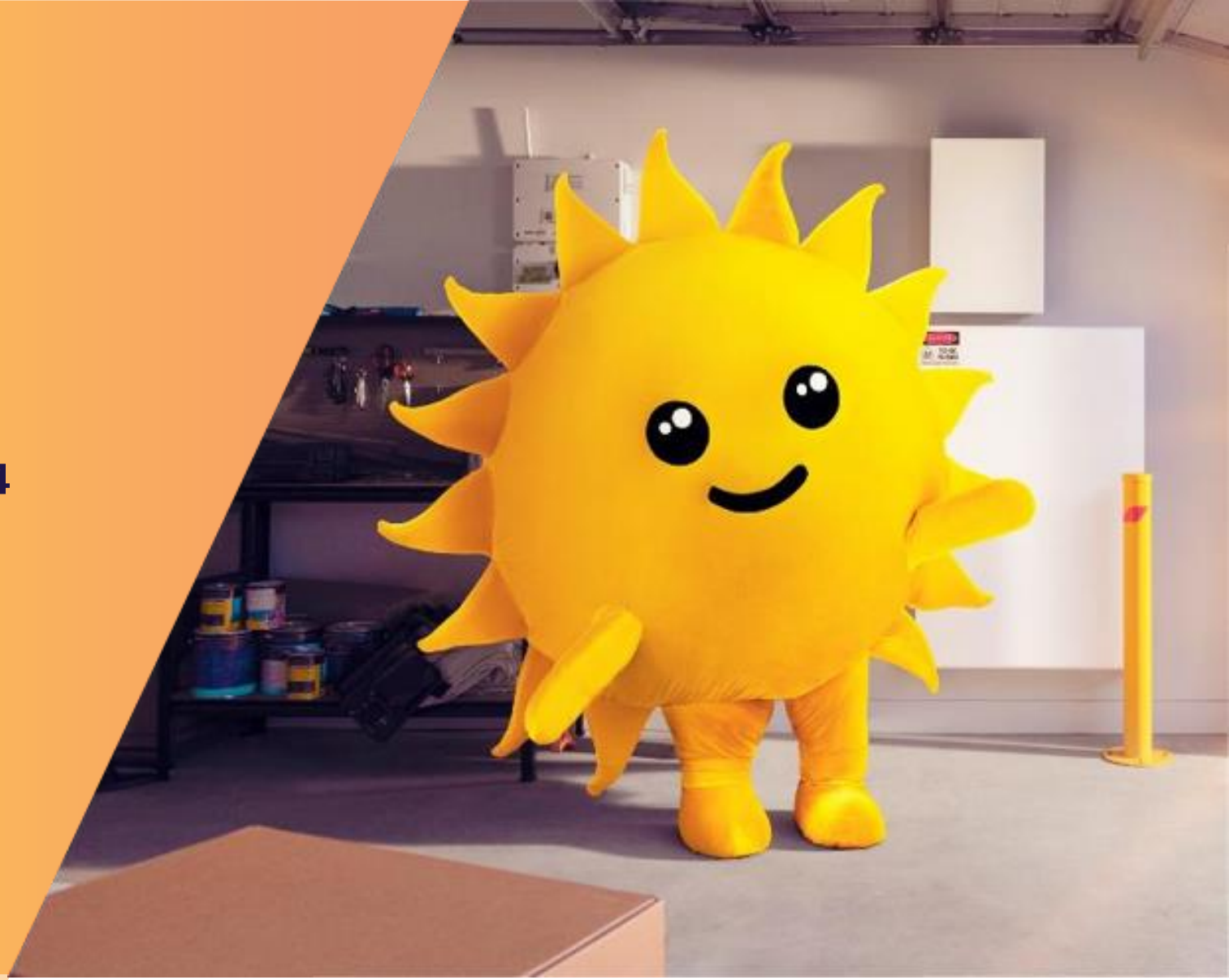
Battery Installations Common Defects



Industry Webinar 3rd December 2024

Host: Benjamin Wright

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Solar Victoria

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Solar Victoria

VICTORIA State Government

We acknowledge and respect Victorian Traditional Owners as the original custodians of Victoria's land and waters, their unique ability to care for Country and deep spiritual connection to it.

We honour Elders past and present whose knowledge and wisdom has ensured the continuation of culture and traditional practices.

DEECA is committed to genuinely partnering with Victorian Traditional Owners and Victoria's Aboriginal community to progress their aspirations.

Meet the speaker

Aaron Cook,
Solar Technical Manager

TechSafe Australia

Disclaimer

The information provided within has been put together to highlight specific aspects of several Australian installation standards that include but are not limited to AS/NZS 3000:2018, AS/NZS 5139:2019, AS/NZS 5033:2021, AS/NZS 4777.1:2016. While care has been taken to provide examples that highlight specific defects or compliance, it should not be assumed that additional defects are not present in the supplied examples. It is a requirement that all aspects of the relevant Australian installation standards are followed, and compliance of any installation remains the responsibility of the installer.

Content provided in this guidance document is also delivered with appropriate guidance and context during webinar session. It is important that content provided in this document is not read in isolation without considering this additional context as incorrect conclusions may be drawn.

This document is designed around providing best practice solutions for specific scenarios. Any advice given is general in nature and if possible, solutions to compliance issues are highlighted, it should not be assumed these are the only methods to achieving compliance.

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All Alternative Energy Supplies Requires A Main Switch

- Where multiple supplies are provided, each supply shall be controlled by a main switch….
- There shall be a main switch for the stand-alone port of multiple mode IES.
- In this example, a socket outlet has been wired to operate off the backup port of multi-mode inverter/battery system. Unfortunately, the backup circuit has not been provided with a main switch.

Standards referenced: AS/NZS 4777.1:2016 clauses 5.4.3 & 6.11 AS/NZS 3000 clause 2.3.3.2 & 7.3.3

RCD Protection of Multimode Inverter Backup Circuits

- Additional protection by RCDs with a maximum rated residual current of 30 mA shall be provided for final subcircuits with a rating not exceeding 32 A supplying socket outlets.

- In this example a socket outlet has been wired as a final subcircuit and operated off the backup port of multi-mode inverter/battery system. Unfortunately, no additional RCD protection has been installed for the socket outlet.

