 Temperature/ humidity cycle	After charging, 20°C ⇔ 80°C 95% rh for 5 cycles	Walk-In Type Temperature & Humidity Chamber
	7.12 High altitude	After charging, after holding at atmospheric pressure of 4000 m above sea level for 5 hours, 1 C discharge	Low Pressure Low Temperature Chamber
	7.13 Overtemperature protection	Charge-Discharge test at at rated maximum temperature in BCU operation state	Advanced Safety Tester
	7.14 Short circuit protection	External short circuit at rated maximum temperature in BCU operation state, 20 mΩ or less, 10 minutes	
	7.15 Overcharge protection	1 C charge in BCU operation state, Stop at 1.2 times the rated upper limit voltage, SOC 130%, or the rated upper limit temperature +5°C	
	7.16 Over discharge protection	1 C discharge (Max. 400 A) in BCU operation state, 30 minutes or more, Stop at 25% the lower limit of total voltage or the rated upper limit temperature +5°C	

According to in-house research as of October, 2018.

1-1 Battery Dry Chamber

Rechargeable Li-ion batteries are classified as non-aqueous electrolyte batteries.
During the production process, a solvent of active material is applied to the collector and then dried. However, moisture in the anode and cathode of the rechargeable battery affects its quality.
The Battery Dry Chamber makes it possible to shorten the time required for solution drying and moisture removal.
High-temperature treatment performed under vacuum or inert gas conditions avoids workpiece oxidation while achieving superior drying performance. Processing is performed at a temperature that is suitable for drying of cathode roll, anode roll, and separator workpieces.
Special specifications can be provided to suit workpiece size and processing volume requirements, and jigs are available for workpiece support, etc.

Battery Dry Chamber

Test area

Features

Shorter drying time

Equipment performance has been improved to shorten the time required for workpiece heat-up and cool-down.
For example a cooling function is equipped to lower the workpiece to normal temperature so it can be removed.

Improved temperature control

More uniform workpiece heat distribution improves heat distribution performance during temperature exposure even in a vacuum, which further improves workpiece drying quality.

Workpiece oxidation prevention

To prevent workpiece oxidation during high-temperature treatment, inert gas is introduced into a vacuum to prevent oxidation of the collector.

Specifications

Performance	Temp. range	+30°C to +250°C
	Pressure range	933×10^2 to 1×10^2Pa
Inside capacity		500 to 2000 L
Operating mode		Program 20patterns 99-steps Constant

1-2 Vacuum Oven

Under low pressure environment, specimens dry at lower temperature and boiling point is also lower, which reduces stress on specimens.
Furthermore, the vacuum and N_2 gas exchange modes enable drying of oxidation-averse specimens, as well as drying and heat treatment within a clean environment by eliminating impurities in the chamber through repeated heat treatments or gas exchanges.

Vacuum Oven

Features

- The vacuum chamber features doublelayered construction. A heater on the exterior of the test area minimizes heat loss and improves temperature uniformity.
- There are five operation ion modes available to select the pressure control.
  A wide variety of programs can be designed by combining constant-temperature operation and programmed operations.
- Oxygen inside the chamber can be eliminated by replacing it with N_2 gas, preventing oxidation during the drying operation. In addition, a high-precision environment can be created by repeatedly performing the exchanges.
  This mode also removes organic substances in addition to preventing oxidation, reducing the impact on specimens.
- Air-tightness and insulation capacity have a significant impact not only on temperature control but also on pressure control. Through improvement of these properties, the VAC-101 achieves up to 40% energy savings.

Specifications

Model		VAC–101P	VAC–201P	VAC–301P
performance	Temperature range	+40 to +200°C		
	Pressure range	933×10² to 1×10²Pa		
	Ambient pressure *1	Less than 133 Pa		
	Pull-down time *1	From atmospheric pressure to 133 Pa		
		Within 7 min.	Within 15 min.	Within 30 min.
	Atmospheric pressure recovery time *2	Inlet open to atmosphere		
		Within 4 min.	Within 8 min.	Within 15 min.
Effective internal volume		91L	216L	512L
Effective internal dimensions		W450×H450×D450 mm	W600×H600×D600 mm	W800×H800×D800 mm
Outside dimensions *3		W902×H1392×D780 mm	W1052×H1532×D930 mm	W1252×H1772×D1130 mm
Pressure operation modes		Automated, Continuous, Open to atmosphere, Gas exchange, Ventilation		

*1 Fixed temperature inside the chamber, vacuum pump connected with exhaust speed of more than 200L/min. and ultimate pressure of 13×10^{-2} Pa or less, no gases emitted from specimen.
*2 Recovery time to atmospheric pressure ($10^{13}\times10^{2}$ Pa) to $10^{10}\times10^{2}$ Pa, recovery time may fluctuate depending on atmospheric pressure.
*3 Excluding protrusions.

