Technical Note

On the Safety and Design of the Battle Born 100Ah Positive Terminal

Issued by **Battle Born Batteries // Dragonfly Energy**
Date **March 31, 2026**

Executive Summary

This technical note describes the design and behavior of the positive terminal assembly used in Battle Born 100Ah batteries. It outlines how the terminal functions under normal operation and under sustained fault conditions, and clarifies the conditions required for its protective mechanism to operate as intended.

The terminal design is deliberate. It is based on well-understood principles of materials science, electrical contact physics, and thermal behavior, combined to create a passive, irreversible shutdown mechanism that activates under sustained thermal fault conditions. This function serves as a last-resort protective feature, designed to stop current flow before a thermal event can propagate to the cells.

This behavior has been validated through third-party certification testing, internal development and verification, and more than a decade of field performance across hundreds of thousands of batteries. Across all of these conditions, the outcome is consistent: when installed and used correctly, the system operates normally and efficiently.

That record is specific. The terminal design within the pack has been certified to UL 2054 Standards by Intertek (ETL Listed), passing the standard's most severe short-circuit test, known as a Single Fault Short Circuit Test, repeatedly and consistently. Across batteries evaluated through our warranty process since early 2022, representing hundreds of thousands of units sold over the past decade, the terminal has triggered approximately 700 times, to the company's knowledge, always as designed and without a single instance of fire or cell damage. Recent videos suggesting otherwise were filmed with the battery enclosure removed, which eliminates the structural constraint the mechanism depends on and does not reflect how the product behaves in its intended configuration. When subjected to sustained fault conditions, it responds as designed to safely interrupt current and prevent escalation.

1. Terminal Design and Safety Testing

This technical note describes how the design for Battle Born's 100Ah batteries came to be and, more importantly, why it works. The focus is on the positive terminal, which utilizes multiple dissimilar metal junctions and a polymer serving the dual purpose of long-term low-creep compression and thermal risk mitigation. We also address why the series of YouTube videos characterizing the design as unsafe is misleading.

All available testing and field data consistently indicate that the design works and the battery is safe.

We are confident that this is the case, because we have a decade of data, hundreds of thousands of use cases, warranty cases, and hundreds of tests by Nationally Recognized Testing Laboratories, including the Intertek lab listing these products under the ETL mark to UL 2054 and IEC 62133 standards. Moreover, the design is based in fundamental science.

The Intertek lab is world-renowned. Many of the electrical appliances in your home carry the same ETL safety mark as all of our 100Ah models. Achieving this listing is not trivial and should not be dismissed. The design and internal testing of the BB10012 ran for three years, from 2014 to 2017. The positive terminal design has remained unchanged since 2015 and it has already passed worst-case validation. Maintaining these listings also prevents us from changing even a single component in the product without getting it relisted. Intertek enforces this policy through random biannual inspections of our manufacturing facility.

The most stringent electrical test in the UL 2054 standard is the single-fault short-circuit test. In this test, the battery management system, the electronic protection circuit that would normally prevent an overcurrent event, is deliberately bypassed or dead-shorted. The battery is then subjected to a direct short circuit with no electronic protection of any kind. Any fire constitutes a failure. The test requires ten samples: five tested at 20°C and five at 55°C. A single failure across all ten samples is unacceptable. The standard requires a perfect result. Battle Born passed this test at the end of 2017 with all ten samples, at both temperatures, without fire. Standing between the battery and an uncontrolled short circuit in that test was the positive terminal. It did its job.

To our knowledge, this made the BB10012 the first deep-cycle lithium-ion battery pack in the RV industry to achieve UL 2054 listing. The test was repeated in 2020, when we updated some components unrelated to the terminal assembly, thus relisting the battery. The short-circuit test was also repeated on all models that feature this terminal design, including the GC2 and 1275 models.

2. How the Terminal Works

At the heart of the terminal is a deceptively simple mechanical assembly. A brass electrical contact and a copper electrical contact are held face-to-face by a horizontal aluminum bolt. Between them sits a layer of PA-765, a tough, flame-resistant engineering plastic chosen for its material properties: it has an elastic modulus of 2 GPa and it begins to soften at 85°C. The bolt is tightened to press the whole sandwich together, and current flows through the assembly in normal operation: from the external cable into the brass contact, through the aluminum bolt, and into the copper busbar connected to the pack's internal circuitry through a thin nickel sheet.