Standards referenced: AS/NZS 4777.1:2016 clause 5.4.4 AS/NZS 3000 clause 2.6.3.2.3.3 and 2.6.3.2.2

Alternative Supply Isolation Switches for Battery Systems

- *Where an electrical installation, or part thereof, is provided with an alternative supply in accordance with Clause 7.3, an isolating switch shall be provided at the source of supply or at a switchboard, in accordance with Clause 7.3.*

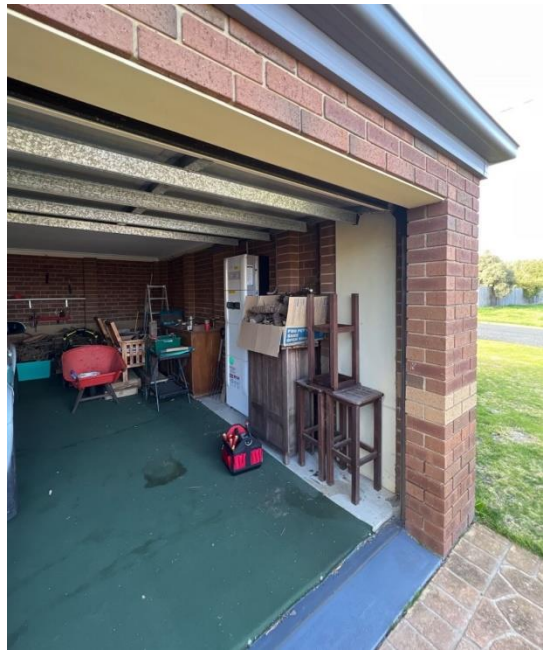
- In this example an alternative supply has been utilised from the backup port of the multimode inverter and no isolation device has been supplied to isolate that circuit from the battery system.

Standards referenced: AS/NZS 4777.1:2016 clause 3.4.3 AS/NZS 3000 clauses 2.3.4.3 & 7.3.4

Mechanical Protection of Battery Systems

Adequate mechanical protection for locations that a vehicle may access

When assessing a location to install a battery system it is important to take note of likely causes of mechanical damage that could occur to the battery system now and for the excepted lifetime of the system. Non-fixed/movable benches and cupboards may not provide suitable protection, as the homeowner could decide to move them in the future. Additionally, if the area in question could allow a vehicle to enter the space (regardless of customers non-fixed objects) then suitable fixed vehicle mechanical protection must be installed.



Standards referenced: AS/NZS 5139:2019 Clauses 4.2.2.1 & 5.2.2.1

Mechanical Protection of Battery Systems

Garage pillars/walls may not provide suitable mechanical protection on their own

Where the battery system is located in the front corner of a standard 6m long garage and is protected by a solid front pillar or wall, it is reasonable to expect vehicle impact could not occur, therefore a bollard may not be required in this location (Please see below Fig .1). If the battery system is set further back, then the area afforded protection by garage pillar then additional protection may be required.

Additionally, if the garage is longer than 6m and could allow a vehicle to proceed past the battery system, then additional mechanical protection may also be required on the trailing edge of battery system.

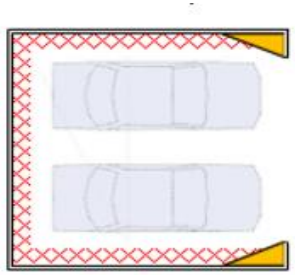
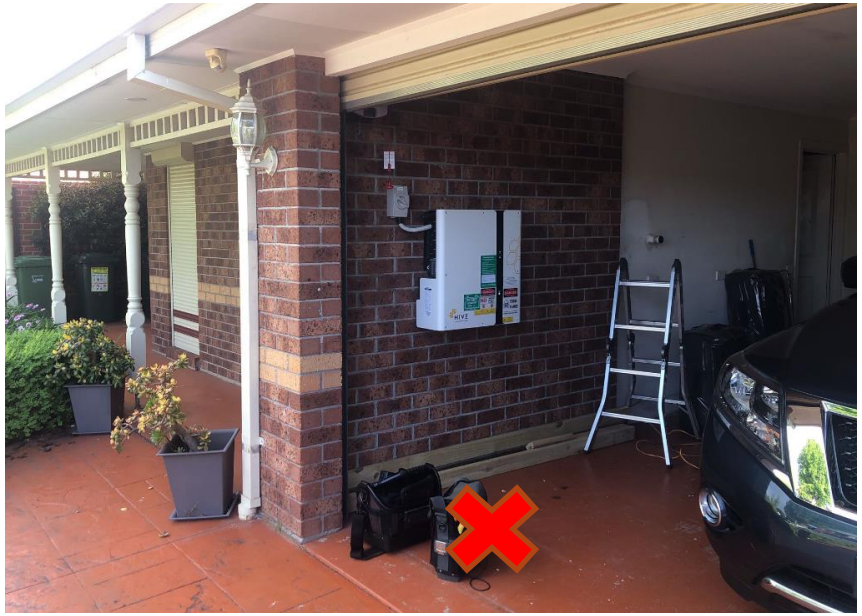


Fig. 1
Standard Double Garage 6m x 6m
Standard Single Garage 4m x 6m
Area requiring Additional Mechanical Protection (such as a Bollard)
- Area deemed protected by the garage pillar or wall, not requiring additional protection.
- As a guide the protected area is calculated at ratio 1 : 2.5 Ie: 500mm garage pillar, would allow an area of 1250mm protection along the wall.
- Each installation must be assessed for potential hazards and any reduction methods implemented.

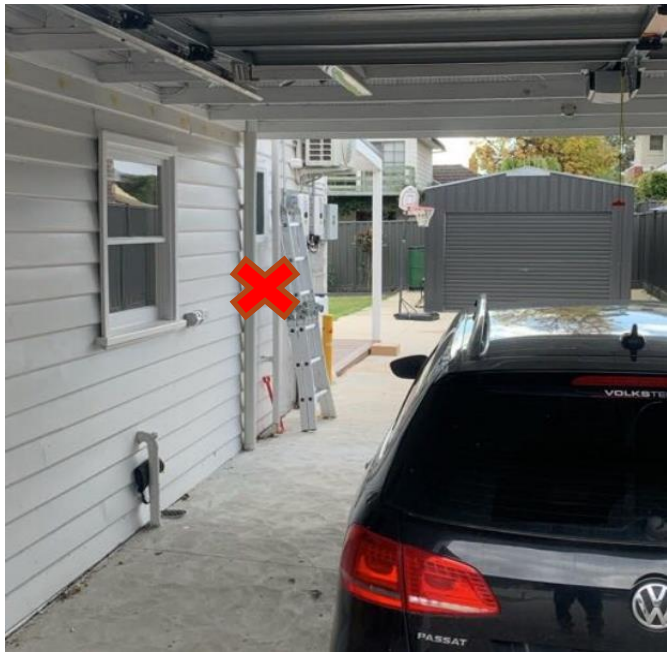


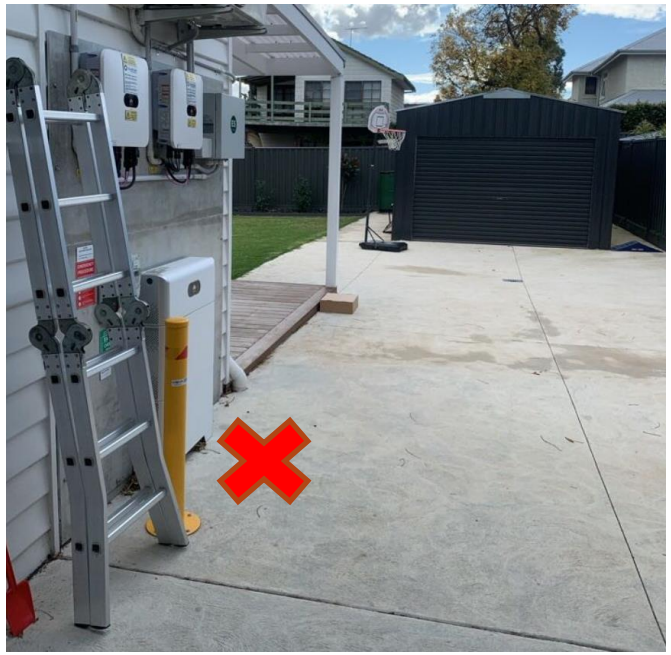
Standards referenced:
AS/NZS 5139:2019 Clauses 4.2.2.1 & 5.2.2.1