1-3 Walk-In Type Temperature Chamber with Safety Devices

The need for large-volume production of rechargeable batteries has grown along with the increase in the use of hybrid automobiles. This makes it necessary to find ways to perform time-consuming processes in a way that treats a large number of units with a single operation.
The Walk-in Type Temperature Chamber with Safety Devices enables one-step large-volume processing of even large rechargeable EV batteries. This chamber really shines when it comes to charge-discharge testing and aging processing.
In addition, a number of safety mechanisms are built in for safe charge-discharge evaluation and other testing that presents the risk of fire due to gas leaking from a rechargeable battery.

Walk-In Type Temperature Chamber with Safety Devices

Features

- A walk-in configuration makes it possible to wheel specimens directly into and out of the chamber without removing them from the cart. This capability is especially useful when testing large, heavy rechargeable EV batteries.
- Gas leaking from a rechargeable battery is detected by a gas detector. When gas is detected, outside air is introduced through a ventilation damper to reduce gas concentration. This device consists of a two-step detection and alarm system. Stage 1 is triggered whenever gas density reaches a preset alert point, and Stage 2 is triggered whenever gas density exceeds that point.
- Whenever flame is emitted from a rechargeable battery (due to abnormal overheating), a CO_2 fire extinguisher can be activated to automatically extinguish it. Operation is also shut down at the same time.
- Whenever pressure rises above explosion level, the ceiling comes off to release pressure. A punching metal frame prevents thermal insulation from scattering in the case of explosion.

Safety devices

- Pressure relief vent
- H_2 & Co_2 gas detection alarm circuit
- Air intake/exhaust damper
- Reinforced door
- CO_2 fire extinguisher
- External alarm input/output terminal

Example of customized specifications

System		Balanced Temp. Control System (BTC System)
Performance	Temp. range	–40 to +80°C
	Temp. fluctuation	± 0.3°C
	Temp. heat up time	–40°C to +80°C within 60 min. (with no load, no specimen)
	Temp. pull down time	+20°C to –40°C within 180 min. +20°C to –30°C within 120 min. (with no load, no specimen)
Inside dimensions		W2500 × H2100 × D1970 mm
Outside dimensions		W4095 × H2675 × D2783 mm (excluding protrusions)

* Contact ESPEC concerning test space, specifications, etc.
* This chamber can be customized to meet customers' testing requirements.

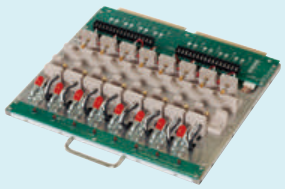
2-1 Advanced Battery Tester

Combining charge-discharge power supplies and a test area within a single structure, the Advanced Battery Tester marks a new style in charge-discharge testing.
Select an optimal system based on battery capacity, shape, number, and other requirements.

Advanced Battery Tester

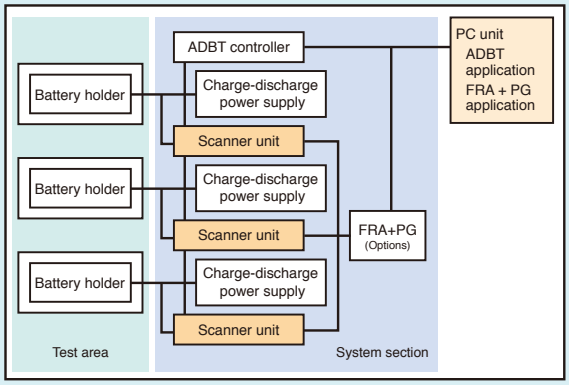
Features

- **Card edge connectors**
  Power supply to battery connection is completed simply by setting batteries in a battery holder equipped with a card edge connector, and inserting the connector into the slot at the back of the inner chamber.
- **Even temperature distribution with batteries in position**
  Taking into consideration factors like battery holder position and battery arrangement, the test area is designed to create an even temperature environment with air circulating horizontally - air blows in from the side in stacked-chamber models and from the back in single-chamber models.
- **Battery holders match battery shapes for easy setup**
  Battery holders are available for coin, cylindrical, rectangular, and laminated cells, as well as to suit charge-discharge conditions.
- **Impedance measurement (tailor-made)**
  When the tester is in a standby state during the charge-discharge cycle, it is possible to perform impedance measurement (sweep measurement/ fixed point measurement).
  As it is possible to make continuous measurements without moving batteries, highly reliable data can be obtained.


