



## PAS 63100:2024 and Tesla Powerwall Safety

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## INTRODUCTION

The British Standards Institution (BSI) recently published PAS 63100:2024, a specification which aims to help manage fire safety related hazards associated with battery Energy Storage System (ESS) installations in the UK\*. A PAS (Publicly Available Specification) is a fast-track document developed to address a perceived market need, and is produced much quicker than conventional standards. A PAS can be considered for further development into a British Standard, or its requirements considered during the development of European or International Standards.

Tesla has a strong commitment to safety, as demonstrated by over 600,000 Powerwalls operating safely and reliably around the world. Tesla has a relentless program of testing, monitoring, and continual improvement, including robust fire safety testing. Tesla has also consistently participated in the development of global regulations concerned with ESS fire safety, including the influential U.S. National Fire Protection Agency (NFPA) documents that are referenced in the PAS.

PAS 63100:2024 covers a wide range of topics. Tesla participated in the development of the document and considers most of the document to be helpful and positive. However, we have concerns on a few provisions in the published document, which while well intended, we consider to be of limited value or can be better addressed by other existing means.

This paper identifies compliance of Tesla Powerwall 3 with key provisions of PAS 63100:2024. This paper also highlights provisions which are of concern and suggests alternative means of addressing the topic.

\* PAS 63100:2024, Electrical installations – Protection against fire of battery energy storage systems for use in dwellings – Specification

## PAS 63100:2024 | SECTION 4 - ELECTRICAL INSTALLATION

Section 4 of the PAS includes reference to BS 7671 (Code of practice for ESS) and straightforward provisions to prevent unqualified persons from accessing live battery circuits, for the prevention of fire and burns from DC arcs.

Powerwall 3 is in full compliance with this section.

# PAS 63100:2024 | SECTION 5 – SYSTEM CONTROLS AND INTEGRATION

Section 5 addresses requirements for system controls, battery management systems, and responses to failure modes.

#### Section 5.1 – System Controls

The system controls for Powerwall 3 comply with BE EN IEC 62933-5-2 and includes a battery management and monitoring system (BMMS).

#### Section 5.2 – Failure Modes

This section requires the BMMS to undertake appropriate actions for detected failure modes, which Powerwall 3 does in compliance with all applicable product standards (including the product standards listed in the PAS). The PAS also requires that systems installed within a dwelling include visual and audible warnings in case of a battery fault or persistent dangerous condition; however, this is not required in any of these product standards.

#### Issue

- 1. Relying on a system that is in the middle of a failure event to trigger an alert may set false performance expectations if a system is in a persistent failure condition, it is not reasonable to expect a reliable alarm to originate from this (failing) system.
- 2. For such an alarm system to provide true customer value and protection, detailed performance and test criteria should be set in the appropriate product standard. Without a robust test and validation framework, very different performance can be expected across different manufacturers.

#### Recommendations

Energy Storage Systems are already designed/required to take corrective protective actions (e.g. shut down) when significant faults are detected; for example, UL 1973 validates the robust mitigation and control features that are part of the Battery Management System (BMS). Tesla recommends that the potential addition of alarms be added to the work program of the international product standard development teams. This work should define what conditions could trigger an alarm, and establish a test procedure with clear pass/fail criteria. In this way, a reliable, robust, and consistent means of providing the intent of PAS section 5.2 could be provided to customers.

If a dependable fire alarm system is required, this should be provided by an external and separate fire alarm system. In this way, the device relied upon to provide the alarm is not the device that is experiencing a failure.

## PAS 63100:2024 | SECTION 6 – STORAGE BATTERIES

This section includes a number of safety requirements and standards references for the batteries in an ESS.

#### Section 6.1 – Access and Basic Mechanical Protection

Powerwall 3 complies with the entirety of this section, which covers enclosure material and access as well as the maximum energy allowed within a single container (20 kWh).

#### Section 6.2 – General Safety Requirements

This section includes the following requirements:

- 1. Battery enclosures shall conform to BS EN IEC 62485-1, BS EN IEC 62933-5-2, and for lithium-ion batteries, BS EN IEC 62485-5. The Powerwall 3 enclosure complies with each of these.
- 2. Battery systems, including interconnections between separate enclosures, shall be installed in accordance with BS 7671. Powerwall 3 has been designed to facilitate a BS 7671 compliant installation.

