



# Battery Testing Calorimeter (BTC)

Thermal 'Abuse' Testing with "ARC-type" Calorimeter

**Adiabatic reaction calorimeter for thermal stability ('abuse') testing of large batteries, battery packs and components.**

The BTC is able to study : -

- Battery components (anode, cathode, electrolyte, SEI)
- Complete batteries
- Overcharged or over discharged batteries
- Charged, discharged and cycled batteries

Even large batteries (EV and HEV, for example) can be directly tested to obtain safety, lifecycle and electrochemical efficiency data. Video of battery explosion at elevated temperature and pressure can be viewed live and saved for later analysis.

## Thermal Stability Testing

Lowest temperature at which battery starts to self-heat can be accurately determined in the standard Heat-wait-search test. To assist with chemical development, the kinetics and energy release can be easily qualified.

## Cycler Integration

Power cyclers, fully software integrated and controlled can supplied for a range of power/current loads enabling different charging, discharging, shorting and other common operations to be automatically tested. Client's own units can also be used.

## Isothermal Testing

Iso-BTC heats/cool the battery to keep the temperature constant during cycling and the amount of heat is measured and displayed.



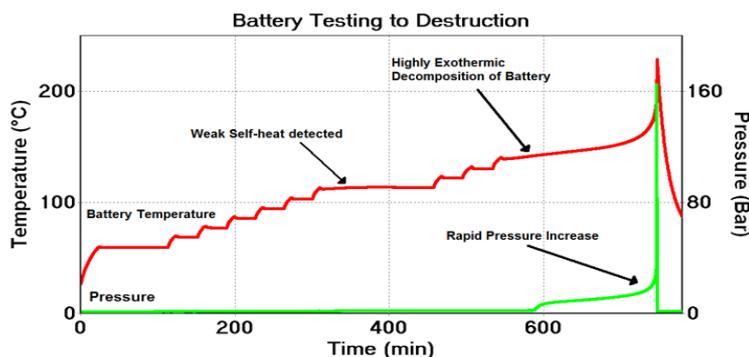
Image during the thermal runaway from the video camera integrated into the BTC



**Custom BTC chamber internal free space**  
**35cm diameter x 35 to 55cm high**  
**Size approximately 60 x 60 x 60 cm (or**  
**1.4 meter high with hood open)**

## Penetration and Low Temperatures Testing

Battery performance change due to physical damage, such as penetration with sharp nails, is also possible with standard and custom design options available. Sub-zero cooling is also possible.





## BTC Design Choices

### “Standard” Calorimeter

Compact design that can be used for battery sizes up to 18650 and all battery components.

Safe to use in **standard fume hood**, confirmed by testing with explosives.

Standard Phi-TEC I Footprint 30 x 37 x 50 cm, test section 3.4cm or 11cm diameter x 17cm high



### “Custom” Calorimeter

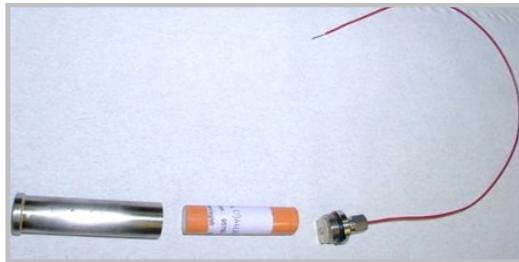
The Custom Testing Calorimeter is used for batteries larger than 18650.

This Calorimeter will allow batteries up to 35cm x 50cm to be tested, and typically includes batteries for EV and HEV, military use, space aircraft and also large packs of smaller batteries. However, the system works equally well for small batteries and components.

**Test batteries, battery packs & components to obtain safety, lifecycle & electrochemical efficiency data**



Lithium Polymer batteries after a test in a ‘Standard’ BTC



18650 battery with custom test cell



Large battery before and after thermal stability testing in BTC

## Technical advantages of Phi-TEC BTC

### Auto-calibration

Phi-TEC BTC self-calibrates each time a test is performed, making operation easier and giving the best results. In contrast, classic “ARC” calorimeters need a day or more for regular calibration and this must be repeated for different sizes and shapes of batteries.

### Operating Safety

The design is based around a steel pressure vessel with attention to detail typical for such designs. Including 3 layers of safety (Inherent mechanical design, self-operating pressure relief vent and software triggered shut down including emergency cooling).

### Power Release and Cp determination

The average Cp (specific heat) of a battery can be obtained with the BTC. This allows the rate of temperature rise to be converted to power, when a battery is self-heating.

**For further information visit <http://www.helgroup.com>**

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