In normal operation the terminal is stable and efficient. The electrical resistance of the entire assembly is less than 200 microohms, so small that even at 100 amps the voltage drop across it is less than 20 millivolts, and the heat it generates is under two watts. Due to the remarkably low creep of PA-765, the terminal has been shown to remain under 200 microohms for over ten years of normal use.

The long-term creep behavior of the PA-765 ABS plastic material was also one of the primary criteria for selection of that material. ABS has remarkably low creep at temperatures below the softening point of 85°C and under the necessary compression required to maintain the metal-metal contacts. The actual metal contact area is small compared to the area of contact with the ABS plastic, ensuring that the compressive pressure against the ABS is low. One study of low stress ABS creep (Suk Choon Kang, Journal of the Korean Society for Precision Engineering Vol. 29, No. 10, pp. 1137-1143, 2012) determined the creep limit of ABS under normal operating conditions to be 30 MPa, at least an order of magnitude greater than in our system (see Figure 1). In that study, creep limit is defined as the stress below which the strain rate is less than 10^{-7} per day. This corresponds to a characteristic creep time of 70 years. We operate far below the creep limit as long as the temperature stays below 85°C. Our long-term measurements of the terminal resistance prove this to be true.

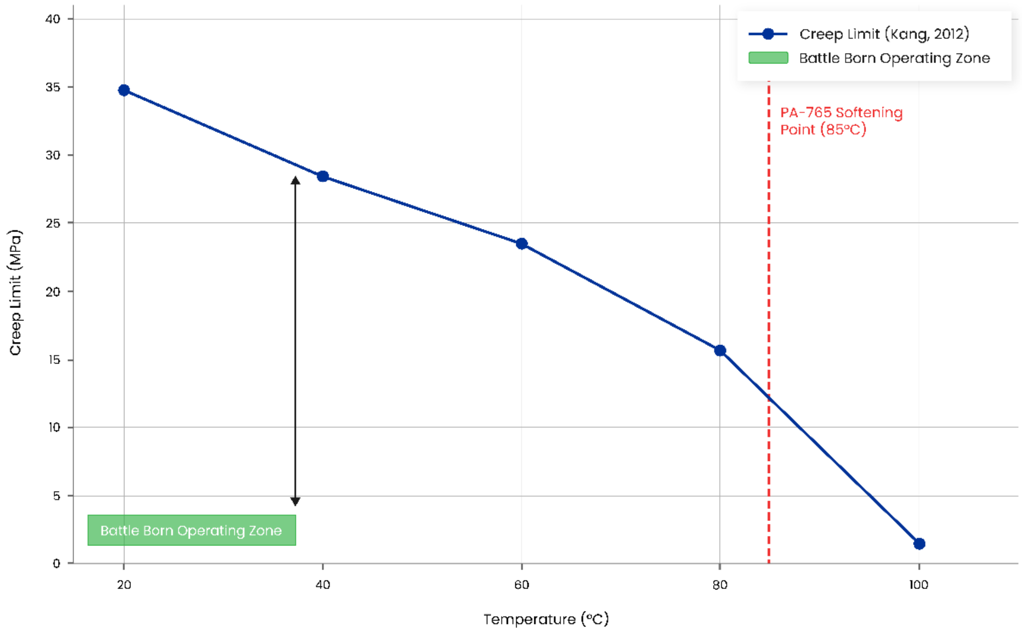

Figure 1: Creep limit of ABS versus temperature (Suk Choon Kang, 2012). Normal operating stress well below the creep limit, confirming long-term dimensional stability. At 85°C the plastic softens by design, triggering the interrupt mechanism.

This stability is only possible because, below 85°C, the PA-765 layer behaves elastically over the relevant range of stress. Above it, that changes entirely. Under a fault condition, such as a loose external connection or undersized cable generating sustained heat at the terminal, the temperature climbs toward 85°C. This does not happen instantly. The thermal mass of the assembly absorbs heat gradually. At the maximum rated current of 100 amps and an undersized cable, it could still take on the order of tens of minutes or more for the terminal and joint to reach the trigger temperature. The protection is proportionate. A brief overload does not trip the terminal. A sustained fault that genuinely threatens the cells does.