Mechanical Protection of Battery Systems

Additional protection may be required on trailing edges of battery systems

In this example the installed battery system was determined to have sufficient mechanical protection for vehicle strike from the leading edge. However, after further inspection it was determined that a vehicle could travel past the battery system and potentially strike the battery system from the trailing edge. As such an additional bollard would need to be installed near the trailing edge of the battery system in this example to ensure adequate mechanical protection from vehicle strike.





Standards referenced:
AS/NZS 5139:2019 Clauses 4.2.2.1 & 5.2.2.1

Mechanical Protection of Battery Systems

One vehicle bollard may not be adequate mechanical protection in all scenarios

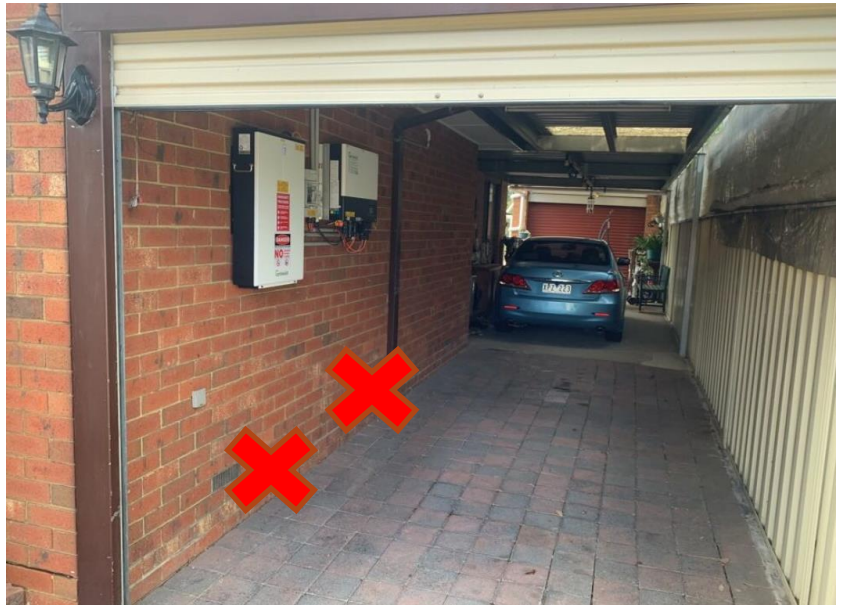
In this example a bollard has been installed in front of the battery system to protect against vehicle strike. The centre placed bollard is inadequate to protect against potential vehicle strikes on the left and right hand sides of the battery. Suggested compliant protection for this example may include the installation of 2 additional bollards (either side of the battery) or a U-shaped bollard system installed around the front of the battery system.

Standards referenced:
AS/NZS 5139:2019 Clauses 4.2.2.1 & 5.2.2.1

Mechanical Protection of Battery Systems

Height of battery system installation may not provide adequate mechanical protection on its own

In the below examples an attempt has been made to install the battery systems higher than the bonnet of the homeowners (current) vehicle to try and mitigate potential vehicle strike. This may not provide adequate protection against an SUV reversing in, or the potential for visitors with different car shapes (eg vans,utes). Additionally, there is always the possibility of the current homeowner or future homeowners using the area to store a trailer or boat in. As such additional bollard's may be required to be installed in all 3 of the below examples to mechanical protect against vehicle strikes.



Standards referenced:
AS/NZS 5139:2019 Clauses 4.2.2.1 & 5.2.2.1

Mechanical Protection of Battery Systems

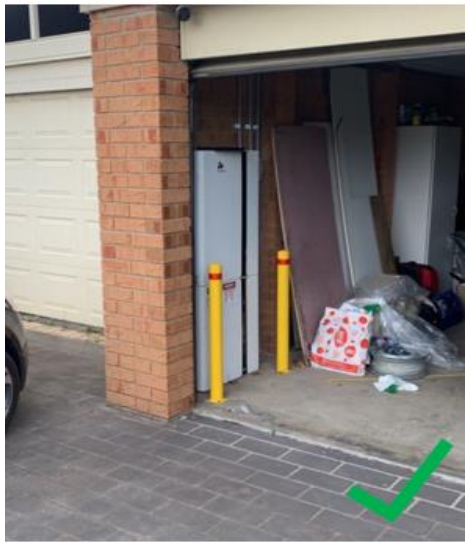
Some Good examples of battery system mechanical protection

- **Example 1:** Garage pillar wall provides mechanical protection on leading edge, and vehicle bollard provides mechanical protection on the trailing edge of the battery system.
- **Example 2:** There is no garage pillar protection, so the installer has provided mechanical protection on both the leading and trailing edges of battery system to mechanically protect against potential vehicle strikes.
- **Example 3:** Garage pillar is not wide enough to provide sufficient side impact mechanical protection, so additional vehicle bollards have been installed on the leading and trailing edges of the battery system to mechanically protect against potential vehicle strikes.
- **Example 4:** One bollard would not be sufficient to mechanically protect this battery system from the left and right sides. Installer has installed 2 vehicle bollards (one on the left and one on the right) and spaced close enough together so that a car cannot fit between.

