

**ASSOCIATED ENVIRONMENTAL SYSTEMS**

# BATTERY SAFETY



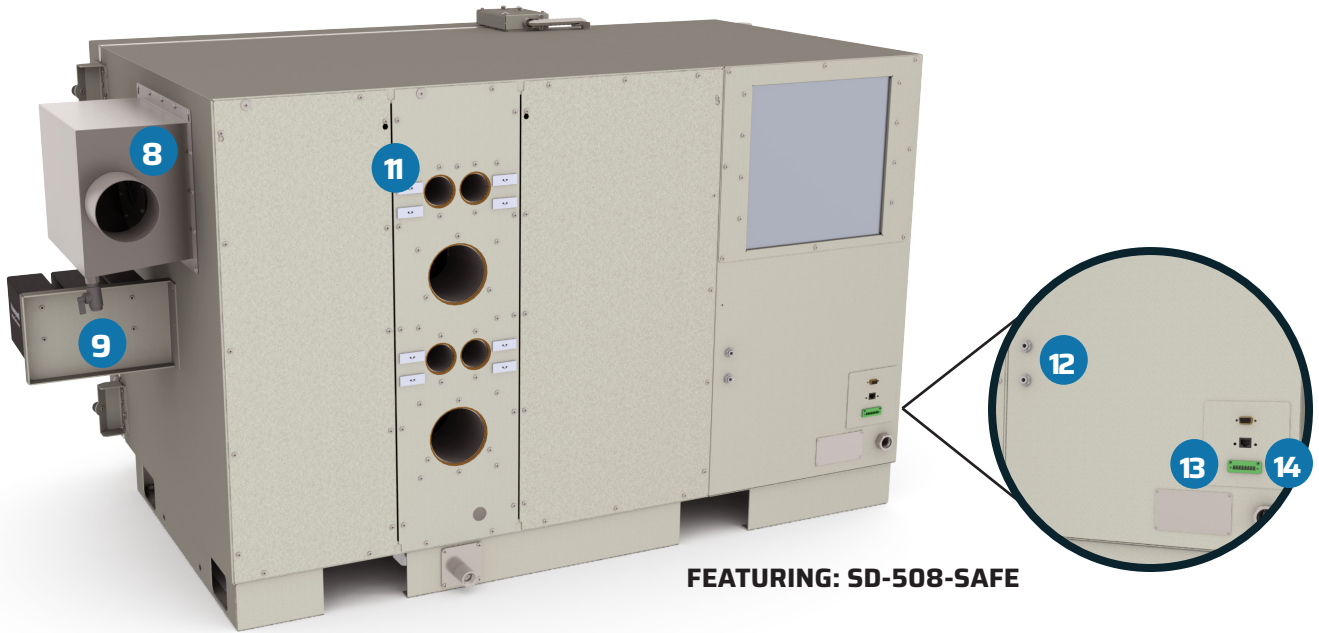
# BATTERY SAFETY FEATURES



FEATURING: SD-508-SAFE

Safety Feature	Description
<b>1</b> Set Point Temperature Limit	Temperature control set points to prevent the user from accidentally setting the chamber's temperature outside of the determined limits.
<b>2</b> High Low Temperature Limit	Designed to be independent of all chamber controls actions that are taking place. <b>*ATP limit point is: -20°C and 80°C</b>
<b>3</b> Rapid Rise	Safety feature in place to monitor and detect a rapid temperature change.
<b>4</b> Emergency Stop Button	Stop button to disable the chamber function rapidly.
<b>5</b> Audible and Visual Alarm	Three color system that emits an audible alarm when the chamber is in an alarm condition. <b>Green</b> - Chamber is ready to use, and door is unlocked. <b>Blue</b> - Chamber is in use, and door is locked. <b>Red</b> - Chamber is in alarm condition, and door is locked.
<b>6</b> Door Lock	Electronic rotary cam fail safe door lock with mechanical override. It is equipped with a cam position sensor indicating the lock state. AES XCHANGE logs door activity (open and close state) *Chamber will not run with an open door. <b>*Door will not open in alarm condition</b> <b>*Lock rated to 1119 lbf or 4980 N</b>
<b>7</b> Reinforcement	Reinforced stainless steel interior.
<b>8</b> Burst Disk/Low Flow Vent	Graphite burst disc with rupture sensor that triggers system alarm.
<b>9</b> Gas Sensor/s	Sensors for monitoring chamber working volume for combustable gasses. <b>*Optional single, dual or triple gas sensors</b>
<b>10</b> Temperature Limited Sheath Heaters	Stainless steel finned tubular heaters with a temperature sensor to limit the max operating temperature.