When the plastic softens and contact pressure at the metal interfaces falls to near zero, aluminum's most important electrical property takes over. Aluminum oxidizes. The instant a fresh aluminum surface is exposed to air it begins forming aluminum oxide, Al_2O_3, one of the hardest and most electrically insulating materials in nature. Al_2O_3 is an extremely well understood dielectric and used in many electrical applications, such as capacitors and magnet wire. Under normal conditions this film is nanometers thick and self-limiting. But the rate at which it forms is extraordinarily sensitive to temperature, according to Arrhenius kinetics. This has been shown specifically for the Aluminum/Copper interface (see for example, Oberst et al., IEEE Holm Conference on Electrical Contacts, 2019). Every ten degrees of additional heat roughly doubles the oxidation rate. At the temperatures reached by the microscopic contact points inside the joint between the aluminum and copper and aluminum and brass, the oxide forms almost instantaneously.

With contact pressure gone, the full current flowing through the terminal concentrates onto the tiny peaks, called asperities, on the aluminum bolt face that are still just barely touching the copper. The current density at these points is enormous, hundreds of times higher than in the surrounding metal, a consequence of current constriction at microscopic contact points that is well established in the electrical contacts literature (R. Holm, Electric Contacts: Theory and Application, 4th ed., Springer, 1967). They heat to hundreds of degrees within seconds. At those temperatures, a film of aluminum oxide just ten nanometers thick, thinner than the smallest virus, forms on each contact point and renders it completely non-conducting. One by one, the contact points are rapidly and progressively extinguished by their own chemistry. As each one fails, the remaining points carry more current, heat faster, and oxidize faster still. The process accelerates until it is complete.

Within seconds, the terminal rapidly transitions to a high-resistance state sufficient to collapse current flow. At 12 volts, a resistance of even a single ohm reduces the available current to a level that cannot sustain meaningful power delivery. The pack shuts down. The PA-765 material re-solidifies around the structures of the joint. The heat source is eliminated before it can reach the cells. The battery is safe.

The intent of this design is that nothing in the terminal moves to achieve this. No spring activates, no fuse element melts, no electronic circuit intervenes. The only change is an invisible ceramic film, ten nanometers of aluminum oxide, on the face of an aluminum bolt. That film is chemically stable, mechanically hard, and impervious to the voltages a 12-volt system can apply. The protection is permanent and irreversible by design.

This is not a conventional fuse and it is not an electronic protection circuit. It is a material system in which the properties of an engineering plastic, the chemistry of aluminum, and the physics of electrical contact are aligned so that the one condition that threatens the battery, sustained heat at the terminal from user error, is also the condition that triggers permanent, passive, fail-safe shutdown. The terminal protects the battery by design, not by intervention.

Initial skepticism about the design is understandable. Aluminum oxidation increasing resistance at an electrical joint is a well-documented phenomenon that created electrical issues in houses for decades. The difference in our oxidation system is the voltage and environment. At 120V, sustained arcs can repeatedly disrupt the formation of oxide layers, enabling a runaway cycle. At 12V, sustaining an arc across a growing insulating interface is more difficult, and once a stable oxide layer forms, the available voltage is insufficient to re-establish conduction. The mechanism that was problematic at 120V is permanently self-extinguishing at 12V. We did not invent new physics. We put known physics on the right side of a voltage threshold. Moreover, the presence of the compressive load-bearing PA-765 element ensures a clear trigger at the softening temperature.

Another material choice that may raise eyebrows is the dissimilar aluminum/copper interface. Engineers will rightly note that such an interface is susceptible to galvanic corrosion. However, this interface is sealed and dry inside the battery. There is no bulk moisture or electrolyte to sustain the reaction under normal operating conditions. From a materials standpoint, copper provides high electrical conductivity to rapidly distribute current past the joint, while the galvanic potential difference between copper and aluminum, copper being cathodic to aluminum, accelerates aluminum oxidation under fault conditions. This is the same electrochemical relationship that makes aluminum/copper contacts problematic in building wiring at line voltage; at 12V it becomes an asset, driving the protective oxide cascade faster and more completely than a same-metal interface would. Ten years of field data supports the conclusion that the sealed interface is electrically stable under normal conditions and triggered under the thermal fault conditions it was designed to address.