Battery holder for cylindrical cells

Battery holder for laminated cells

System configuration (ex)



Three-chamber type

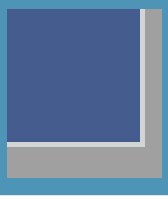
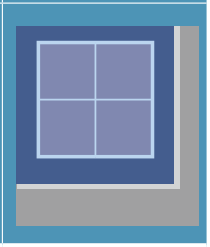
Options

- Test area safety specifications
  - Heat detector
  - Smoke detector
  - Signal tower
  - CO_2 fire extinguisher
  - Pressure relief vent, etc.
- Auto calibration board

Tailor-made

- Impedance measurement function

System types

Type			Three-chamber type	Single-chamber type	Wide single-chamber type	Four area-chamber type
						
Interior dimensions (mm)			W 510 H 400 × 3 chambers D 400	W 640 H 850 D 544	W 890 H 850 D 544	W1130 H 980 D 525
Outside dimensions (mm)			W 950 H2022 D1300	W1250 H 1875 D 1560	W1750 H2030 D 1690	W1590 H 2410 D 1954
Standard	ADBT-5-1	5 V, 1 A	72ch (24ch/chamber)	72ch	—	—
	ADBT-5-10	5 V, 10 A	72ch (24ch/chamber)	72ch	—	—
	ADBT-5-50	5 V, 50 A	24ch (8ch/chamber)	24ch	—	—
High-speed High-current	ADBT-6-400	6 V, 400 A	3ch (1ch/chamber)	contact us	4ch	4ch
	ADBT-6-600	6 V, 600 A	3ch (1ch/chamber)	contact us	contact us	4ch
	ADBT-6-100 to ADBT-6-1600	6 V, 100 A to 6 V, 1600 A	Please contact ESPEC or your dealer regarding chamber combinations.			

* A parallel connection (for 2-unit and 4-unit operation) is available for 5V, 10A and 5V, 50A testers.
* Requires separate battery holder for use with parallel connection.

Example of customized specifications

Model		Standard			High-speed High-current
		ADBT-5-1	ADBT-5-10	ADBT-5-50	ADBT-6-400
Test area	Control range	−40°C to +100°C			
	Temperature distribution	±1.5°C			
Output voltage	Setting range	0 to 5000 mV (5V)			0 to 6000 mV (6V)
	Output accuracy	±0.1% of F.S.			±0.03% of F.S.
Output current	Setting range	0 to 1 mA 0 to 10 mA 0 to 100 mA 0 to 1000 mA/1 A	0 to 100 mA 0 to 1000 mA/1 A 0 to 10000 mA/10 A	0 to 500 mA 0 to 5000 mA/5 A 0 to 50000 mA/50 A	0 to 50 A 0 to 200 A 0 to 400 A
	Output accuracy	±0.1% of F.S.			±0.03% of F.S.
	Charge-discharge switching time	within 100 msec			within 5 msec
Output power	Setting range	0 to 5 W	0 to 50 W	0 to 250 W	0 to 2000 W
	Output accuracy	±0.2% of F.S.			±0.08% of F.S.
Parallel connection function	2 units	———	16 A	80 A	———
	4 units	———	32 A	160 A	———
Measurement points	Current/Voltage	Current: 1 point per channel / Voltage (specimen edge): 1 point per channel			
	Temperature	1 point per channel		2 points per channel	1point per channel
Pulse mode	Pulse width (Min.)	1 sec			10 msec
	Number of pulse	5000 pulse			60000 pulse × 2

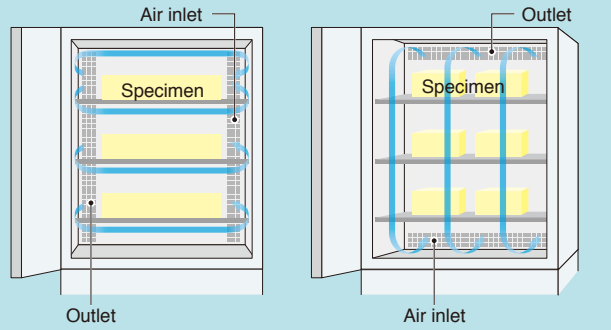
3-1 Temperature Chamber for Charge-Discharge Testing

The Temperature Chamber for Charge-Discharge Testing is specially designed for safety and can be used for small to large automotive batteries.

Temperature Chamber for Charge-Discharge Testing

Features

- Selection of horizontal or vertical airflow according to the shape and quantity of batteries allows for optimal temperature uniformity.
- Safety functions are standard in case of emergency. (Large pressure relief vent, emergency stop switch, screw-type door lock)
- Continuous operation at +25°C and above is possible without defrosting.
- Combined use with charge-discharge systems from various companies is possible.



