COMPOSITES

FR.10 – 2mm thick UL2596 BETR & TaG Testing

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‘The World’s only fireproof composite materials’

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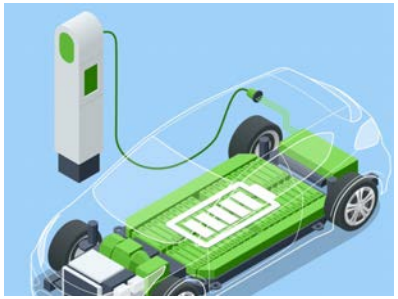
What is UL 2596 Test Scope

Battery Enclosure Material Screening (BEMS) Services

BEMS evaluates the performance of battery enclosure materials in a thermal runaway event, outlined under UL 2596, Test Method for Thermal and Mechanical Performance of Battery Enclosure Materials.

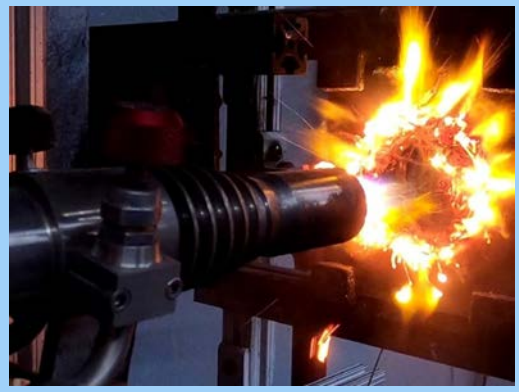


Battery Enclosure Thermal Runaway (BETR) Evaluation

Test method for thermal and mechanical performance of battery enclosure materials, evaluates electric vehicle (EV) battery enclosure materials.

Torch and Grit (TaG) Test

This test method screens material performance used for electric vehicle (EV) battery enclosures.



Test Method – BETR – Thermal Runway Test

Test Apparatus

The test apparatus consists of a five-sided steel test box with an opening at the top for supporting the test sample. The test apparatus houses a fuel package as depicted in Figure 1 below:

The following provides a brief description of the test apparatus and accompanying components:
An approximate 100 mm (L) x 100 mm (W) by 75-89 mm (H)interior volume of a steel enclosure with an open top.

- Means for mounting test samples to be tested (threaded flange).
- Means for thermocouple leads and related hardware to enter the test fixture for temperature measurement inside the enclosure during tests.
- Pressure transducers installed outside the test fixture to record the pressure developed during the test.
- A vent orifice located near the midpoint of one side of the test box used to help regulate the maximum pressure.

Fuel Package

The fuel package consists of twenty-five lithium-ion cells arranged in a 5-by-5 array. The cells utilized in the fuel package were 18650 format manufactured by **[**Panasonic model NCR18650B with a nominal capacity of 3350 mAh**]**. All cells were charged to 100% state of charge (SOC). The cells were positioned in direct contact with each other with the overpressure vents facing the test sample.
Two cells, one at the centre and one adjacent to the centre but furthest from the orifice, were covered with flexible film heaters with wire leads. Thermocouples were attached near the centre of the cells to monitor the cell temperature. The flexible film heaters were used to drive the fuel package into thermal runaway.

Test Method – BETR – Thermal Runway Test Continued

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Test Procedure:

Three test samples were tested for each test configuration, unless otherwise requested by the customer.
The general test procedure steps included:

