

TESLA

POWERWALL 2

ANSI/CAN/UL 9540A:2019 Fourth Edition
Test Report Supplemental Guide



INTRODUCTION

Tesla Powerwall 2 was tested by Right Testing Lab, LLC, an ISO 17025 accredited laboratory, and witnessed by CSA Group, also ISO 17025 accredited and Nationally Recognized Testing Laboratory (NRTL). Testing was conducted in March 2021 in accordance with ANSI/CAN/UL 9540A:2019 Fourth Edition, Dated November 12, 2019 - *Test Method for Evaluating Thermal Runaway Fire Propagation in Battery Energy Storage Systems*.

This supplemental guide is intended to aid Authorities Having Jurisdiction (AHJs) in the application of the test results to determine compliance with applicable codes. Specifically, where building and/or fire codes require large-scale fire test data to support deviations from the minimum requirements set forth in those codes.

The Tesla Powerwall 2 has met the unit level performance criteria outlined in ANSI/CAN/UL 9540A when installed as follows:

- The Powerwall must be installed in accordance with accompanying Powerwall 2 mounting bracket as detailed in the installation instructions. No additional non-combustible substrate is required.
- For stacked installations, the Powerwall 2 stack kit accessory must be installed to provide adequate clearances for preventing unit to unit propagation.
- Where applicable, a minimum clearance of 6" on the side(s) of the unit is required to prevent side-to-side propagation to adjacent units and walls.

*Page and Section numbers referenced from the test report are presented in bold type. For example, verification that the Tesla Powerwall 2 has met the performance criteria outlined in ANSI/CAN/UL 9540A can be found on **pages 4 through 6** of the report.*

For ease of use, this guide is arranged to follow the sequence used in the report issued by CSA Group titled *UL 9540A Checklist and Test Result*. The scope of the report includes the performance criteria outlined in Section 9 - Unit Level Testing of ANSI/CAN/UL 9540A:2019 Fourth Edition. The report also includes a summary of data acquired at the cell and module levels during prior testing.

All Section numbers in the report are references to ANSI/CAN/UL 9540A:2019 Fourth Edition, Dated November 12, 2019.

PRODUCT DETAILS

The device under test (DUT) in the attached report is the Tesla Powerwall 2, model 3012170-XX-Y, which is also the ESS included as part of the Powerwall+ all-in-one Solar PV and Storage solution (1850000-XX-Y). Full product specifications and certifications are available on request from all Tesla authorized installers.

General product details are outlined on **Page 2** of the CSA Group Checklist and Test Result document.

UNIT CONSTRUCTION

Figure 1 below illustrates the location of the battery module with in the unit as noted on **Page 3** of the report.

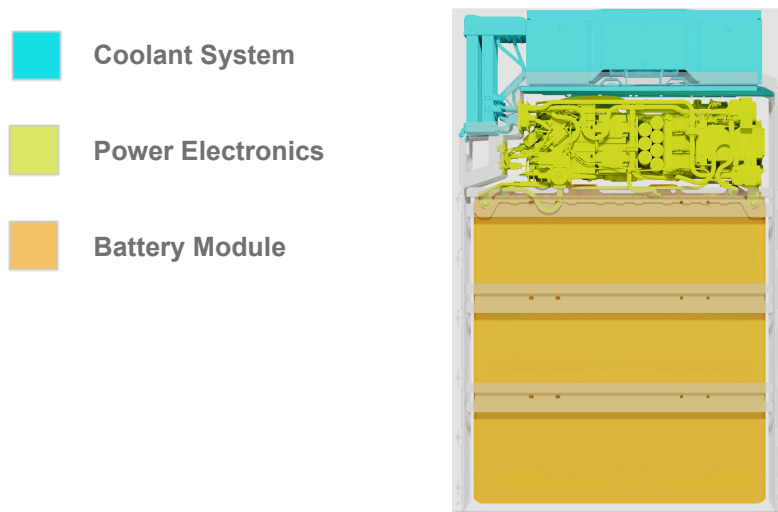


Fig. 1 - Powerwall 2 Internal Component Layout

SUMMARY OF RESULTS

A comprehensive summary of the test results for each installation layout and test configuration is provided beginning on **page 3**. This section provides important information needed to determine residential and fire code compliance where reduced minimum separation distances are permitted, and where the unit is intended to be installed on a combustible substrate.