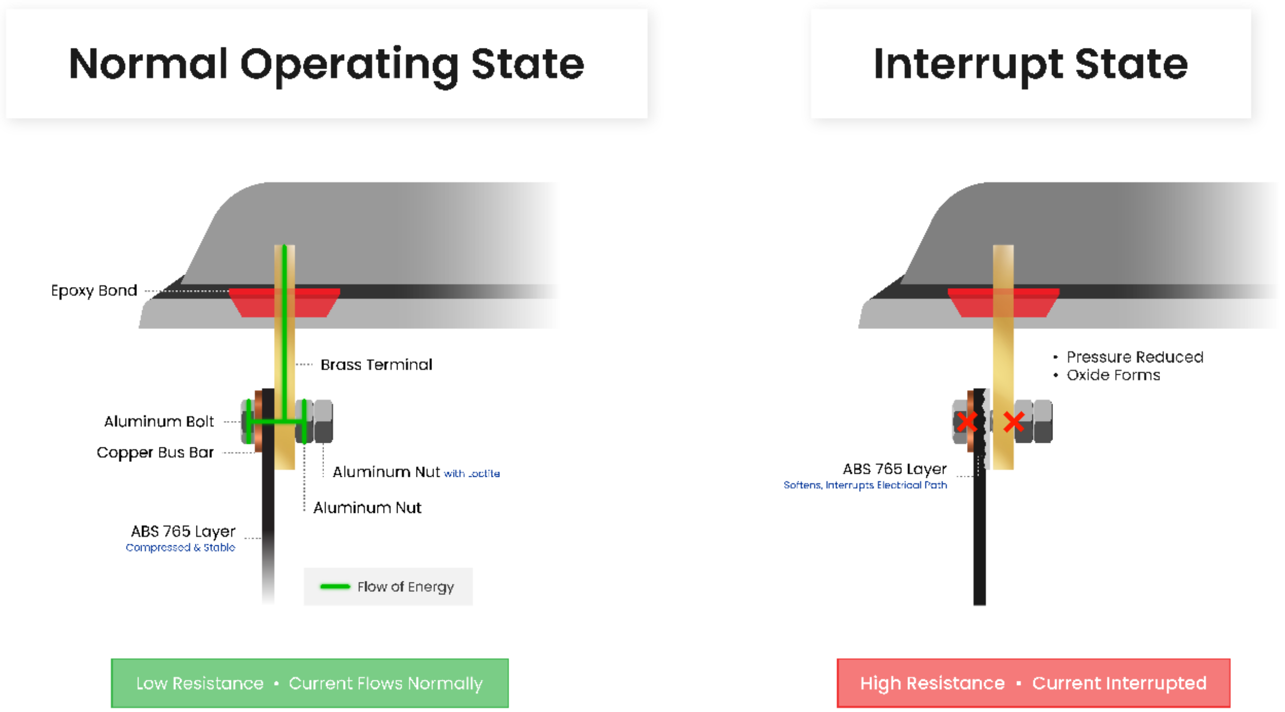

Figure 2: Cutaway diagram of the BB10012 positive terminal in normal operation (left) and following activation of the thermal interrupt mechanism under fault conditions (right). The PA-765 polymer layer is a mechanical element, not part of the electrical current path.

This diagram is a simplified representation for illustrative purposes only. Actual component geometry, materials, and behavior may vary. The illustration is not intended to represent exact construction or electrical pathways.

3. Lid Removal Invalidates Interrupt Testing

A critical feature of the positive terminal design is that the brass terminal is fixed to the lid of the battery with high-temperature epoxy after the aluminum bolt is tightened. When the PA-765 layer reaches its softening temperature, the compression drops to near zero, but the brass terminal remains rigidly fixed, and the aluminum bolt is held in place. This is the intended operating condition: contact pressure collapses, the oxidation cascade proceeds, and resistance rapidly rises.

YouTube videos showing disassembled battery packs under fault conditions led to a different and incorrect conclusion. When the lid is removed from a damaged pack, the brass terminal is no longer affixed by the epoxy bond to the structure. With the terminal free to move, the torque from the attached cables drives continuous relative motion between the brass terminal and the aluminum bolt. This continuously presents fresh aluminum surface to the copper and brass contacts, precisely the condition that prevents the oxidation cascade from completing. The result is repeated arcing as current is briefly interrupted and re-established at each new contact point. This appears dramatic on video, but is an artifact of the disassembly, not a characteristic of the intact assembly.

This behavior is consistent with a known measurement artifact. The act of removing the lid to observe the mechanism destroyed the mechanical boundary condition the mechanism depends on. The videos do not show a failed or dangerous interrupt mechanism. They show a correctly designed mechanism operating incorrectly because a critical structural constraint was removed. It is unfortunate that this artifact led some observers to conclude the interrupt was inherently unsafe, when the opposite is true: in the intact assembly, the terminal operates reliably and without hazard.