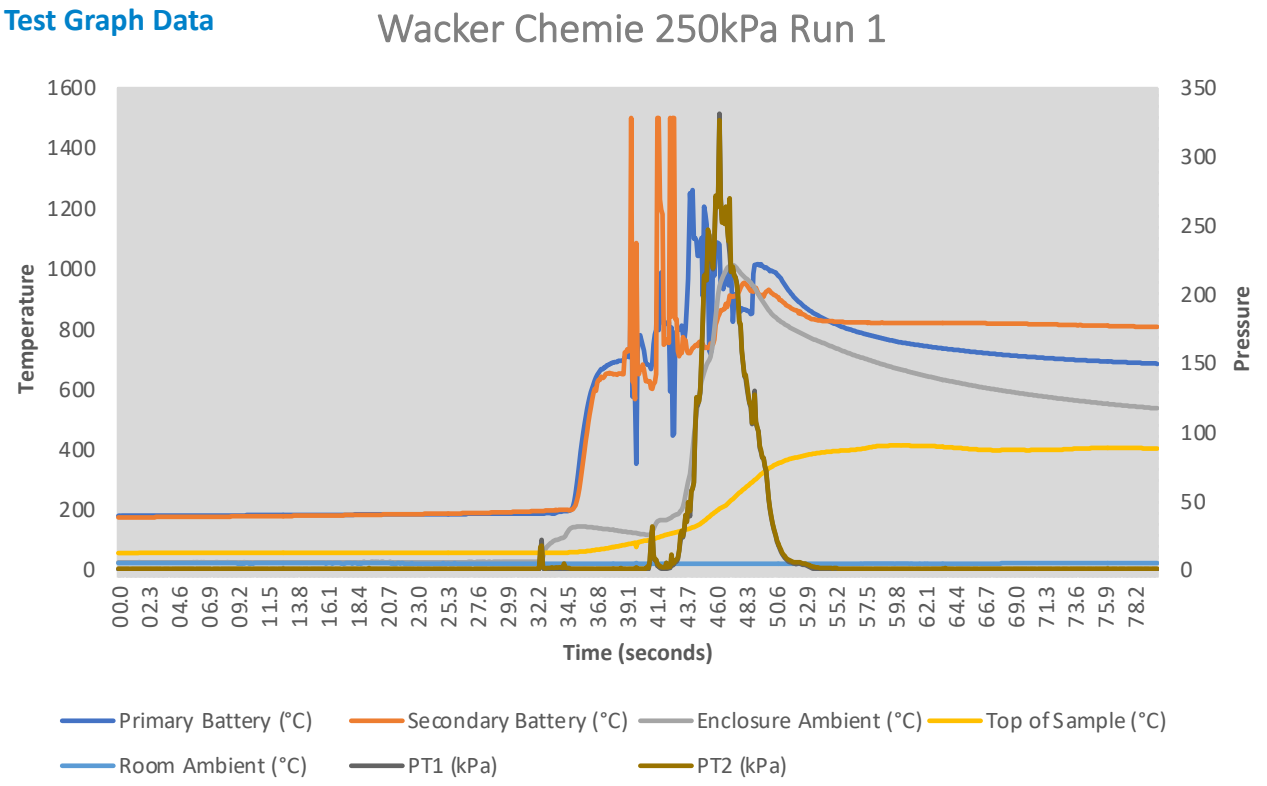
1. A fuel package was installed inside the test box.
2. A test sample was secured and sealed onto the open side of the test box.
3. A thermocouple was attached to the external surface of the test sample near the midpoint.
4. The vent orifice desired for the test configuration was installed (if applicable) and verified.
5. All ports (pass-throughs) used for instrumentation or unused parts were sealed to prevent pressure leakage that is unrelated to the performance of the test sample.
6. The test was initiated by heating both flexible film heaters at an approximate rate of 6 °C/min.
7. The data acquisition system was started prior to thermal runaway and for at least 5 min after the onset of thermal runaway.
8. The test sample was visually observed for at least 5 min. after the onset of thermal runaway and any visual observations documented (e.g. test sample rupturing, smoking, flaming).