Placing the batteries horizontally hinders downflow air to pass from the top.
Using airflow in a horizontal direction will improve temperature uniformity.

System example with charge / discharge test system (SBT)

Specifications

Model	BTC-408Hb	BTC-408Vb	BTC-655Hb	BTC-655Vb
Airflow direction	Airflow in horizontal direction	Airflow in vertical direction	Airflow in horizontal direction	Airflow in vertical direction
Temperature range	−40 to +100°C			
Temperature heat-up time	−30°C → +80°C in 48 minutes or less		−30°C → +80°C in 70 minutes or less	
Temperature pull-down time	+25°C → −30°C in 55 minutes or less		+25°C → −30°C in 75 minutes or less	
Temperature uniformity *1	±0.5°C		±1.0°C	
Allowable heat load	500 W (−30°C when stabilized)		400 W (−30°C when stabilized)	
Capacity	408L		655L	
Inside dimensions *2	W800×H850×D600mm		W1100×H850×D700mm	
Outside dimensions *2	W1000×H1790×D1306mm		W1300×H1790×D1406mm	
Standard equipment	Large pressure relief vent, ø100 mm cable port (3 on rear), Screw-type door lock, Flameproof rubber, RS-485 communication function, 3-color status indicator light (with buzzer), Emergency stop switch, Floor reinforcement (Supports 100 kg total load for shelf bracket and floor)			
Power supply	AC200V 3φ 30A AC100V 1φ 15A			
Weight	400kg		490kg	

*1 Variation from average of the maximum and minimum values from nine temperature uniformity measurement points.
*2 Partial protrusions not included.

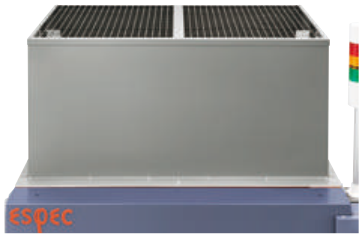
Main fittings and options

Status indicator light
Standard equipment

Screw-type door lock
Standard equipment

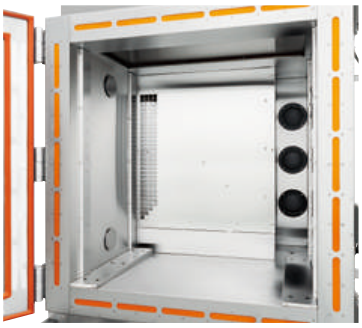
Large pressure relief vent (300×750mm)
Standard equipment

Releases sudden pressure buildup inside the chamber to prevent equipment damage.



Cable port ϕ100mm×3
Standard equipment

Providing a cable port on the rear makes it possible to install the Charge-Discharge System on either side of the chamber. Comes with a cap & a rubber plug.

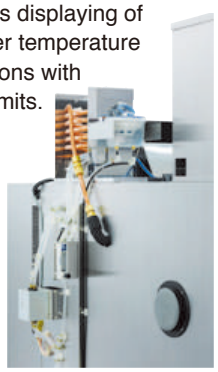


Rubber plug
Spiral-wrapped plug
Standard equipment

Spiral-wrapped plug

Smoke detector / Thermal detector / H_2 detector / CO detector (option)

Ensures obvious displaying of internal chamber temperature and concentrations with respect to set limits.



Switches

Emergency stop switch
Standard equipment

Door close detection select switch
Standard equipment

Fire extinguisher start switch

Air supply / exhaust damper start switch

Air supply/exhaust damper (without exhaust fan) (option)

Introduces outside air into the chamber by replacing the atmosphere using the building's exhaust equipment.

- Air exhaust damper connection port: ϕ50 mm flange (SUS)

Air exhaust damper

Air supply damper

Flameproof rubber
Standard equipment

Should the battery explode in the chamber, the flameproof rubber prevents sparks from escaping from the door and ensures the sparks stay inside the chamber.

CO_2 fire extinguisher (option)

Begins injection when the detector reaches the set temp. or when turned ON using the start switch.

Other options

Shelf/shelf bracket [load capacity:50kg]
- Resin-coated

Forced supply exhaust damper with exhaust fan

Floor reinforcement [up to 300kg]

Anchoring fixtures

Charge-discharge cable fixed jig

Thermal detector for specimen temperature

3-2 Bench-top Type Temperature (& Humidity) Chamber

In charge-discharge tests, specimens are repeatedly charged and discharged while undergoing prolonged exposure to a uniform temperature environment.
SU/SH Series bench-top chambers are capable of maintaining a stable temperature environment for long periods of time.
These compact test chambers are available with an interior volume of either 22.5L or 60L. They also come in three types that can precisely control temperature range from −60°C/−40°C/−20°C to +150°C. This allows you to select the optimal test chamber based on the shape and number of batteries.

