

# Insulation Performance Data – UL Tested Dec 1<sup>st</sup> 2023



## UL 2596 Testing:

Developed to simulate the peak heat and debris ejected during a thermal runaway

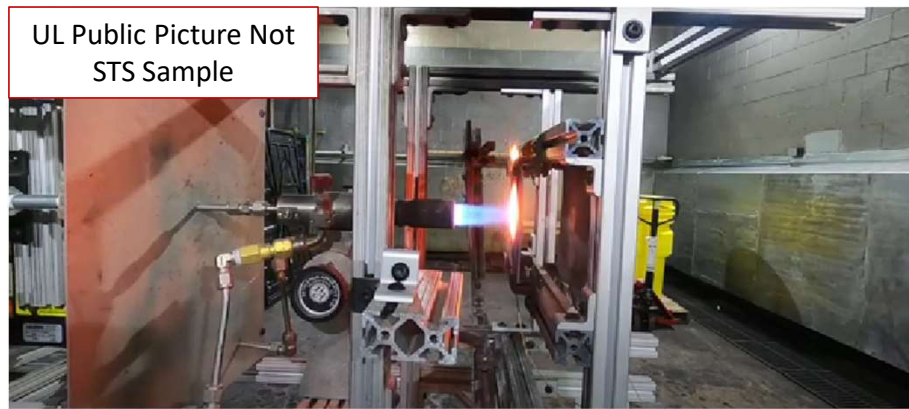
1,200C (2,100F) continuous flame applied to one side  
1.35g – 1.65g of Grit ejected under pressure through the flame

Material Sample: 0.1mm SS foil with 5mm of insulation

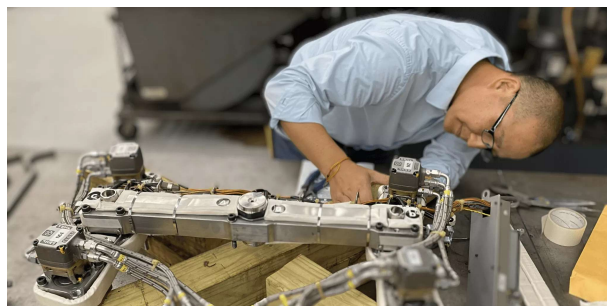
Cold Face surface temp of STS material peaked at 120C (250F)

***Temperature delta between hot and cold face over 200 seconds is > 1,000C***

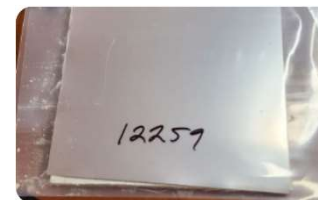
UL Public Picture Not STS Sample



At UL Solutions, we developed a unique set of test methods, known as Battery Enclosure Material Screening (BEMS), to evaluate the performance of different battery enclosure materials in response to a thermal runaway event, outlined under [UL 2596, Test Method for Thermal and Mechanical Performance of Battery Enclosure Materials](#). Our Torch and Grit (TaG) test method screens for the dynamic stresses found in a thermal runaway event, focusing on the evaluation of temperature and mechanical abrasion. We



***Same insulation & construction used for STS injection molding application***



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## Test Report for UL 2596 Torch and Grit(TaG) test

**Date Issued:** 2024-01-09  
**Version:** 1.0  
**Project Number:** 4791066304

**Test Location:**  
 UL Solutions  
 333 Pfingsten Rd  
 Northbrook, IL 60062

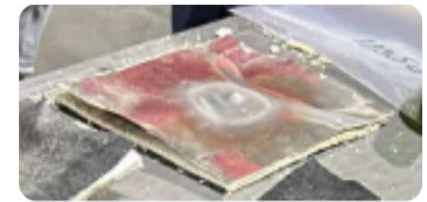
### References

- UL 2596, Test Method for Thermal and Mechanical Performance of Battery Enclosure Materials, 2nd edition (2023-09-08)
  - Clause 5: Torch and Grit (TAG) Test
- UL Solutions Laboratory Procedure Guide (LPG) for UL 2596 Torch and Grit Test (TaG) **(Draft under development)**

### Relevance

The UL Torch and Grit test is a thermomechanical stress test designed for performance screening of materials intended for battery enclosures. The performance characteristics of a material determined by this test method shall not be assumed to correlate with its performance in the end-use application. The actual response of materials to thermal and mechanical stresses depends upon the size and form of the material, as well as the end-use application of the product using the material. Tests conducted on a material under the conditions specified are intended to provide information when comparing the relative performance characteristics of different materials or assessing any change in performance characteristics prior to or during use. This report describes the basics of the test method and provides a summary of the test results.