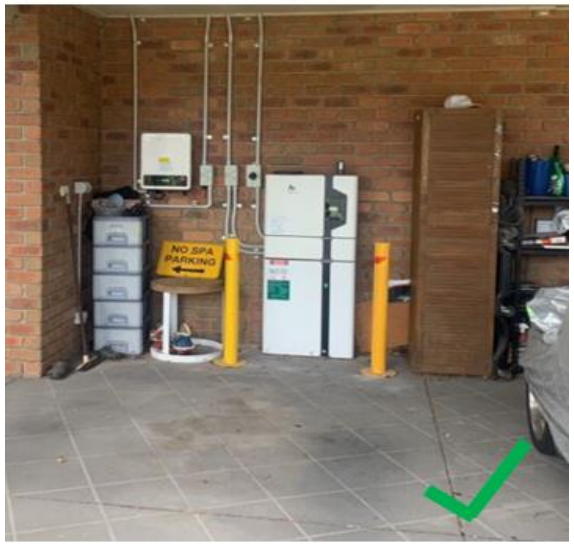
Example 1

Example 2

Example 3



Example 4



Standards referenced:
AS/NZS 5139:2019 Clauses 4.2.2.1 & 5.2.2.1

Battery Protection Against the Effects of Water Ingress

Electrical equipment with IP ratings less than IP33 must be sufficiently protected against water ingress

In the below example a battery system has been installed with an ingress protection rating of IP30. This means there is zero water ingress protection provided by the battery enclosure. The installer has made an attempt at protecting the battery system by installing a small veranda/overhang above the battery. As the electrical equipment has no water ingress protection rating, in this example the entire piece of equipment would need to located within 30 degrees of an adequately waterproof veranda or overhang. (as per AS/NZS 3000:2018 clause 4.1.3)

Standards referenced:
AS/NZS 5139:2019 Clauses 4.2.2.1, 4.2.3.2, 5.2.2.1 & 5.2.3.2
AS/NZS 3000:2018 Clauses 4.1.2 & 4.1.3

Protection Against the Effects of Moisture and Direct Sunlight

Please ensure you follow all manufacturers additional installation requirements

Most manufacturers will stipulate additional installation requirements above the minimum outlaid in Australian installation standards. Please ensure you read these before beginning any works and apply as required under AS/NZS 3000:2018 clause 4.1.2 (e). Please see below for an example of a manufacturers additional requirements potential not being met.

3.2 Installation location

Make sure that the installation location meets the following conditions:

- The building is designed to withstand earthquakes.
- The location is far away from the sea, to avoid salt water and humidity.
- The floor is flat and level.
- There are no flammable or explosive materials nearby.
- The optimal ambient temperature is between 15 and 30°C.
- The temperature and humidity stays at a constant level.
- There is minimal dust and dirt in the area.
- There are no corrosive gases present, including ammonia and acid vapor.

NOTICE

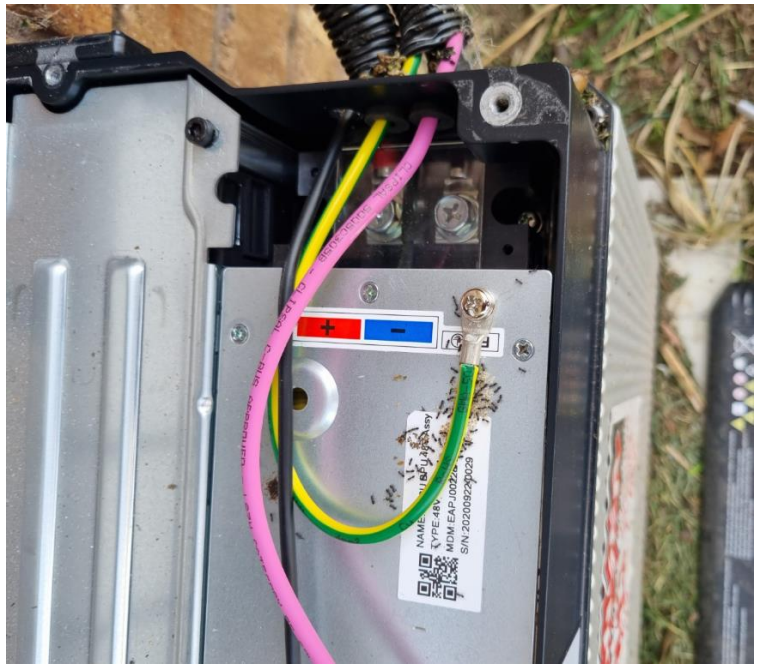
The RESU battery pack is rated at IP55 and thus can be installed outdoors as well as indoors. However, if installed outdoors, do not allow the battery pack to be exposed to direct sunlight and moisture.

Standards referenced:
AS/NZS 5139:2019 Clauses 4.2.2.1, 4.2.3.2, 5.2.2.1 & 5.2.3.2
AS/NZS 3000:2018 Clauses 4.1.2 & 4.1.3

Protection Against the Effects of Vermin

Battery and cable entries must be appropriately sealed to stop the entry of potential vermin

Most manufactures will supply additional bungs or sealing kits for unused cable entry points into their battery systems. It is important these unused cable entry points are correctly installed to prevent the entry of vermin and also to maintain manufacturers Ingress Protection ratings.



Standards referenced:
AS/NZS 5139:2019 Clauses 4.2.2.1, 5.2.2.1, 4.2.3.2 & 5.2.3.2
AS/NZS 3000:2018 Clauses 3.3.2.10 , 4.1.2, & 4.1.3

Battery system Protection Against Spread of Fire and Restricted Locations

What is considered a habitable room?

- AS/NZS 5139:2019 defines a habitable room as a room associated with a domestic or residential electrical installation used for normal living activities

- Some example of habitable rooms include:
  - Bedroom, living room, lounge room, music room, television room, kitchen, dining room, study, theatre room, playroom, sunroom, spare bedroom, family room, billiards room, etc

- Some examples of non-habitable rooms include:
  - Bathroom, laundry, powder room, etc

- Additional to the above, it is important to check what the room is currently being used for and what it may be used for in the future. For instance, a homeowner may be using a spare bedroom as extra storage space but if it could be turned back into a bedroom in the future, then it should be classed as a habitable room.

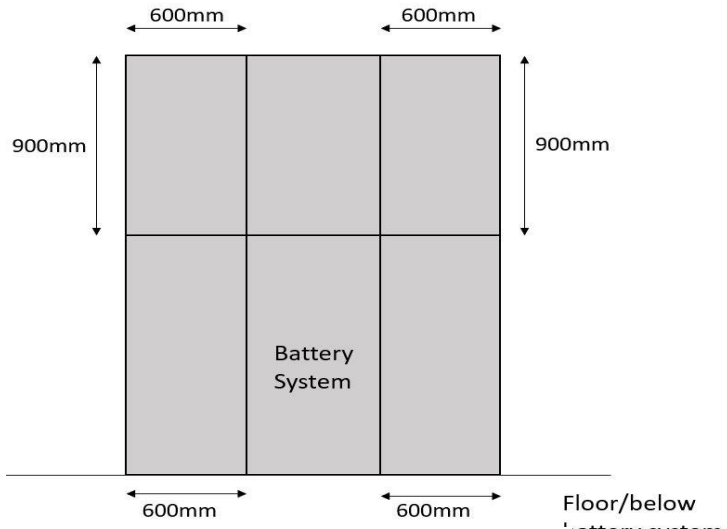
Standards referenced:
AS/NZS 5139:2019 Clauses 1.3.42

Battery System Protection Against Spread of Fire

Barrier to habitable rooms

AS/NZS 5139:2019 clause 4.2.4.2 & 5.2.4.2 states that if a battery system is mounted on or placed against or near a surface of a wall or structure that has a habitable room on the other side, the wall or structure shall be a suitably non-combustible barrier. If the mounting or nearby surface itself is not made of a suitably non-combustible material, a non-combustible barrier shall be placed between the battery system and the surface of the wall or structure. The dimensions for the required non-combustible barrier are listed below (figure 1). If the battery system is within 900mm of the ceiling surface, then the ceiling must also be protected with a non-combustible barrier that extends 600mm past the outer extremities of the battery system.