Bench-top Type Temperature (& Humidity) Chamber

Features

- Special movable stand with vibration-damping brackets allows two bench-top chambers to be stacked one on top of the other for effective use of space.
- Temp. fluctuation is ±0.3°C up to 100°C and ±0.5°C from 100 to 150°C.
- Capable of high temperature control to the upper limit + 180°C. (Option)

* Temperature and humidity models also available.

Specifications

Model			SU-222	SU-242	SU-262	SU-642	SU-662
System			Balanced Temperature Control system (BTC system)				
Temp. performance *1	Temp. range		−20 to +150°C	−40 to +150°C	−60 to +150°C	−40 to +150°C	−60 to +150°C
	Temp. fluctuation		±0.3°C(−20 to +100°C) ±0.5°C(+100.1 to +150°C)	±0.3°C(−40 to +100°C) ±0.5°C(+100.1 to +150°C)	±0.3°C(−60 to +100°C) ±0.5°C(+100.1 to +150°C)	±0.3°C(−40 to +100°C) ±0.5°C(+100.1 to +150°C)	±0.3°C(−60 to +100°C) ±0.5°C(+100.1 to +150°C)
	Temp. rate of change	Heat up rate	3.2°C /min.	3.2°C /min.	3.2°C /min.	2.9°C /min.	2.9°C /min.
		Pull down rate	2.1°C /min.	2.1°C /min.	2.1°C /min.	1.7°C /min.	1.7°C /min.
Capacity			22.5L			64L	
Inside dimensions *2			W300×H300×D250mm			W400×H400×D400mm	

*1 The performance values are based on IEC 60068-3-5:2001 for the temperature chamber. Performance fi gures are given for a +23°C ambient temperature, 65%rh, rated power supply and no specimens inside the test area. However, the lowest attainable temperature is given for a max. ambient temperature of +30°C.
Heat-up time is the achieved time from lowest temperature to highest temperature within temperature range.
*2 Excluding protrusions.

3-3 Constant Climate Cabinet

In charge-discharge tests, specimens are repeatedly charged and discharged while undergoing prolonged exposure to a uniform temperature environment.
These constant climate cabinets are capable of maintaining a stable temperature environment for long periods of time.
They are available with an interior volume of either 105L or 206L and can create a stable temperature environment of between −20°C and +85°C with a temperature fluctuation of ±1.0°C.

Constant Climate Cabinet

Features

- Can be used with a 100 VAC 15 A power supply.
- Tests can be registered up to 12 steps in program operation and three patterns in constant operation.

* Temperature and humidity models also available.

Specifications

Model		LU–114	LU–124
System		Balanced Temperature Control system (BTC system)	
Performance *1	Temperature control range	–20 to +85°C	
	Temperature fluctuation	±1.0°C	
	Temp. extreme achievement time (Pull down time)	+20 to –20°C Within 130min.	
Capacity		105L	206L
Inside dimensions *2		W500×H600×D390mm	W500×H750×D590mm

*1 The temperature chamber conforms to IEC60068-3-5:2001 and the humidity chamber conforms to IEC60068-3-6:2001 under the conditions of an ambient temperature of +23°C, rated voltage, and no specimen.
*2 Excluding protrusions.

3-4 Airborne Test Chamber for Batteries
(Low Pressure Low Temperature Chamber)

Airborne test recreates supposed conditions of low pressure during air transportation of devices. This equipment can perform tests according to below standards.

Airborne Test Chamber for Batteries

Features

- Magnetic coupling airflow system.
- Thorough safety chamber thanks to various safety measures such as specimen temperature protection, refrigeration circuit protection, etc.

Test standards

- **IEC 62133 (JIS C8712)**
  Safety requirements for portable sealed secondary cells
- **IEC 62281**
  Safety of primary and secondary lithium cells and batteries during transport
- **UL 1642 Lithium Batteries**

Specifications

Model	VLC-300
Sytem	Mechanical cascade refrigeration system (water-cooled condenser)
Temperature range	–20°C to +80°C
Temp. fluctuation	±0.5°C
Temp. heat up time	+20°C to +80°C within 60 min.
Temp. pull down time*	+20°C to –20V within 90 min.
Temp. uniformity	+5°C (at +20°C, 11.6kPa)
Pressure control range	93.3kPa to 10.1kPa
Attainment pressure	Below 10kPa
Inside dimensions	W800 × H800 × D700 mm
Capacity	448 L

* With no load, no specimen, under atmospheric pressure conditions.
* Please ask us for CE-marked product.