Final verification that the Tesla Powerwall 2 has met the performance criteria outlined in ANSI/CAN/UL 9540A can be found beginning on **page 4 through 6** of the report. This portion of the report can be used as a checklist to aid in the verification of the unit's conformance to the performance criteria for each installation configuration.

In the unit level test it was demonstrated that:

- The Powerwall 2 mounting bracket provides adequate clearance from the wall surface on which it is mounted. Wall surface temperatures did not exceed 97°C (175°F) or temperature rise above ambient per **Section 9.2.15**. No additional substrate is needed.
- The Powerwall 2 stack kit provides adequate clearances to prevent unit-to-unit propagation when an internal fire condition is established in an initiating unit.
- The recommended clearance of 6" on the side of the Powerwall 2 unit, as specified in the installation manual, is also adequate to prevent side-to-side propagation to adjacent units.

CELL AND MODULE LEVEL TESTS

Pages **7 through 9** of the report provide background information and data collected during cell and module-level testing previously conducted. This data does not directly correlate to residential or fire code requirements, rather it is used to document and compare the characteristics of different cell chemistries and designs. One important value recorded is the temperature at which thermal runaway occurs. This temperature of 185.8°C is used to verify that an internal fire condition has been established during the Unit Level test.

PERFORMANCE CRITERIA - CELL LEVEL

Application of heat using film heater methodology did result in a thermal runaway condition, therefore module level testing was required,

PERFORMANCE CRITERIA - MODULE LEVEL

Application of heat using film heater methodology did result in a thermal runaway condition, and the resulting event was not contained by the module design, therefore unit level testing was required.

The Powerwall is intentionally designed without a module-level enclosure. This allows vent gases to be routed in such a way that adds to the overall propagation resistance of the module, and prevents a dangerous buildup of gases that may lead to an explosion or deflagration hazard.

UNIT LEVEL TEST - GENERAL

Section 9 Unit Level Testing information begins on **page 10** of the report. In addition to providing greater detail on the test setup and unit performance, this portion of the report can also be used as a checklist to aid in the verification of the testing laboratory's conformance to the test procedure.

SAMPLE AND TEST CONFIGURATION

ANSI/CAN/UL 9540A provides for several configurations:

- Residential and non-residential use cases
- Wall and floor mounting
- Indoor and Outdoor locations

The Tesla Powerwall 2 is intended to be installed in any of the configurations noted in **Section 9.1**, so testing is representative of each, and aligns with installation requirements established in the product installation manual.

The unit level test begins with the application of heat at a specific site selected to present the greatest amount of thermal exposure to adjacent cells within the module. This application of heat must result in an internal fire condition in accordance with the module level test previously conducted. This was verified by laboratory staff using temperature data recorded during initiation of the event, compared against the cell surface temperature at thermal runaway during the cell level test. This temperature was determined to be 185.8°C. (See **Section 5.1.1** and **Section 9.1**).

Beginning with the indoor floor-mounted unit test, **Section 9.2** on **page 11** the report goes into more detail on each test setup and installation configuration.

UNIT LEVEL TEST - INDOOR FLOOR MOUNTED

Section 9.2 begins on **page 11** by outlining conformance to the physical test layout and data captured during the test. An example test layout graphic has been reproduced from ANSI/CAN/UL 9540A on **page 13** for cross reference with the actual layout represented in the 3D graphic provided. A summary of the recorded dimensions is included below for clarity, along with the corresponding dimension callouts from the table on **page 14**.

The units in this test configuration were installed according to the installation instructions using the Tesla supplied support bracket and optional stack kit. The layout was chosen to represent a worst-case installation with the minimum recommended clearances specified in the installation instructions.