Test Video – BETR – Thermal Runway Test

or copy this link into your browser: https://youtu.be/7sN_E6zawW4

Test Results – BETR – Thermal Runway Test

Test Graph Data



Test Results

Vent Orifice Size (mm)	16
Target Pressure (kPa)	250
Max. Internal Pressure (kPa)	331
Max. Temperature on Primary Cell (℃)	1260
Max. Temperature Inside Test Enclosure (℃)	1011
Max. Temperature Top of Test Sample (℃)	413

FR.10-2mm Thick
After test panel photo
Inside
Did not Perforate

FR.10-2mm Thick
After test panel photo
Outside
Did not Perforate

Test Method – TaG – Fire, Particle & Debris Test

UL Solutions Test Apparatus

The test apparatus consists of a premixed flame torch and grit-blast assembly that ejects grit particles with compressed air along the axial center of the torch (Figure 1). A test sample is installed on a sample holder, centred with the torch, with its leading surface located 60 mm from the torch tip. Behind the sample, a steel backplate is installed. The purpose of the backplate is to contain particles from a grit blast and to help provide an indication of sample breach. Both the sample and the backplate have a Type K thermocouple installed on the unexposed side (Figure 2). A flame shield mechanism is used to begin flame exposure at the start of a test. Flame and grit blast parameters are set and adjusted by a user-control interface system.

Figure 1: Torch and Grit Apparatus

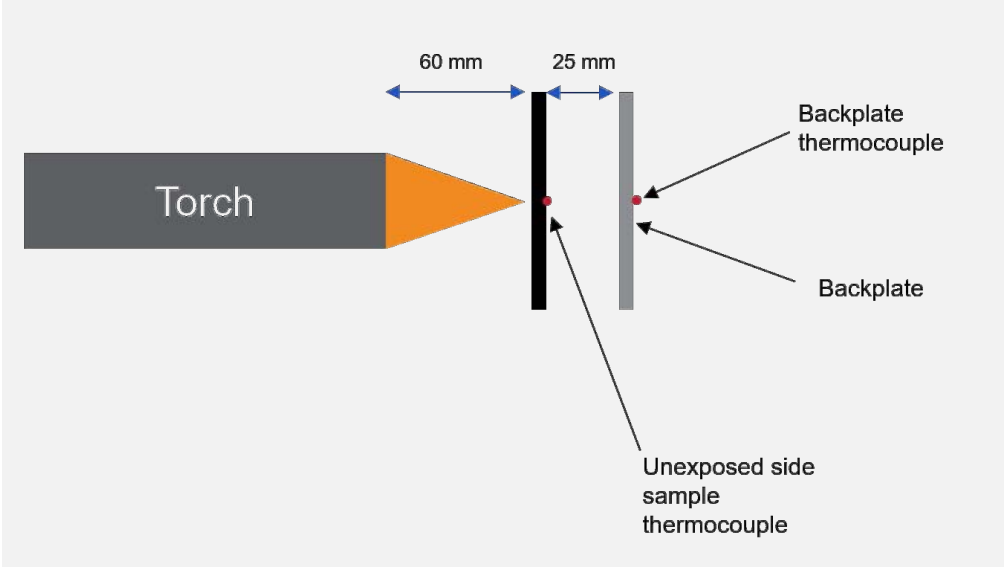


Figure 2: Torch and Grit Apparatus Sample Setup Diagram

The general test procedure steps included:

1. The flame and grit test parameter set points are established in the apparatus user interface
2. A sample is installed in the sample holder and secured in place
3. A Type K thermocouple is installed on the centre of the unexposed side of the test sample
4. The torch is ignited and the fuel and oxygen set points are ramped up to their test values
5. Video recording of the test is initiated
6. The flame shield is removed to begin sample exposure to the flame
7. The specified test profile (flame dwell time, grit blast dwell time, maximum number of cycles) is carried out
8. Post-test, the sample is photographed before being removed from the sample holder
9. The sample is removed from the sample holder and discarded
10. The sample holder is cleaned of sample residue and allowed to cool before the next test is conducted