3-5 Temperature & Vibration Combined Environmental Test Chamber

This combined test chamber accurately recreates usage conditions of various industrial products such as mobile electronic devices, precision machinery, automotive components, or aircraft, to evaluate the product reliability.
The Temperature & Vibration Combined Environmental Test Chamber carries out tests complying with lithium batteries safety standards. The product lineup offers great variations to be selected according to the test purpose and installation environment.

Temperature & Vibration Combined Environmental Test Chamber

Features

- Capable of performing vibration testing conform to IEC, UN, UL and Electrical Appliances and Material Safety Act standards relating to Li-ion batteries.
- ESPEC suggests system combination of temperature chamber and shaker according to the test purpose, installation environment, and mounting method of specimen.
- The system comes in two nodels with optimized test space, featuring a large viewing window and a programmed instrumentation with interactive input.

Test standards

- **IEC 62133 (JIS C8712)**
  Safety requirements for portable sealed secondary cells
- **Table 9: Li-ion batteries, Technical Standards for Electrical Appliances and Material Safety Law**
- **UL 1642 Lithium Batteries**
- **UN Manual of Test and Criteria, Part III**
- **IEC 62281**
  Safety of primary and secondary lithium cells and batteries during transport

Specifications

Chamber

Model	Temp. range	Inside dimensions (W×H×D mm)
PVU–3KP(H)	–40 to +100 (150)°C	600×850×600
PVU–5KP(H)		1000×1000×1000
PVG–3KP(H)	–70 to +100 (150)°C	600×850×600
PVG–5KP(H)		1000×1000×1000

Shaker

Model	Force magnitude	Frequency	Max. load capacity*
V1	120kgf	5 to 4500Hz	66kg
V2	200kgf		
V3	300kgf	5 to 4000Hz	116kg
V4		2 to 2000Hz	122kg
V5S	600kgf	5 to 3000Hz	192kg
V6S	1000kgf		132kg
V7S		5 to 2000Hz	120kg
V8S	1500kgf	5 to 3000Hz	290kg
V9S	2000kgf		
V10S	3000kgf	5 to 2500Hz	492kg
S1S	100kgf	5 to 4000Hz	66kg
S2S	200kgf		116kg
S3S	300kgf		
S4S		2 to 2000Hz	292kg
S5S	500kgf	5 to 4000Hz	196kg
S6S	1000kgf	5 to 3000Hz	192kg
S7S		5 to 2000Hz	292kg
S8S	1500kgf	5 to 3000Hz	
S9S	2000kgf	5 to 2500Hz	492kg
S10S	3000kgf		

* For a shaft of ø125xH180mm
* Please ask us for CE-marked product.

4-1 Advanced Safety Tester

Lithium-ion secondary batteries are adopted wider applications in everything from consumer use to storage and automobiles, and there is greater interest not only in advancing performance testing but also in safety testing.

ESPEC designed the Advanced Safety Tester to perform multiple safety tests under precise temperature environments.

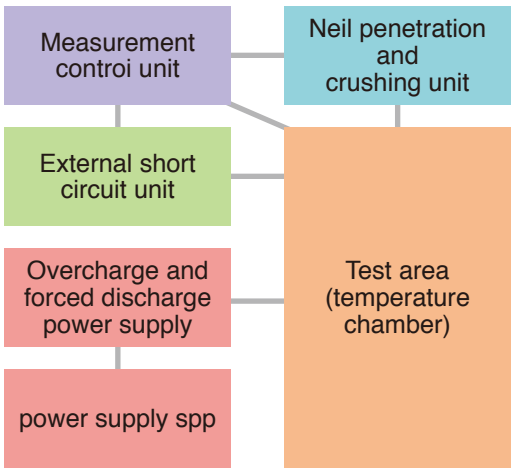
Advanced Safety Tester

Features

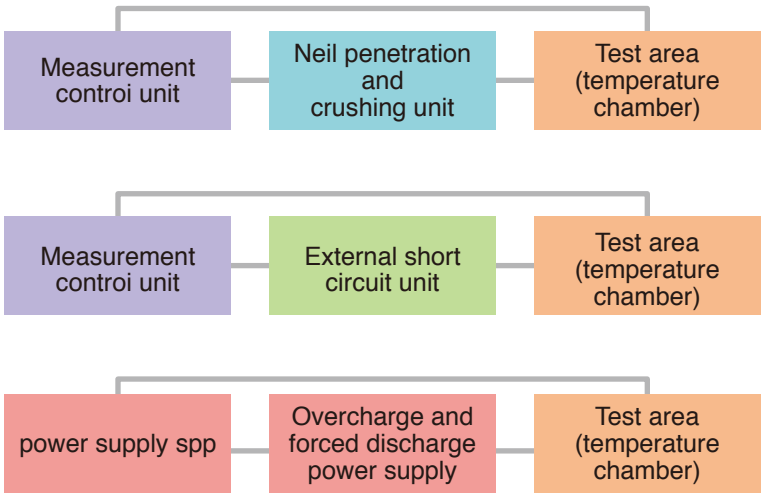
- One unit with four functions. Introducing an all-in-one safety tester.
- The function elements of the safety tester are in separate modules, enabling flexible system construction and expansion.
- The combination of each unit enables support of batteries from small cells to large packs.
- Constructed with an integrated system using a measurement control unit. This system provides central management of testing operations and minimizes complex operations for performing tests.
- One-stop service provides enhanced product and service quality as well as speed.