4. Direct Observation of the Interrupt Condition

Direct observation of the interrupt event in a fault scenario is not easy, because any disruption to the pack enclosure for viewing creates a measurement artifact. Here, we present our approach to this issue.

First, we performed the test with three sealed new BB10012 batteries by purposefully undersizing the cables to create heat at the terminals. Running a continuous 100A current through undersized cable generated a peak temperature of 121°C at the terminal, high enough to trigger the interrupt mechanism.

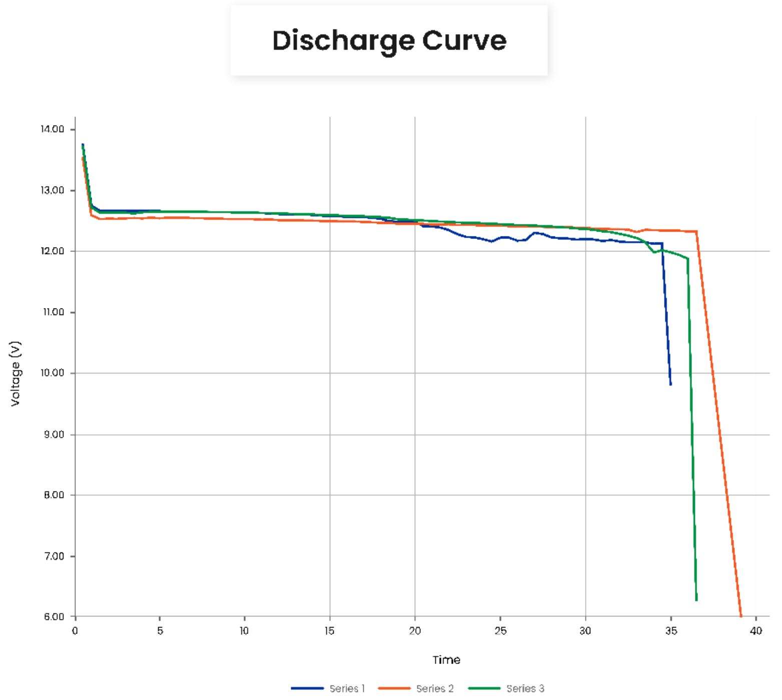

Figure 3: Discharge curves for three BB10012 batteries at 100A through undersized cables. Time is presented in 1 minute intervals, with interrupt occurring at approximately 35 minutes. Each point represents a 30-second average voltage.

As evidenced in Figure 3, the interrupt mechanism was triggered repeatably at around 35 minutes of continuous discharge. This response time reflects the thermal mass of the system and is designed to discriminate between transient overloads and sustained fault conditions. None of the three batteries was able to deliver meaningful power after the test, confirming that the interrupt mechanism is irreversible under the conditions tested. The photograph in Figure 4 shows the aftermath, including the result of ABS softening surrounding the terminal.

Figure 4: Photograph of opened BB10012 after triggered interrupt at positive terminal.

For comparison, when correctly sized 1/0 AWG cable was used at the maximum continuous rated current of 100A, the terminal temperature never exceeded 43°C and the battery cycled indefinitely without any softening of the terminal. This confirms that the interrupt mechanism is inert under correct installation conditions and responds only to a genuine thermal fault.

5. A Decade of Data

In addition to the insights gained from fundamental science, design, and testing, we are uniquely positioned due to the volume of real-world data available to us. Some of these data come from teardown and analysis of batteries that have gone through our warranty process over the last decade, allowing us to validate the efficacy and safety of the battery design, including the positive terminal, at scale.

We analyzed warranty return data collected since May 2022, corresponding to the introduction of our current ERP system (*enterprise resource planning system used to track and manage operational data*). By that point, hundreds of thousands of 100Ah batteries were already in the field, as the product first reached market in 2016. Between May 2022 and December 2025, Battle Born sold over 175,000 100Ah batteries. Just over 4,000 of these entered the warranty process. Some had no issues, others exhibited a range of conditions, such as batteries that had never been fully charged, had been improperly stored, or had been submerged in water. The vast majority, regardless of age, had intact positive terminals with normal resistance.

A fraction, just over 700 batteries, exhibited a positive terminal that could no longer deliver current: an interrupt event had been triggered. This represents approximately 0.4% of 100Ah batteries sold during that period, and approximately 0.2% of the total 100Ah installed base, which extends back to 2016. Consistent with years of testing and field observation, we observed no evidence of fire or cell damage among these 700 batteries. Every interrupt event resolved as designed. The battery stopped delivering power and nothing else happened.