Additionally, the standard states any penetration through a non-combustible barrier to a habitable room within the defined zones, with an internal free space greater than 5mm diameter, shall be sealed with a fire-retardant material.



Standards referenced:
AS/NZS 5139:2019 Clauses 1.3.42, 4.2.4.2 & 5.2.4.2

Battery System Protection Against Spread of Fire

Barrier to habitable rooms

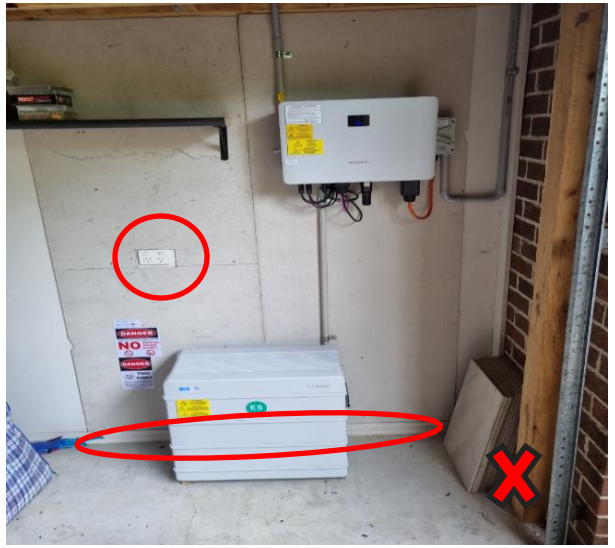
In the below example a battery has been installed backing onto a habitable room. While the wall separating the battery system from the habitable room is brick and classed as non-combustible, there are multiple gaps in the barrier that are not protected against the potential spread of fire. Above the battery system is a switchboard enclosure with wooden backing boards. The dc isolator located below the PCE is not classed as non-combustible and has a gap greater than 5mm in diameter behind and through the brick wall. There is also a hole larger then 5mm in diameter next to the isolator that has not been filled. Additionally, there is a combustible door/hatch separating the battery system from the combustible flooring underneath the habitable room.

Standards referenced:
AS/NZS 5139:2019 Clauses 4.2.4.2 & 5.2.4.2

Battery system protection against spread of fire:

Barrier to habitable rooms

- In the below example a battery has been installed backing onto a habitable room.
- An attempted has been made to provide a non-combustible barrier of compressed cement sheeting to protect against the potential spread of fire.
- In the supplied example the barrier does not extend the required 600mm to the left-hand side of the battery system.
- There is also a combustible skirting that is within the defined zone.
- Additionally, a gap with internal free space greater than 5mm has been created in the non-combustible barrier in order to install a socket outlet that is not sufficiently rated as non-combustible.



Standards referenced:
AS/NZS 5139:2019 Clauses 1.3.42, 4.2.4.2 & 5.2.4.2

Battery System Protection Against Spread of Fire

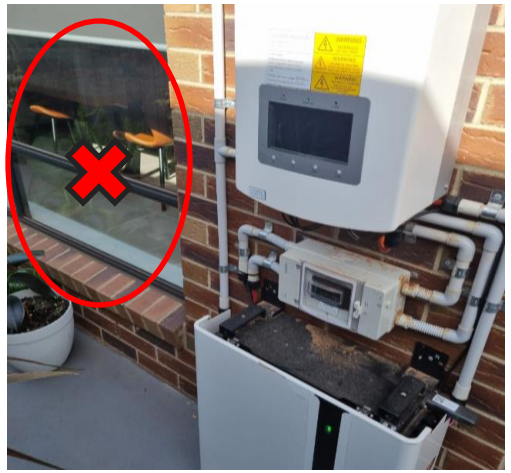
Barrier to habitable rooms : Non-Combustible material

AS/NZS 5139:2019 clause 4.2.4.2 & 5.2.4.2 states that in order to be classed as non-combustible a material must be tested to AS 1530.1. Exemptions to this requirement are the following materials

- Brick or masonry block;
- Concrete;
- Compressed cement sheeting; and
- Ceramic or terracotta tiles.

Any other material not listed above must have documentation to prove it has been tested and passed to AS 1530.1 before being suitably rated to be used as a non-combustible barrier.

Please Note: Glass windows and corrugated steel sheeting are not automatically classed as non-combustible and must be tested to AS 1530.1 before they can be used as a suitable non-combustible barrier.



Standards referenced:
AS/NZS 5139:2019 Clauses 4.2.4.2 & 5.2.4.2

Battery System Restricted Locations

AS/NZS 5139:2019 clauses 4.2.2.2 and 5.2.2.2 states the following areas are restricted locations for a battery system to be installed in:

- Any location specified under AS/NZS 3000:2018 clause 2.10.2.5
- Within 600mm horizontally and 900mm below any exit (doorways etc).
- Within 600mm horizontally and 900mm below the vertical side of a window or building ventilation that ventilates a habitable room.
- Within 600mm horizontally and 900mm below any hot water unit, air conditioner or any other appliance not associated with the battery system.
- In ceiling spaces
- In wall cavities
- On roofs, except where specifically deemed suitable (suitable roofs are deemed those with a permanent ladder or stairway for access)
- Under stairways
- Under access walkways
- In an evacuation route or escape route (must be a minimum 1m clearance around the battery system to allow safe egress)

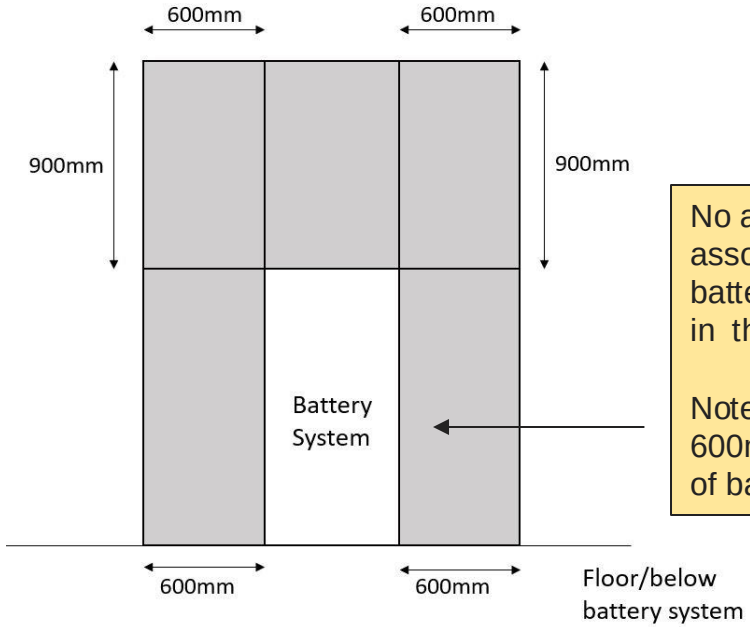
In addition to the above battery systems shall not be installed in habitable rooms of domestic and residential installations.