Example of system configuration

【Example of integrated system】



【Example of single test system】

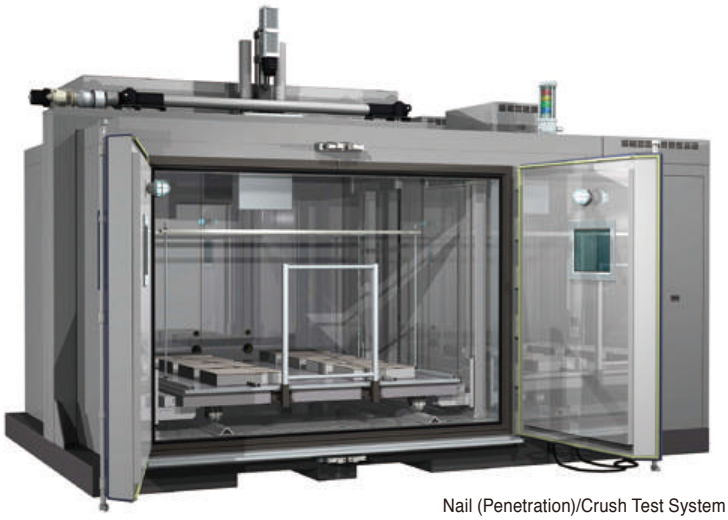


Specifications (example)

Category	Item	Specifications (example)
Applicable battery		Small capacity cells to laptop battery packs
Test chamber	Temperature range	−40 to +100°C
	Temperature fluctuation	±0.3°C
	Safety devices	• Pressure release vent • Forced supply exhaust damper and duct flange • Heat detector, smoke detector, CO_2 extinguisher, Gas detector
Measurement control unit	System	Test chamber, nail penetration, crushing, external short circuit integrated system
	Monitored items	(Nail penetration, crushing) load, transfer distance, velocity, battery voltage, battery temperature (External short circuit) battery voltage, battery temperature
	Data output	Monitored items can be saved to a CSV file
Crushing/nail penetration unit	Size of mountable battery	W245mm×D215×H180mm
	Load range	0.4 to 20kN
	Velocity	0.1 to 50mm/sec.
	Stroke	2 to 200mm
External short circuit unit	Short circuit current	500 A
	Circuit resistance	Resistance switching inside unit (1) 5 mΩ or less (resistance short) (2) 10 to 30 mΩ (3) 80 to 100 mΩ

4-2 Nail (Penetration)/Crush Test System

This system evaluates the safety of batteries suffering internal short circuits caused by penetration by a foreign object or deformity caused by a heavy object.
It consists of a test area equipped with a safety function and a nail (penetration)/crush (mechanical section).
The structure features a design that allows for easy post-test cleaning and maintenance.
The system also supports tests on large battery packs for vehicles.



Nail (Penetration)/Crush Test System

Features

- The integrated design allows for nail (penetration) and crush tests to be conducted in an accurate temperature environment.
- Supports tests for various standards for different-sized batteries, from (small size) batteries to large battery packs.
- Equipped with safety functions that protect against fire and bursting of the battery, including a door lock, pressure (relief) vent, forced exhaust, and fire extinguisher.
- The chamber structure is designed for easy maintenance and cleaning after testing.
- Viewing window and external camera allow for observation of test progress.
- Pressure and speed can be selected for the nail (penetration)/crush mechanical) section.
- Supports testing of various battery sizes with an automatic lift stage inside the chamber. (optional)
- Supports testing for UN ECE R100.02 Part II requirements.