The most telling statistic is the source of these events. During this period, ~63% of Battle Born's sales were to OEM customers, professional integrators installing batteries into manufactured systems. Yet ~99% of interrupt events came from DIY installations. The implication is clear: the interruption mechanism is rarely triggered in professionally installed systems and activates when user error creates a genuine thermal fault. This is precisely the fault class the terminal was designed to catch.

6. Conclusion

The positive terminal of the Battle Born 100Ah battery is a protection device that contains no electronics, no moving parts, and no consumable elements. It is a material system, a sealed aluminum bolt, a thermoplastic layer, and dissimilar metal contacts, in which the laws of chemistry and physics are aligned such that the one condition capable of threatening the battery is also the condition that triggers permanent, passive shutdown.

The science is not speculative. Every mechanism involved, polymer stress relaxation, asperity Joule heating, Arrhenius oxidation kinetics, and arc suppression at low voltage, is well established in scientific literature and in practice. What is novel is the deliberate combination of these mechanisms into a protection system that requires no intervention, no awareness, and no maintenance to operate correctly. The terminal protects the battery by design. No human intervention is required to activate the mechanism.

The evidence supporting this design is equally unambiguous. A decade of internal and third-party testing, including repeated certification under independent laboratory supervision, validates that the terminal performs as designed under the most severe conditions the standard specifies Field data further reinforces this. Among BB10012 batteries evaluated through our warranty process since early 2022, approximately 0.2% of units in the field have exhibited elevated resistance at the positive terminal, with occurrences concentrated almost entirely in non-professional installations where issues such as loose connections or undersized cables were present. There has not been a single instance of fire or cell damage associated with these events. In professionally installed systems, the occurrence rate is far lower.

The YouTube videos that prompted this technical note do not show a dangerous terminal. They show a correctly designed terminal operating under an incorrect boundary condition, one created by removing the lid that is an integral part of the protection mechanism. The intact assembly, as deployed in hundreds of thousands of batteries in the field, behaves exactly as the science predicts and the certification data confirms.

Battle Born did not invent new physics. We identified a set of well-understood physical phenomena, recognized that they could be combined into a reliable and passive protection mechanism at low voltage and high current, and built a terminal around them that has now been validated across a decade of real-world deployment. The design works. The battery is safe.

Appendix A.

Frequently Asked Questions

What is the concern raised in recent YouTube videos?

Recent online videos show disassembled batteries under extreme conditions and suggest that the positive terminal design used in 100Ah Battle Born batteries is unsafe. These demonstrations do not reflect how the battery is designed to operate as a complete, sealed system.

Is the Battle Born battery safe?

Yes. Battle Born batteries are designed with multiple layers of protection and have been validated through third-party certification, internal testing, and real-world use across hundreds of thousands of batteries over more than a decade. Across that time, there have been no known instances of fire or cell damage caused by this design in the field.

What is the positive terminal designed to do?

The positive terminal includes a passive, built-in protective feature. Under normal use, it conducts power efficiently. Under sustained fault conditions, such as excessive heat caused by improper installation, it is designed to permanently interrupt current flow. This is a last-resort safety mechanism intended to prevent a thermal event.

What do you mean by "fault conditions"?

Fault conditions are situations outside of normal use, typically caused by installation or system issues. Examples include externally loose connections, undersized cables, or sustained high-resistance connections that generate heat at the terminal. The battery is designed to operate normally under proper installation and use. The terminal protection only activates under sustained abnormal conditions.

What happens when this protection activates?

When triggered, the terminal transitions to a high-resistance state and interrupts current. This response is intentional and irreversible. It removes the energy source from the fault condition, preventing further escalation. In simple terms, the battery shuts itself off in a way that prioritizes safety.

Why does the design look "unconventional"?

The design uses a novel combination of materials and physical principles to create a passive protection mechanism rather than relying solely on electronics or traditional fuses. While this approach may look different from typical terminals, it is based on well-established science and was intentionally engineered for this function.

Why is plastic used in what looks like an electrical connection?

It isn't part of the electrical path. The material is an engineered component used to maintain contact pressure and to respond predictably to excessive heat under fault conditions. That behavior is intentional and enables the terminal's passive safety mechanism.