Standards referenced:
AS/NZS 5139:2019 Clauses 4.2.2.2 & 5.2.2.2
AS/NZS 3000:2018 Clauses 2.10.2.5

Battery System Restricted Locations

Appliances not associated with the battery system

In the below examples a battery system has been installed within 600mm of appliances not associated with the battery systems. As such the battery systems would be in a restricted location and uncompliant as per AS/NZS 5139:2019 clauses 4.2.2.2 (d) and 5.2.2.2 (d).



No appliances not associated with the battery system located in these zones

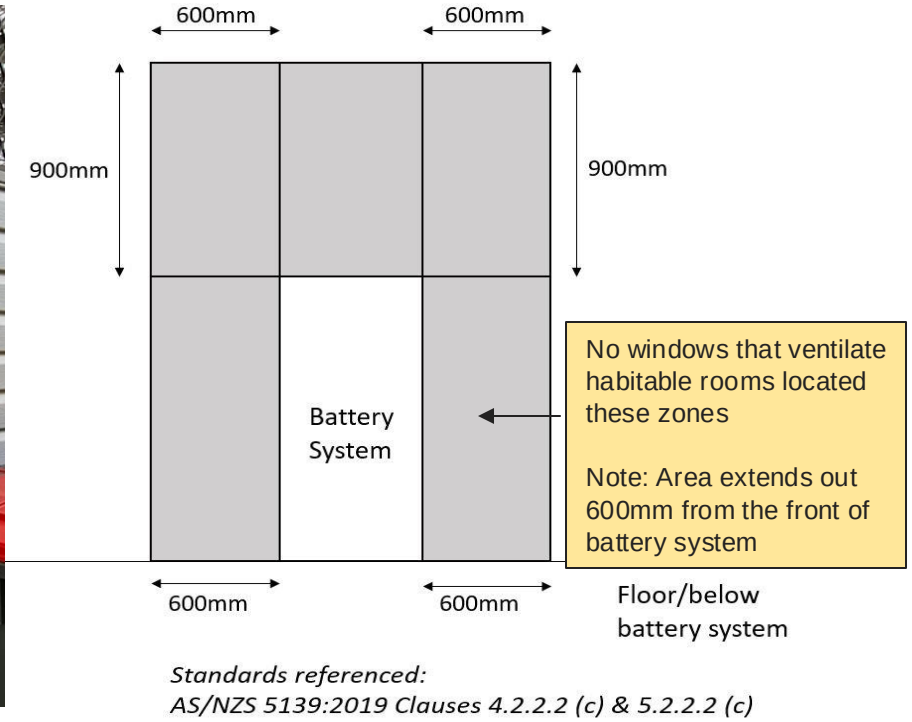
Note: Area extends out 600mm from the front of battery system

Standards referenced:
AS/NZS 5139:2019 Clauses 4.2.2.2 (d) & 5.2.2.2 (d)

Battery System Restricted Locations

Windows and ventilation for habitable rooms

In the below 2 examples a battery system has been installed in a restricted location. Battery systems must not be installed Within 600mm of the vertical side, and 900mm below a window or building ventilation system that ventilates a habitable room. As such the battery locations would be non-compliant with AS/NZS 5139:2019 Clause 4.2.2.2 (c) and 5.2.2.2 (c).

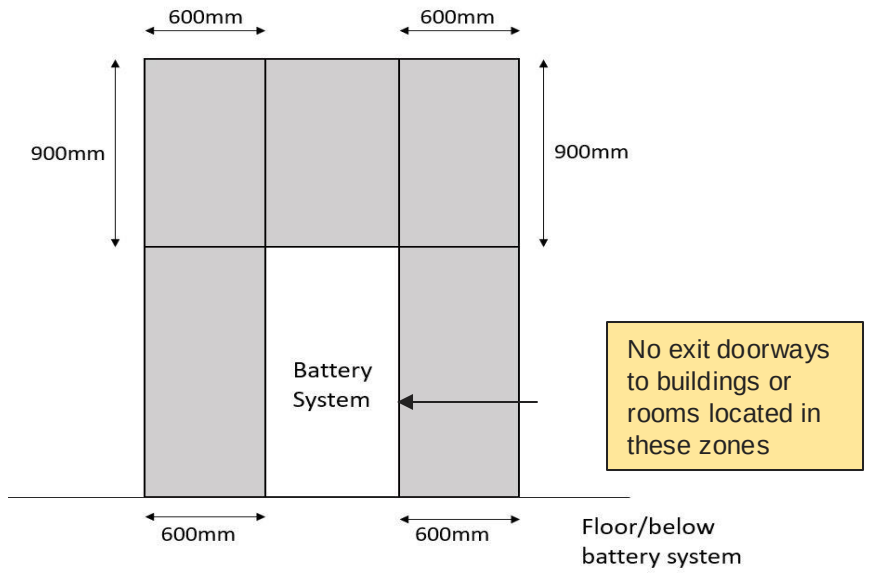


Standards referenced:
AS/NZS 5139:2019 Clauses 4.2.2.2 (c) & 5.2.2.2 (c)

Battery System Restricted Locations

Exit/Entry doorways to rooms and building

In the below 2 examples a battery system has been installed in a restricted location. Battery systems must not be installed within 600mm of an exit/entry doorway to a room or building. As such the installation locations would be uncompliant as per AS/NZS 5139:2019 Clause 4.2.2.2 (b) and 5.2.2.2 (b)



Standards referenced:
AS/NZS 5139:2019 Clauses 4.2.2.2 (b) & 5.2.2.2 (b)

Battery System Restricted Locations

Passageways, walkways, exits and escape routes

In the below example a battery system has been installed on a second story balcony with one entry/exit. In this specific scenario as there is only 1 entry/exit to the balcony the battery system cannot be placed in a location that would prohibit occupants from safely reaching the entry/exit if they were located past the battery system. The battery systems must not be installed in an evacuation or escape route without sufficient space to egress past the system (free space greater than 1m from the front of the battery system).