Pages 11 through 17 demonstrate that the test layout, wall constructions, placement of the cheesecloth indicator and instrumentation fully conformed to the test standard methodology.

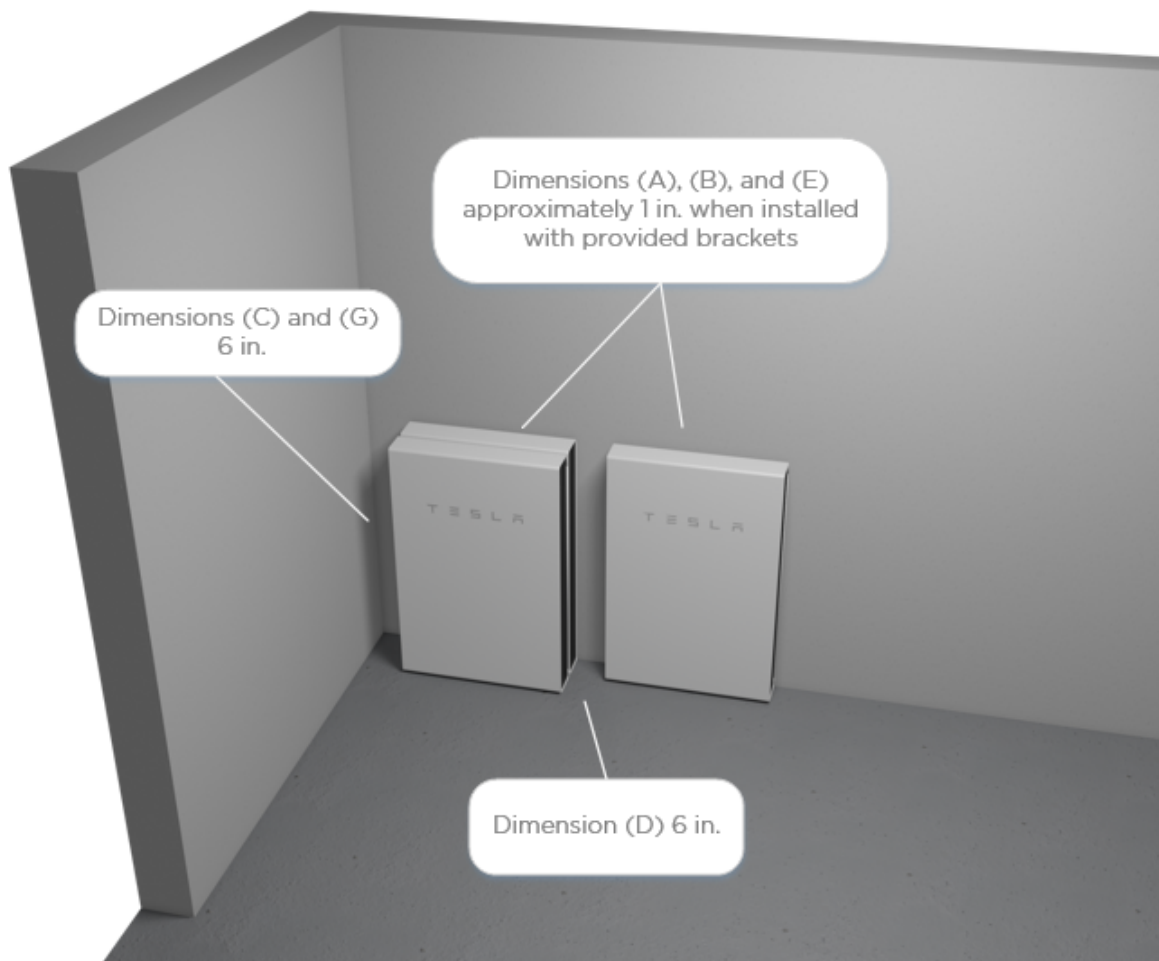


Figure 2 - Indoor Floor Mount Dimensions

UNIT LEVEL TEST - OUTDOOR GROUND MOUNTED

In accordance with **Section 9.1.2** the indoor floor mounted test is also considered representative of outdoor ground mounted installations, with the addition of a 1-ft wide horizontal soffit instrumented in accordance with **Section 9.3.3**. Tesla does not require an additional installation substrate, so this was omitted during testing.

