



UL9540a Large Scale Fire Test Report Analysis **7/14/2022**

Both the Fortress eVault MAX and eFlex batteries have been evaluated by an National Recognized Test Lab TUV Rheinland for UL9540a large scale fire unit testing. The following report is taken from the draft report which is now available on request from local AHJ authorities. The official report will be issued shortly.

During this test, thermal runaway is induced by attaching a heating element to a centrally-located battery cell and heating to 1166°F/630°C, well above the temperature required to induce thermal runaway in lithium iron phosphate batteries. The external heat is then removed, allowing the battery to undergo thermal runaway. Temperatures of nearby batteries (adjacent and above) as well as nearby walls are measured to analyze the environmental risk during a thermal runaway event.

Based on the data provided, Fortress Power batteries are suitable for a minimum 1" air gap between or above each battery relative to themselves or any wall or ceiling surface. Additionally, we do not require Type X gypsum board to be required for indoor battery applications.

In summary, no external flaming was observed during this test for either eVault MAX or eFlex UL9540a tests. Adjacent sidewall temperature remained below 104°F/40°C during the tests for both battery systems.

Fortress may recommend a larger air gap to encourage airflow between batteries, but the minimum allowable battery spacing between batteries on all sides is 1" as evidenced by the UL9540a test report.

eFlex Summary Report

The UL9540a test included both the battery module and the Fortress battery rack. The batteries inside the rack have 1" air gap between themselves and the sidewall. An additional 1" air gap is between the rack and the exterior wall. Temperature sensors are placed around the inside of the cabinet, as well as adjacent walls. No flaming or explosions were observed in both external and internal unit testing. The maximum battery surface temperature of the initiating unit was 94.9°C / 203°F. The maximum battery surface temperature of the 1" adjacent battery was 40.9°C / 106°F. No alarming heat flux levels (1.3 kW/m² or higher) were measured. Fortress does not require use of the battery cabinet and includes a wall mount bracket which spaces the battery 1" from the wall.

Figure 1. Top view of sub-unit's layout

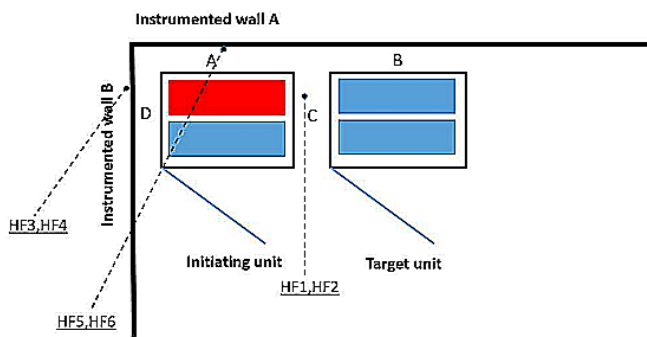


Figure 2. Module numbering in unit

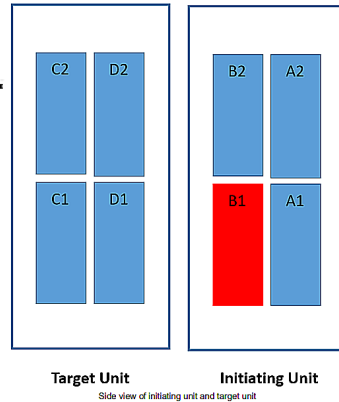


Figure 7. Temperature of instrumented wall A

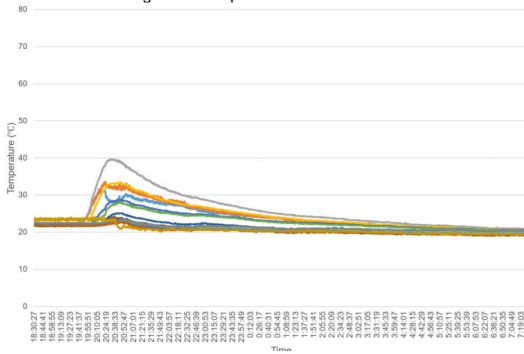
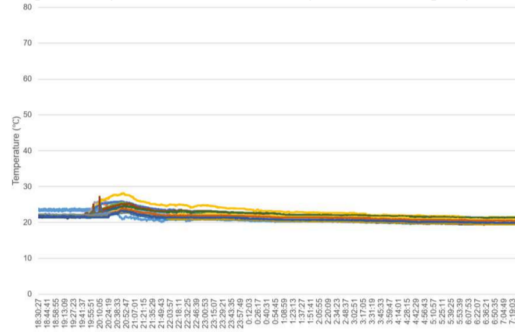


Figure 6. Temperature of instrumented wall B (Left side of initiating unit)



eVault MAX Summary Report

The UL9540a test included eVault MAX units located adjacent to themselves and to adjacent walls, using a 1" air gap in all possible configurations. Temperature sensors are placed within the battery unit, as well as within 6" vertical intervals on adjacent walls. In this test, heat flux was measured using cheese cloth as referenced in the CRD issues on March 21, 2021 and October 21, 2021. The eVault MAX is only allowed in indoor locations.

No fire or explosions were ignited during unit level testing, so almost no chemical heat release rate was captured. Peak heat release rate was 7.37kW and total release was 13.2 MJ. No convective heat release was captured during the test. The maximum wall temperature measured was 35.6°C / 96.1°F