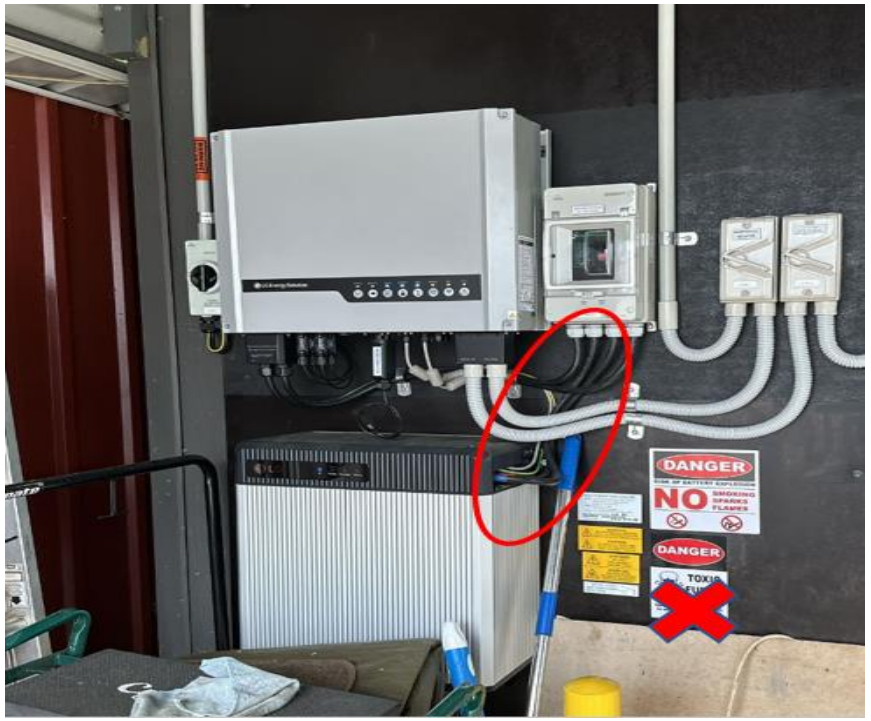
Single exit from balcony →

Less than 1m clearance

Standards referenced:
AS/NZS 5139:2019 Clauses 4.2.2.2 (k) & 5.2.2.2 (k)

Mechanical Protection of Cables between Battery System and Overcurrent Protection Device/s

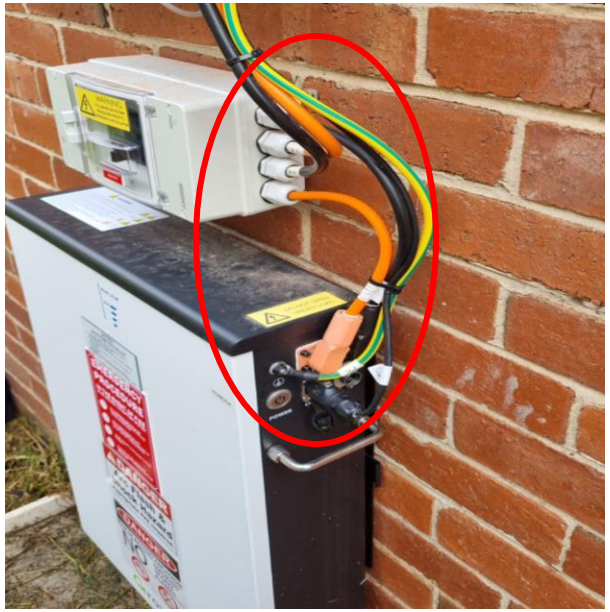
In the below examples, the battery manufacturer does not allow their internal overcurrent protection to protect outgoing conductors. As such the installer is required to install external overcurrent protection and enclose the cables between the battery system and the external overcurrent protection device in at least medium duty conduit.

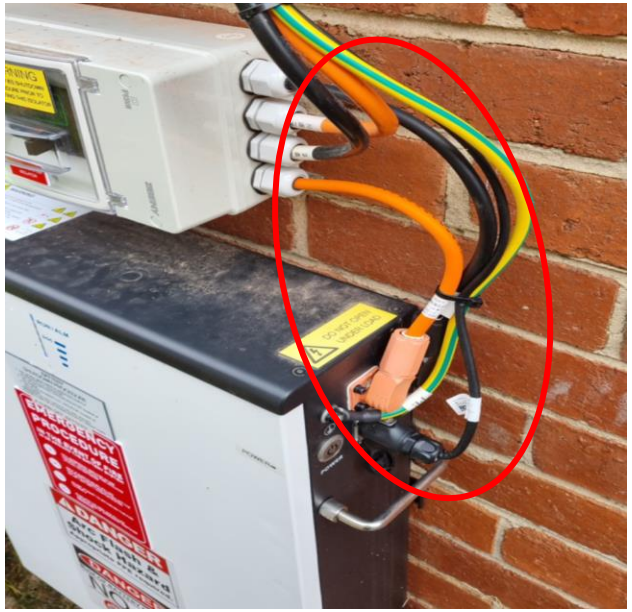


Standards referenced:
AS/NZS 5139:2019 Clauses 5.3.1.2.1, 5.3.1.2.4 & 5.3.1.4.3

Mechanical Protection of Cables between Battery System and Overcurrent Protection Device/s

In the below example, the battery manufacturer has stated there is internal overcurrent protection in the battery system, however the internal fuse protection is rated higher than the current carrying capacity of the outgoing cables. As such the installer is required to install additional overcurrent protection and enclose the cables between the battery system and the external overcurrent protection device in at least medium duty conduit. As can be seen external overcurrent protection has been installed however the cables between it and the battery system have not been enclosed in MD conduit as required.





Standards referenced:
AS/NZS 5139:2019 Clauses 5.3.1.2.1, 5.3.1.2.4 & 5.3.1.4.3

Mechanical Protection of Cables between Battery Systems and PCE for Pre-Assembled Battery Systems Above DVC-A

For pre-assembled battery systems above DVC-A (>60Vdc), the battery cables must be mechanically protected all the way from the battery system to the inverter/PCE, regardless of overcurrent protection as per AS/NZS 5139:2019 Clause 5.3.1.4.3.
In most situations this will be achieved by enclosing the cables in at least Medium duty conduit, however some circumstance may require additional protection as per appendix H of AS/NZS 3000:2018.

Standards referenced:
AS/NZS 5139:2019 Clauses 5.3.1.4.3

Overcurrent Protection of Battery System DC Cabling

The current-carrying capacity of the pre-assembled battery system cables to the PCE shall be greater than the rating of the overcurrent protection devices installed.