Pages 17 and 18 demonstrate that the test layout, wall constructions, placement of the cheesecloth indicator and instrumentation fully conformed to the test standard methodology.

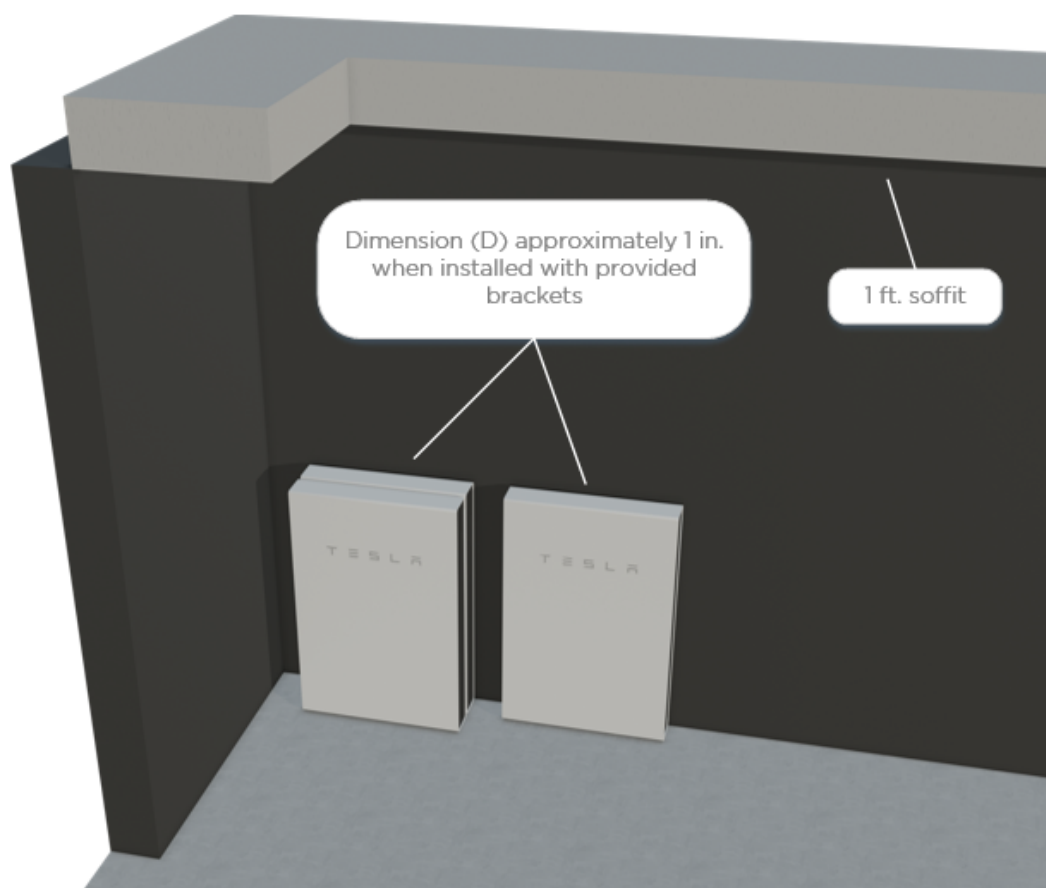


Figure 3 - Outdoor Ground Mount Dimensions

UNIT LEVEL TEST - INDOOR WALL MOUNTED

The indoor wall mounted test was performed in accordance with **Section 9.2** except as modified by **Section 9.4**, which specifies a standard NFPA 286 fire test room and additional instrumentation placements.

Pages 18 through 20 verify that the test layout, wall constructions, placement of the cheesecloth indicator and instrumentation fully conformed to the test standard methodology.