Example of customized specifications

Nail (penetration)/ crush cylinder section	Lift system	Hydraulic cylinder
	Stroke	350mm Min. 1mm step
	Stop accuracy	Within ±1mm
	Load range	1.0kN to 100kN (Consult us for details regarding load range and velocity)
	Velocity	1 to 100mm/s (Consult us for details regarding load range and velocity)
Measuring section	Temperature measurement	Supports various types of thermocouples
	Voltage measurement	−100V to +100V (Consult us for higher voltages)
	Nail (penetration) section	Analog measurement output
Test area section	Temperature range	−40 to 95°C
	Temperature fluctuation	±4.0°C
	Test chamber interior dimensions	W3000 × H2000 × D3000 mm
	Safety devices	Gas detector, pressure (relief) vent, forced exhaust system, fire extinguishers

4-3 External Short Circuit Test System

This test system evaluates the safety of batteries with short circuits between the positive and negative electrodes.
It consists of a test area equipped with a safety function and an external short circuit (mechanical) section.
The structure features a design that allows for easy post-test cleaning and maintenance.
The system also supports tests on large battery packs for vehicles.

External Short Circuit Test System

Features

- The integrated design allows for external short circuit tests to be conducted in an accurate temperature environment.
- Supports tests for various standards for different-sized batteries, from (small size) batteries to large battery packs.
- Equipped with safety functions that protect against fire and bursting of the battery, including a door lock, pressure (relief) vent, forced exhaust, and fire extinguisher.
- The chamber structure is designed for easy maintenance and cleaning after testing.
- Viewing window and external camera allow for observation of test progress.
- Supports a wide range of tests that use variable resistance up to a maximum current of 24,000A.
- Measures the pre-test resistance using a circuit resistance checker.
- Supports testing for UN ECE R100.02 Part II requirements.

Example of customized specifications

External short circuit test section	Short circuit resistance range	5 to 100 mΩ
	Maximum voltage	500V
	Allowable current	24,000A (0.1s) 12,500A (0.4s) 2,500A (10s)
Measuring section	CCD camera	270,000 pixels Max. recording time: 24 hours
	Data logger	200 Ch (voltage/temperature measurement) Min. measuring time: 10ms
Test area section	Temperature range	10 to 60°C
	Temperature fluctuation	±2.0°C
	Test chamber interior dimensions	W3000×H1800×D3000 mm
	Safety devices	Gas detector, pressure (relief) vent, forced exhaust system, fire extinguishers

4-4 Environmental Stress Chamber

These high-power temperature (& humidity) chambers are capable of performing temperature increases for carrying out battery heat testing (5°C/min).
Standard models with large capacities up to 1100 L and rapid temperature change models with selectable temperature change speeds of 6 to 18°C per minute are available.
All models can be used for IEC standard and various automobile-related standard testing.

Environmental Stress Chamber

Specifications

Model		Temp. & humid. range	Temp. rate of change	Inside dimensions (W×H×D mm)
Rapid-Rate Temperature Cycle Type	ARS-0680-5	–70 to +180°C 10 to 98%rh	6K/min.	850×1000×800
	ARS-1100-5			1100×1000×1000
	ARSF-0250-10		10K/min.	600×830×500
	ARSF-0250-15		18K/min.	
	ARSF-0400-10		10K/min.	600×830×800
	ARSF-0400-15		15K/min.	
	ARSF-0800-10		10K/min.	1000×980×800
	ARSF-0800-15		15K/min.	
	ARG-0680-5	–70 to +180°C	6K/min.	850×1000×800
	ARG-1100-5			1100×1000×1000
	ARGF-0250-10		10K/min.	600×830×500
	ARGF-0250-15		18K/min.	
	ARGF-0400-10		10K/min.	600×830×800
	ARGF-0400-15		15K/min.	
	ARGF-0800-10		10K/min.	1000×980×800
	ARGF-0800-15		15K/min.	
Standard Type	ARS-0220-J	–75 to +180°C 10 to 98%rh	4 to 6.3K/min.	700×800×400
	ARS-0390-J			700×800×700
	ARS-0680-J			850×1000×800
	ARS-1100-J			1100×1000×1000
	ARL-0680-J	–45 to +180°C 10 to 98%rh		850×1000×800
	ARL-1100-J			1100×1000×1000
	ARG-0220-J	–75 to +180°C		700×800×400
	ARG-0390-J			700×800×700
	ARG-0680-J			850×1000×800
	ARG-1100-J			1100×1000×1000
	ARU-0680-J	–45 to +180°C		850×1000×800
	ARU-1100-J			1100×1000×1000

* Rapid-Rate temp. cycle: The performance values are based on IEC60068-3-5:2001 and IEC60068-3-6:2001; Performance figures are given for a +23°C, ambient temperature relative humidity of 65±20%rh, rated voltage, and no specimen inside the test area.
Standard: The performance values are based on IEC60068-3-5:2001 and IEC60068-3-6:2001; Performance figures are given for a +20°C, rated voltage, and no specimen inside the test area.

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●Specifications are subject to change without notice due to design improvements.