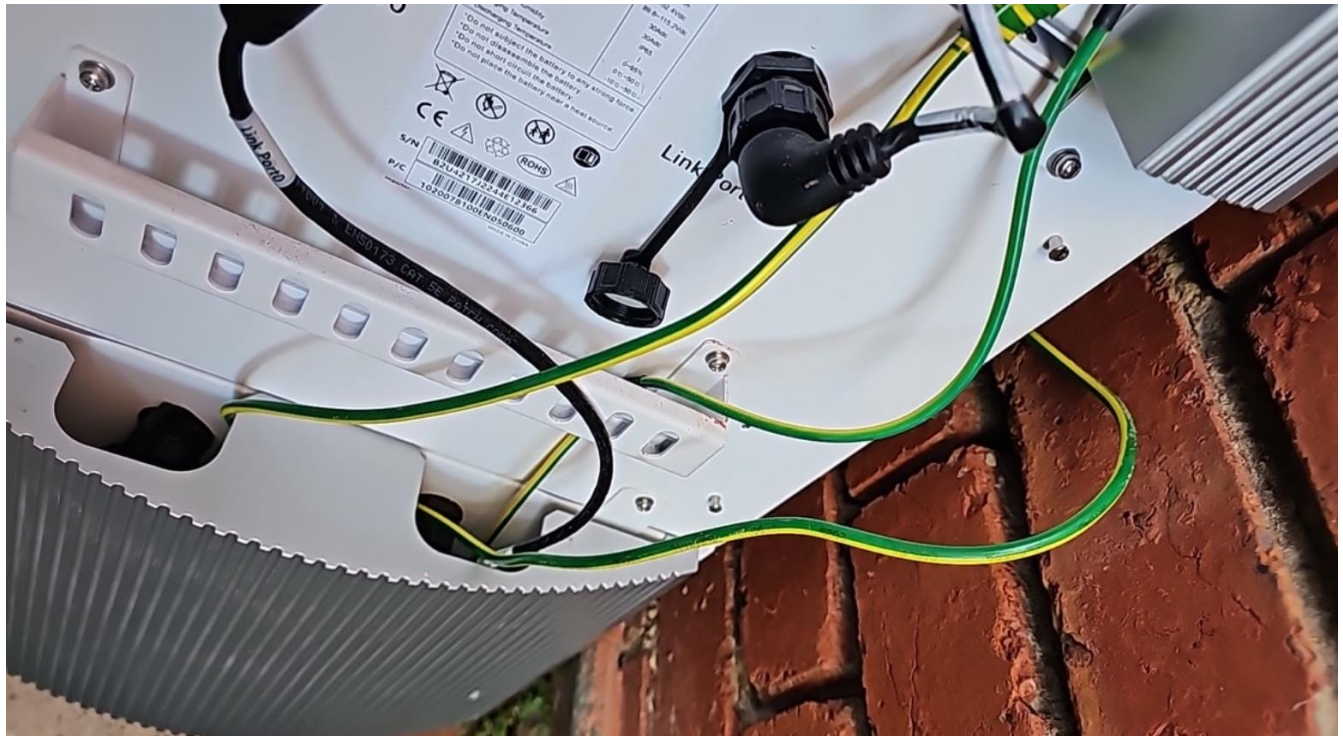
In this example the installer has installed 10AWG (6mm2) dc cabling between the battery system and PCE. The installer is relying on the battery systems integrated 63amp dc circuit breaker as overcurrent protection for the outgoing conductors. As the 63amp circuit breaker is rated higher than the current carrying capacity of the battery cable as per AS/NZS 3008.1 this is considered uncompliant.

Standards referenced:
AS/NZS 5139:2019 clause 5.3.1.4.5

Bonding of Non-Earthed Battery Systems Above DVC-A

For installations comprised of single battery system with voltages greater than DVC-A all metallic equipment enclosures associated with installation shall be bonded together and connected to the earthing system of the electrical installation. The minimum size of the bonding conductor shall be 6mm2

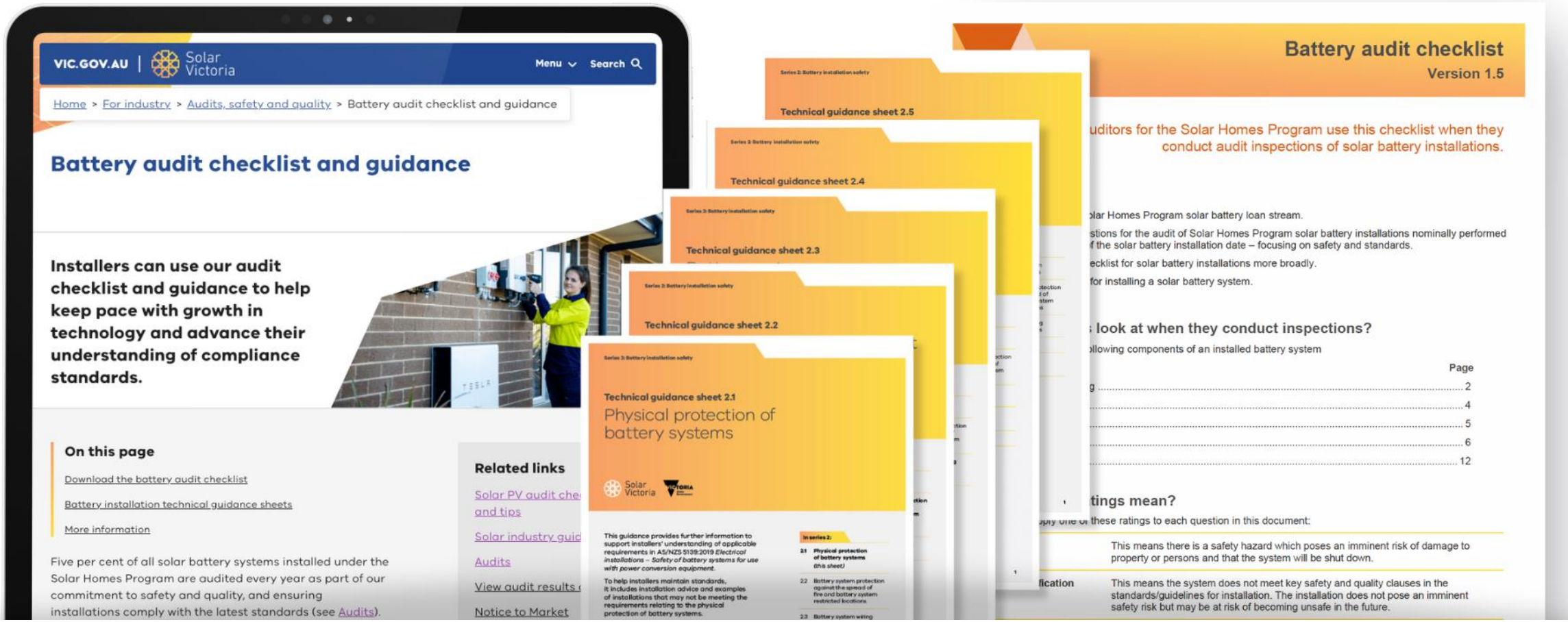
In this example the installer has bonded the battery enclosures with a 4mm2 conductor instead of the required 6mm2 conductor.



Standards referenced:
AS/NZS 5139:2019 clause 5.3.1.7.2

Battery Audit Checklist and Guidance

Installers can use the Solar Victoria battery audit checklist and guidance to advance their understanding of compliance standards.



Thank you & Q&A

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