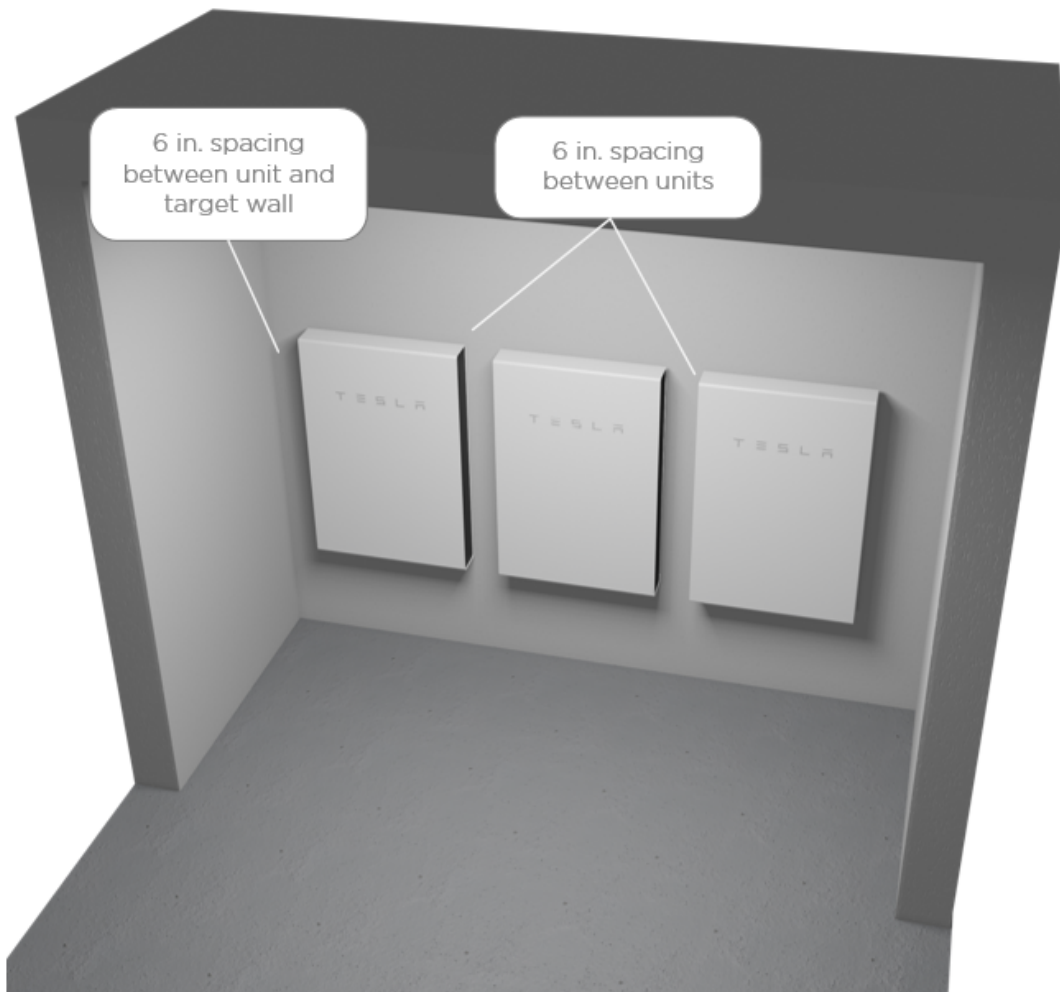


Figure 3 - Indoor Wall Mount Dimensions
(Door opening omitted for clarity)

UNIT LEVEL TEST - OUTDOOR WALL MOUNTED

The outdoor wall mounted test was performed in accordance with **Section 9.2** except as modified by **Section 9.5**, which again adds the 1-ft wide soffit and associated instrumentation.

Pages 20 through 22 verify that the test layout, wall constructions, placement of the cheesecloth indicator and instrumentation fully conformed to the test standard methodology.