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	Safety Feature	Description
11	<b>Product Sensors</b>	8 Thermocouple connectors installed on the rear of the chamber for customer device under test monitoring. <b>*Additional Thermocouples are optional</b>
12	<b>Safety Purge</b>	Inert gas purge is triggered when the chamber is in an alarm state
13	<b>Chamber Alarm Input</b>	The external terminal block sends a voltage signal that, when interrupted, will trigger an alarm state and shut down the chamber. <b>*This can be interfaced with other test equipment or DUT.</b>
14	<b>Chamber Alarm Output</b>	When the chamber is powered and in a safe state the contact closes. Loss of power or alarm condition opens the contacts. <b>*This Alarm output is designed to safely disable test equipment or DUT.</b>

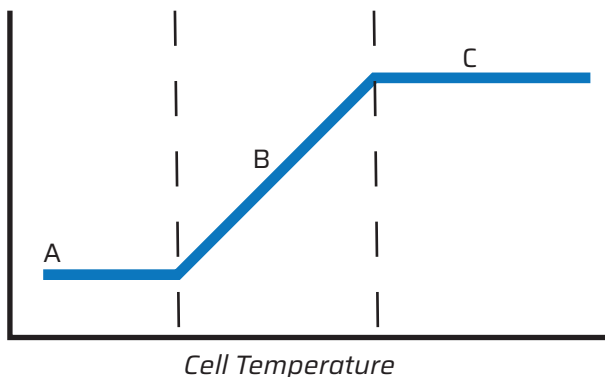
# BATTERY SAFETY FEATURES

Battery safety features are important for operator safety during a battery thermal event (BTE). The AES SAFE chamber series is designed to first prevent and then mitigate a BTE.

Preventative Safety Features	Preventative Action
<b>Set Point Temperature Limit</b>	Prevents the chamber from being set to a temperature outside the desired range.
<b>High Low Temperature Limit</b>	High low limit control( FM approved) is independent from primary chamber controller. This is a back-up safety to the set point temperature limit safety feature.
<b>Product Sensors</b>	Measures the cell temp. If cell temperature gets too high, testing will be stopped.
<b>Rapid Rise<sup>1</sup></b>	Measures cell and air temperature. If the chamber is heating or cooling too fast, this feature shuts down testing prior to a BTE.
<b>Temperature Limited Sheath Heaters</b>	Keeps surface temperature of the heater far below the auto-ignition temperature of any gas present in the chamber, preventing ignition.
<b>Alarm Input/Output</b>	I/O designed to communicate alarm status between chamber and cycler, hardwired.
<b>Gas Sensor/s</b> <i>Optional</i>	Monitor gas levels inside the chamber for abnormal conditions. Puts chamber in alarm state with abnormal levels.

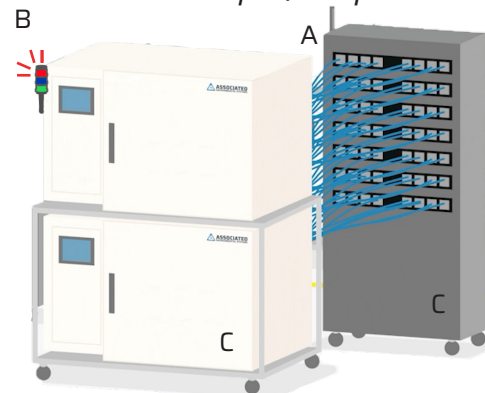
Mitigation Safety Features	Mitigation Action
<b>Emergency Stop Button</b>	Stops all temperature conditioning and put the chamber in an alarm state.
<b>Reinforcement</b>	Reinforced chamber inner structure and enhanced door structure hinging and latching. Designed to handle pressure increase during BTE.
<b>Safety Purge</b>	Removes oxygen from chamber and replaces with inert gas (fire suppression).
<b>Audible and Visual Alarm</b>	Alerts chamber user/s to alarm status and evacuate area.
<b>Burst Disk/Low Flor Vent</b>	Graphite burst disk and rupture sensor relieve pressure in case of BTE.
<b>Door Lock</b>	Prevents access to the chamber when running or in alarm condition. Intergrated door position sensor (open/close).
<b>Alarm Input/Output<sup>2</sup></b>	Communicates alarm status between chamber and cycler and triggers audible and visual alarms. Halts temperature conditioning and charging/discharging.

<sup>1</sup> Rapid Rise: Safety Algorithm



- A. Cell is at room temperature cell is being loaded into the chamber and in nominal state.
- B. Cell heat is rising during charge/dishcharge testing.
- C. Cell has hit max heat rise during charge/dishcharge testing.