#### Section 6.3 – Safety of Battery Assemblies for Protection Against Fire and Burns

This section sets out requirements for quantifying the arc-flash energy potential from the DC circuits in the battery enclosure, and links enclosure and installation requirements based on those declared energy values.

The battery circuits within the Powerwall are sealed within module enclosures, and are not accessible for installers or for field servicing. Nonetheless, Powerwall has redundant overcurrent protection in the battery circuit which has a significant impact on limiting arc-flash energy. Using the calculation methodology described in AS/NZS 5139 which the PAS recommends, Powerwall's battery DC arc flash incident energy is determined to be well under 1 cal/cm<sup>2</sup>. This energy level is below the threshold defined in the PAS both for additional enclosure requirements and for additional installation requirements or precautions.

#### Section 6.4 - Safety of Cells and Monobloc Batteries

This section requires lithium-ion battery-based systems to comply with BS EN IEC 62281 related to the safety cells and batteries during transport. The Li-Ion battery cells used in Powerwall 3 are certified to IEC 62281.

#### Section 6.5 – Protection Against Fire

This section covers installation requirements for indoor/outdoor installations, fire resistive materials, ventilation, setbacks and energy thresholds. Most of these requirements are consistent with the guidance provided in the Powerwall installation manuals.

The PAS states that "where practicable, storage batteries should be installed outdoors." Powerwall 3 is suitable for outdoor installation, providing an installer with a ready means to comply with this section.

For indoor installations, the PAS states that any location in which a battery is installed shall have fire resisting separation (from specific indoor locations, via walls, ceilings and floors) of at least REI 30 to BS EN 13501 series (30 min to BS 476 series for load bearing capacity, integrity and insulation). Due to the wide variation in building construction, it is not feasible to provide detailed guidance on specific locations, and installers will need to look at each location on a case-by-case basis. Many of the common locations selected for a Powerwall may meet the requirements stated in the PAS – for example NHBC specifies a minimum of REI 30 / 30min fire resistance for attached or integrated garages\*\*.

\*\* NHBC 2024, 10.1 Garages, 10.1.6: Resistance to fire spread

#### Section 6.5.3 – Ventilation

The PAS states that interior locations where ESS units are installed shall have fresh-air ventilation to outdoors. Ventilation systems should not compromise the fire resistance of the battery enclosure, and outdoor ports of the ventilation must be at least 1 m from doors, windows, ventilation ports, and escape routes. An informational note also points to BS EN IEC 62485 for further guidance.

#### Issue

This requirement is well intended but, broadly applied, ignores distinctions that are addressed in other installation and product standards. For example, the validation and testing section of IEC 62933-5-2 acknowledges that requirements should depend on chemistry-specific accumulation and cites off-gassing measurements in large-scale fire testing as a means to determining venting requirements. It cites an Annex describing UL 9540A large-scale fire testing as a means to do this. All Powerwall products have demonstrated through UL 9540A testing that under normal operating conditions (charging or discharging) there is no production of hydrogen or other flammable gasses.

#### Recommendation

While many of the common locations where Powerwall is typically installed may already comply with this requirement, Tesla considers the PAS approach to be unnecessarily broad-brush. The UL 9540 and 9540A certification requires that the Powerwall installation manual address any and all ventilation requirements based on the results of the testing under normal and failure conditions. Tesla's position is that the PAS should acknowledge the use of these rigorous type tests and their findings as an alternative to a blanket ventilation requirement.

#### Section 6.6 and 7.3 – Protection Against Impact

The PAS requires that storage batteries (Section 6.6) and power conversion equipment (Section 7.3) installed in locations subject to vehicle damage (garages, driveways and similar locations) shall have a minimum degree of protection against external mechanical impact. PCE equipment is required to have an impact protection rating of IK08 in accordance with IEC 62262 (equivalent to 5 Joules), and storage battery enclosures a rating of IK10 (20 Joules). Powerwall is tested for compliance with the IK08 rating, in accordance with the requirements in IEC 62933-5-2 and IEC 62477-1. Therefore, installers wishing to meet the requirements of the PAS should consider additional protection (barriers, enclosures, or equivalent) in these locations.

## **REVISION HISTORY**

Revision	Date	Description
1.0	2024-09-23	Initial publication