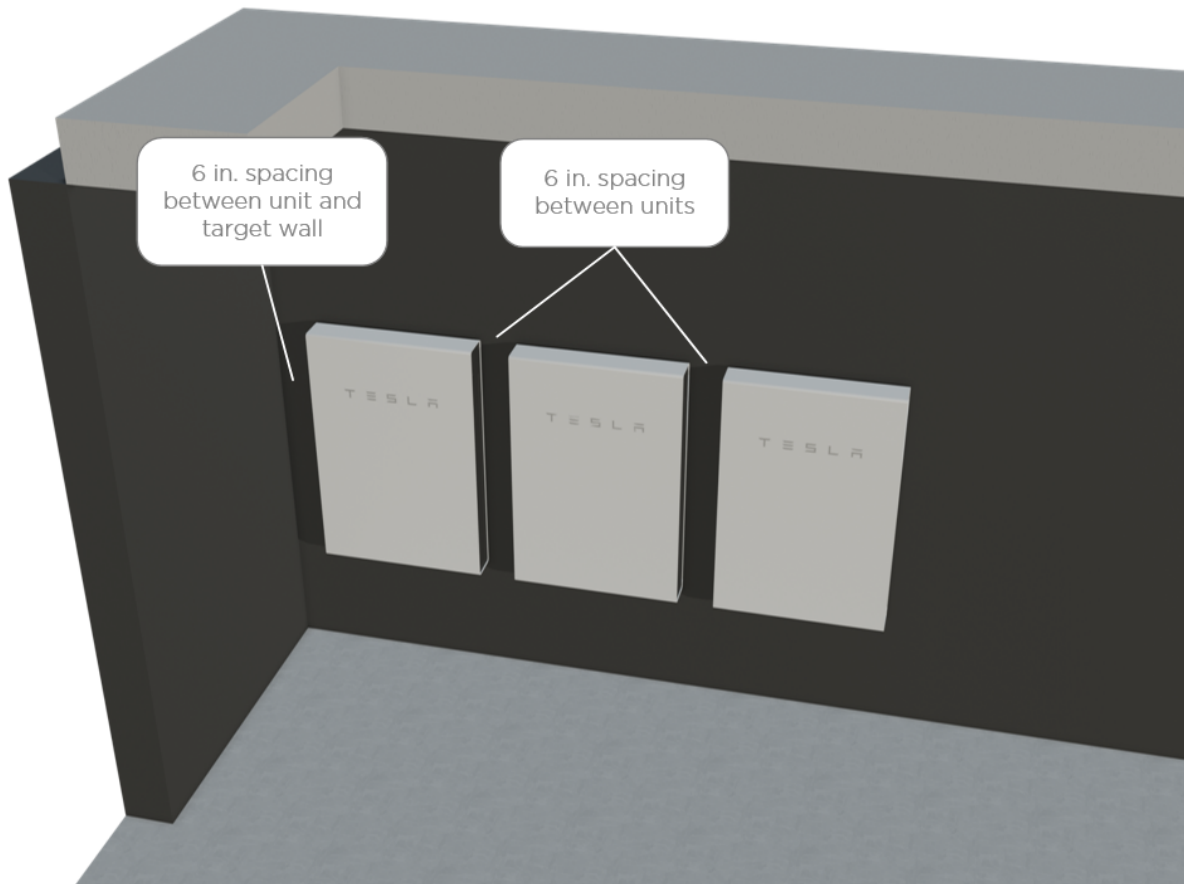


Figure 5 - Outdoor Wall Mount Dimensions

UNIT LEVEL TEST - REPORT DETAILS

Beginning on **page 22**, an overview table of each test is provided including a timestamped outline of observations noted. The data provided in the graphs in this section is intended to be used as a means of characterizing and comparing different ESS products in a standardized way.

Another use is for evaluating non-residential installations, or ESS that exceed the aggregate quantities established in codes. The design of room construction and/or fire suppression for those systems based on this data is beyond the scope of this guidance document.

We would like to answer any questions you have. Please feel free to email codecompliance@tesla.com.