Test Video – TaG – Fire, Particle & Debris Test

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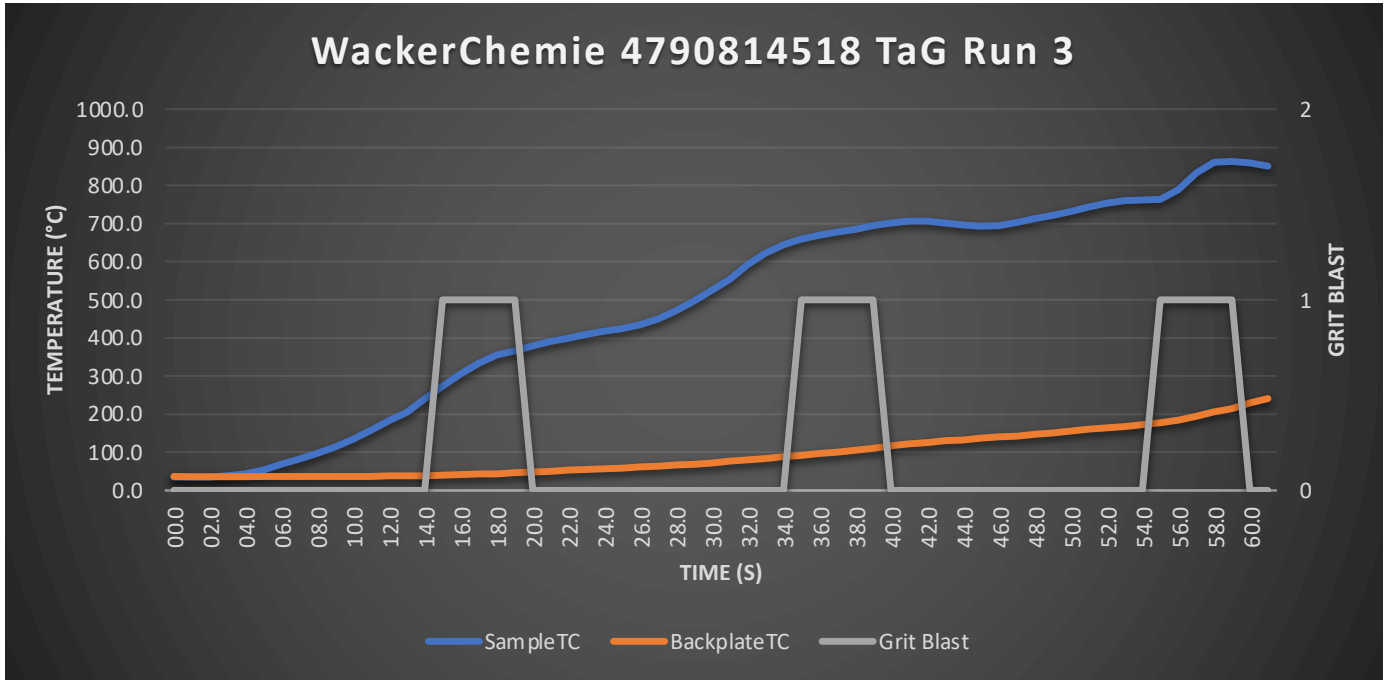
Test Results – TaG – Fire, Particle & Debris Test