<sup>2</sup> Alarm Input/Output



- A. Communicates chamber alarm status
- B. Triggers Audible and Visual alarm on chamber
- C. All temperature conditioning inside the chamber stops
- D. Cycler charge/dishcharge testing halts

# BATTERY TEST CHAMBERS

All AES SAFE series battery test chambers are safe up to EUCAR Hazard Level 7. See EUCAR hazard level chart on page 7.

## FD-548-7.5-SAFE



### SPECIFICATIONS

<b>Volume</b>	48 cubic ft (1359.2liters)
<b>Temperature</b>	-40°C to 180°C (-40°F to 356°F)
<b>Pull Down Rate</b>	4.5°C/min
<b>Electrical Supply</b>	480 VAC, 3 PH, 60Hz
<b>Full Load Amps</b>	35 A
<b>Electrical Connectivity</b>	Hardwired
<b>Refrigeration System</b>	Single stage

## FD-527-7.5-SAFE



### SPECIFICATIONS

<b>Volume</b>	27 cubic ft (764.55 liters)
<b>Temperature</b>	-40°C to 180°C (-40°F to 356°F)
<b>Pull Down Rate</b>	5.5°C/min
<b>Electrical Supply</b>	480VAC, 3 PH, 60Hz
<b>Full Load Amps</b>	28 A
<b>Electrical Connectivity</b>	Hardwired
<b>Refrigeration System</b>	Single stage

## SC/SCH-512-4-SAFE



### SPECIFICATIONS

<b>Volume</b>	12.95 cubic ft (366.7 liters)
<b>Temperature</b>	-37°C to 180°C (-34.6°F to 356°F)
<b>Pull Down Rate</b>	5°C/min
<b>Electrical Supply</b>	208 VAC, 1 PH, 60Hz
<b>Full Load Amps</b>	50 A
<b>Electrical Connectivity</b>	6' cord with 2-Pole 3-Wire Grounding, Non-NEMA, Twist lock plug. CATALOG# CS8265C
<b>Refrigeration System</b>	Single stage
<b>Humidity Range (SCH only)</b>	10-95% RH, limited by +4°C Td (for 98% add option)

# BATTERY TEST CHAMBERS

## SC/SCH-508-4-SAFE



### SPECIFICATIONS

<b>Volume</b>	8.64 cubic ft (244.65 liters)
<b>Temperature</b>	-37°C to 180°C (-34.6°F to 356°F)
<b>Pull Down Rate</b>	5°C/min
<b>Electrical Supply</b>	208 VAC, 1 PH, 60Hz
<b>Full Load Amps</b>	50 A
<b>Electrical Connectivity</b>	6' cord with 2-Pole 3-Wire Grounding, Non-NEMA, Twist lock plug. CATALOG# CS8265C
<b>Refrigeration System</b>	Single stage
<b>Humidity Range (SCH only)</b>	10-95% RH, limited by +4°C Td (for 98% add option)

## SD/BHD-508-SAFE



### SPECIFICATIONS

<b>Volume</b>	8 cubic ft/226.53 liters
<b>Temperature</b>	-37°C to 180°C (-34.6°F to 356°F)
<b>Pull Down Rate (SD)</b>	1.24°C/min 4°C/min
<b>Pull Down Rate (BHD)</b>	4°C/min
<b>Electrical Supply</b>	208 VAC, 1 PH, 60Hz
<b>Full Load Amps (SD)</b>	21 A
<b>Full Load Amps (BHD)</b>	25 A
<b>Electrical Connectivity</b>	Attach power cable with NEMA L6-30
<b>Refrigeration System</b>	Single stage
<b>Humidity Range (BHD only)</b>	10-95% RH, limited by +4°C Td (for 98% add option)

## SD-501-SAFE



### SPECIFICATIONS

<b>Volume</b>	1.01 cubic ft (28.59 liters)
<b>Temperature</b>	-37°C to 180°C (-34.6°F to 356°F)
<b>Pull Down Rate</b>	3°C/min
<b>Electrical Supply</b>	208 VAC, 1 PH, 60Hz
<b>Full Load Amps</b>	13A
<b>Electrical Connectivity</b>	Attach power cable with NEMA 5-15p
<b>Refrigeration System</b>	Single stage

# AES SAFETY LEVELS

Standard AES Chambers
  AES SAFE Required

Severity Level	Description	Severity Classification & Effects Criteria
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. Cell reversibly damaged. Repair of protection device needed.
2	Irreversible 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 $\Delta$ mass <50%	No venting, fire, or flame*; no rupture; no explosion. Weight loss <50% of electrolyte weight (electrolyte = solvent + salt).
4	Venting $\Delta$ 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)

**\*Gas Sensors and Additional Safety Features Available**



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**AES SAFE**