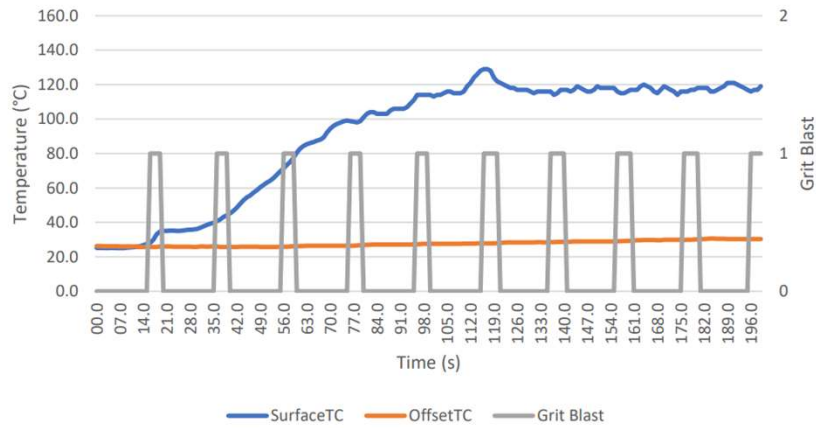
Run	Torch Temperature and Power Set Point	Maximum Torch Dwell Time	Grit Blast Dwell Time	Sample Breach (Y/N)	Approximate Time to Sample Breach (s)	Temperature Measurement at Breach (°C)	Observations (Note: Temperature measurements charts are included in Addendum "A")
1	1200 °C 3 KW	15s	5s	N	N/A	N/A	Breach did not occur, Maximum temperature during last cycle: 121°C
2	1200 °C 3 KW	15s	5s	N	N/A	N/A	Breach did not occur, Maximum temperature during last cycle: 131°C
3	1200 °C 3 KW	15s	5s	N	N/A	N/A	Breach did not occur, Maximum temperature during last cycle: 130°C
4	1200 °C 3 KW	15s	5s	N	N/A	N/A	Breach did not occur, Maximum temperature during last cycle: 139°C
5	1200 °C 3 KW	15s	5s	N	N/A	N/A	Breach did not occur, Maximum temperature during last cycle: 115°C



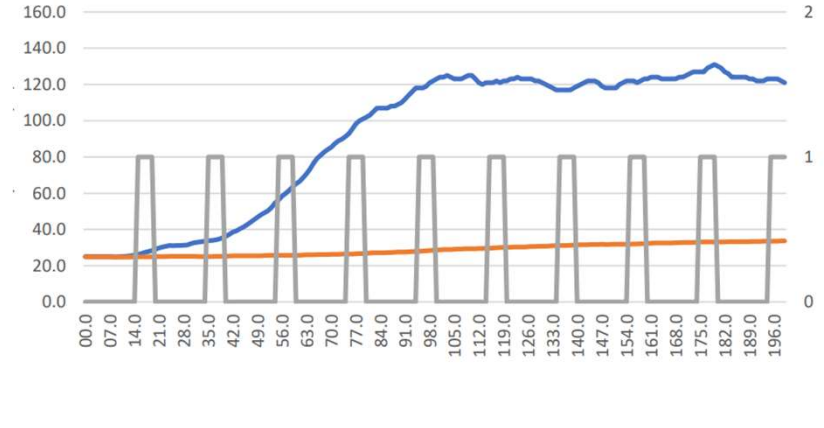
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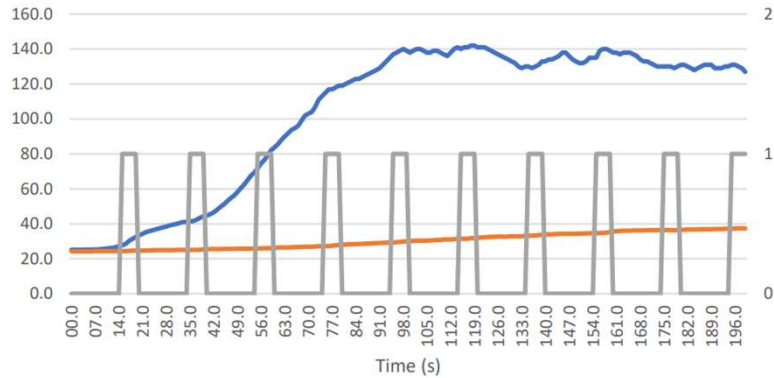
Test Sample 1



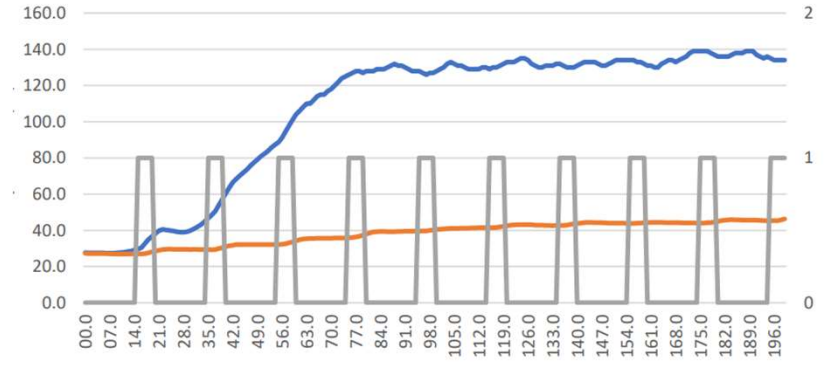
Test Sample 3



Test Sample 2



Test Sample 4





# Insulation Performance Data – UL Tested Dec 1st 2023



Test Sample 5