Test Graph Data



After test panel photo

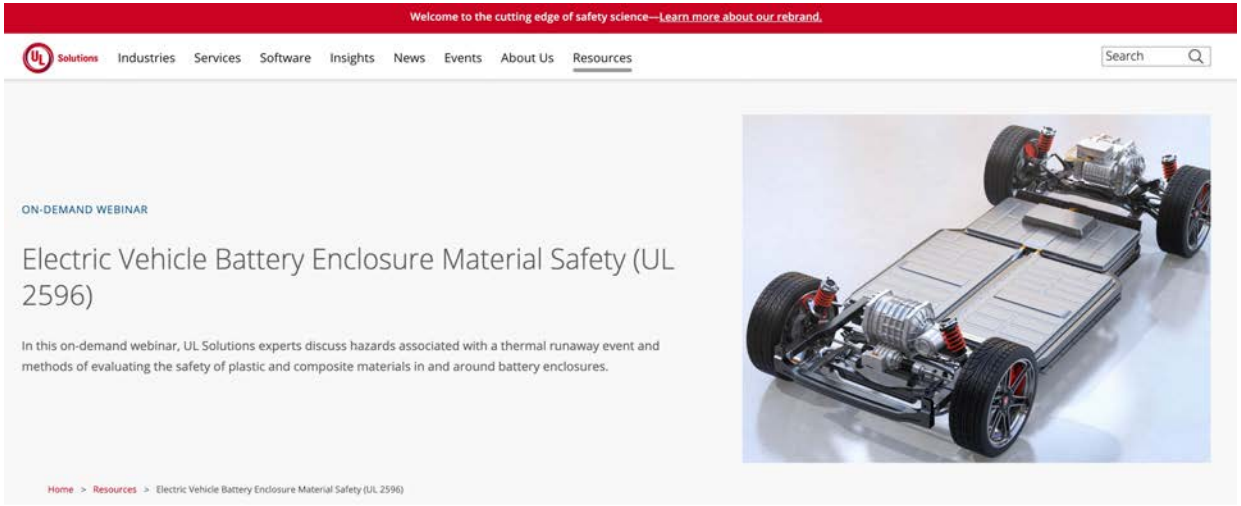
Test Results

Torch Temp (°C)	1200
Torch Power (KW)	3
Max. Torch Dwell Time (secs)	15
Grit Blast Dwell Time (secs)	5
Temperature Measurement at Breach (°C)	721

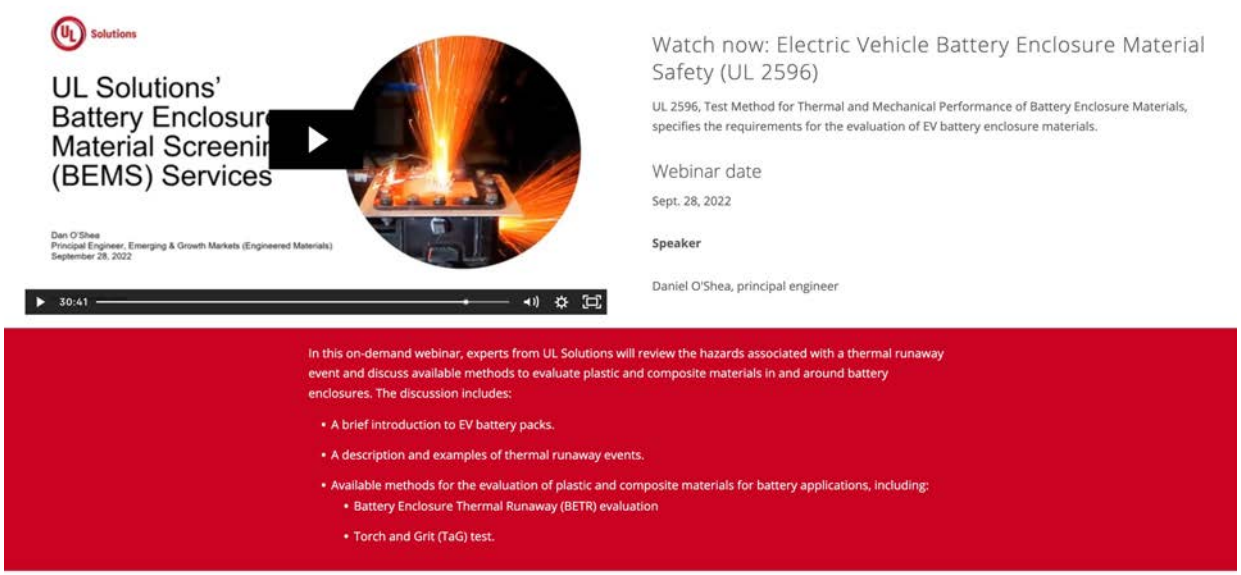
Visit UL Solutions for more information about UL2596

Copy & paste the below link into your web browser or click on it:

https://www.ul.com/resources/electric-vehicle-battery-enclosure-material-safety-ul-2596



Watch the UL video's online



Key Contacts

For more information contact:

Simon Price – CEO
CFP Composites Ltd
E: simon.price@cfpcomposites.com
M: +44 (0) 791 861 6731

Darren Deakin - COO / CTO
CFP Composites Ltd
E: darren.deakin@cfpcomposites.com
M: +44 (0) 790 6576 933

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