Why do third-party videos show arcing or different behavior?

In the videos, the battery lid is removed and the terminal is no longer constrained as it is in normal operation. This changes how the mechanism behaves. With the structural constraint removed, the terminal components can move in ways they cannot in a sealed battery. This creates a test condition that does not represent real-world use and prevents the protective mechanism from functioning as designed.

Has this design been independently tested?

Yes. Battle Born Batteries have been tested and certified by Nationally Recognized Testing Laboratories, including Intertek, to recognized safety standards such as UL 2054 and IEC 62133. These tests include severe fault scenarios and require that no fire occurs in order to obtain certification.

Why is Battle Born only responding to this now?

We take safety questions seriously, and that means responding accurately and completely rather than quickly. Preparing this response required verification of field and warranty data and new testing conducted under controlled conditions. We also made a deliberate decision to share details of our terminal design that we would not ordinarily disclose publicly. This is proprietary engineering, and we do not take that decision lightly. We made it because we believe transparency about how this product works is more important than protecting those details.

How often does this protection activate in the real world?

Based on field data, this type of terminal interrupt event is rare. It has been observed in a small fraction of batteries and is overwhelmingly associated with improper or DIY installations. In professionally installed systems, it is extremely uncommon.

What should customers take away from this?

When installed and used correctly, the battery operates reliably as intended. In the rare case of a sustained thermal fault condition, the terminal is designed to act as a final layer of safety protection by stopping current flow and preventing further risk.

Did the third-party videos uncover a safety issue?

No. The videos demonstrate behavior in a disassembled condition that does not reflect how the battery operates as a complete system. The terminal design functions as intended in real-world conditions and has been validated through testing and field use.

Appendix B.

Additional Safety Design Features

The body of this technical note addresses the positive terminal in detail. The terminal does not exist in isolation, however. It is one layer in a system where multiple independent design decisions each contribute to overall safety. Several of those decisions are worth noting here.

Lithium iron phosphate ($LiFePO_4$) chemistry

All Battle Born batteries use lithium iron phosphate, $LiFePO_4$. Compared to the nickel manganese cobalt and nickel cobalt aluminum oxide chemistries found in many electric vehicle and consumer electronic products, $LiFePO_4$ is significantly more resistant to thermal runaway, requires substantially higher temperatures to trigger it, and releases far less energy if it does occur. It is the most thermally stable lithium cell chemistry available for this application.

Battery management system

The BMS in Battle Born 100Ah batteries is not an off-the-shelf component. It is engineered specifically for our cell chemistry, pack architecture, and application requirements. It provides active protection against overcharge, over-discharge, overcurrent, short circuit, and temperature extremes. In normal use it is the first line of defense: the vast majority of fault scenarios are caught and interrupted by the BMS before any other protection mechanism is engaged. The positive terminal interrupt described in the body of this note is a passive, last-resort backstop for conditions in which the BMS has already acted or has been bypassed. The two systems are complementary and independent.

Flame-retardant enclosure

The outer case of all Battle Born 100Ah batteries is molded from PA-765 ABS injected with a flame-retardant additive. ABS was selected for several reinforcing reasons: it is a good electrical insulator, it has a high storage modulus below its glass transition temperature of 105°C, and it has very low creep under sustained mechanical stress. The flame-retardant formulation adds a further layer of passive protection: in the event of an internal fault that generates heat, the enclosure is designed to resist ignition rather than contribute to it.

Cylindrical cell architecture

Battle Born 100Ah batteries use cylindrical lithium iron phosphate cells rather than the prismatic cells found in many competing products. Cylindrical cells are individually more reliable: if a single cell degrades or fails, the pack continues to operate, whereas a prismatic cell failure typically takes the entire pack offline. Each cylindrical cell also incorporates its own burst cap, a pressure relief mechanism that vents safely in the rare event of an internal fault, preventing pressure buildup from propagating to adjacent cells. The physical assembly of cylindrical cells also provides passive thermal management by design, with natural air gaps between cells allowing heat to dissipate without active cooling systems conditions.

Layered protection by design

The $LiFePO_4$ chemistry, the purpose-built BMS, the flame-retardant enclosure, the burst caps on individual cylindrical cells, the passive thermal management from the cell assembly geometry, and the positive terminal mechanism described in the body of this note represent a layered approach to safety in which no single element carries the full burden. Each layer is independently effective. Together they reflect a decade of deliberate engineering decisions made with safety as the guiding principle.