

Energy Safe Victoria Guide

Identifying mismatched d.c. connectors in PV installations

14 November 2022

Background

Since July 2012 it has been a requirement within solar installations to only mate d.c. connectors from the same manufacturer.

AS/NZS 5033:2021 clause 4.3.9.1 Installation of plugs, sockets and connectors

Plugs, sockets and connectors shall-

(d) only be mated with those of the same manufacturer and designed to be mated together

The current solar audit findings indicate either:

1. A misunderstanding within our industry to identify a mismatched d.c. connector, or
2. A blatant lack of care to ensure compliance to the minimum safety standards.

Installing or certifying a solar system with mismatched d.c. connectors is a breach against section 44(1)(a) of the *Electricity Safety Act 1998* (the Act). Enforcement action may be taken by Energy Safe Victoria (ESV) where a breach of the Act has been identified.

The result of a mismatched d.c. connector failing has the potential to cause major damage with a safety risk to occupants due to fire or smoke inhalation.

ESV developed this guide to assist all parties involved in installation, inspection and auditing of solar installations, to ensure compliance and safety requirements are met.

Why is it so important, what's the risk?

In 2019 [Solar Victoria's](#) audit program identified an alarming 30 per cent of PV systems installed in Victoria to contain mismatched d.c. connectors.

In 2022 Solar Victoria audits indicate a significant reduction in these non-compliances, reporting around 8% of PV systems identified with mismatched d.c. connectors.

Whilst this is a significant improvement, ESV continues to receive notifications from [Fire Rescue Victoria](#) (FRV) and [Country Fire Authority](#) (CFA) relating to fires caused by mismatched d.c. connectors.

Investigations nationally show the cause of failure in many solar installations was the result of different brands of solar d.c. cable connectors mated together.

The connections had failed and the arcing of the d.c. cables started a fire within the PV systems. This problem was examined in ESV's [EnergySafe magazine Winter 2020 edition](#).

Identifying mismatched d.c. connectors

How can we ensure mismatched d.c. connectors are not mated together?

It can be difficult identifying the brands of connectors on the panel as they all look very similar. It is important to ask your supplier or check the panel spec sheet for the details of the connector.

Guidance for installers (licensed electrical workers)

Ensure the same type of connectors from the same manufacturer are used, and the manufacturer approved crimping tool is used for the connections.

Crimping

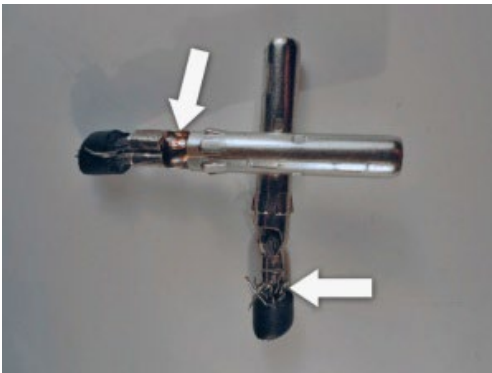
Some failures have been found to have been caused by a poor cable crimp, either by a set of pliers or a non-approved crimping tool.

The correct (manufacturer approved) crimping tool must be used, ensuring the connection is crimped to the required pressure (Nm) using the method (technique) as required by the manufacturer, to ensure the connection is rated for the designed current carrying capacity.

AS/NZS 5033:2021 now makes this requirement mandatory:

Clause 4.3.9.1 states: Plugs sockets and connectors shall-

(e) be terminated using a tool (where required) designed for the purpose and technique specified by the plugs, socket or connector manufacturer's instructions.



Poorly crimped connection



Result of a poor crimp under the array

D.c. connectors carry significant direct current energy, therefore it is very important crimping is done correctly.

A poor joint with a d.c. cable can lead to arcing, and as solar panels are energised by the sun it will continue arcing while the sun shines.

Don't risk it!

If the panel has different connectors than the ones you carry, ask your supplier for spare matching connectors.

Guidance for Licensed Electrical Inspectors (LEIs) / Auditors

Ideally you will find matching connectors from one PV panel to the next, which have been fitted and supplied by the PV panel manufacturer.

As an inspector you are looking for the d.c. connectors that have been crimped and fitted to the cables by the installer.

The d.c. connectors will be located at the start of the return d.c. cable from the end of the PV array, or from a top PV array to a lower PV array, between split PV arrays, and at the DC Isolator. See Figure 1 below.

Note: you must also check d.c. connectors at the inverter.

There is no need to remove PV modules as you should not dismantle the PV Array to conduct an inspection.

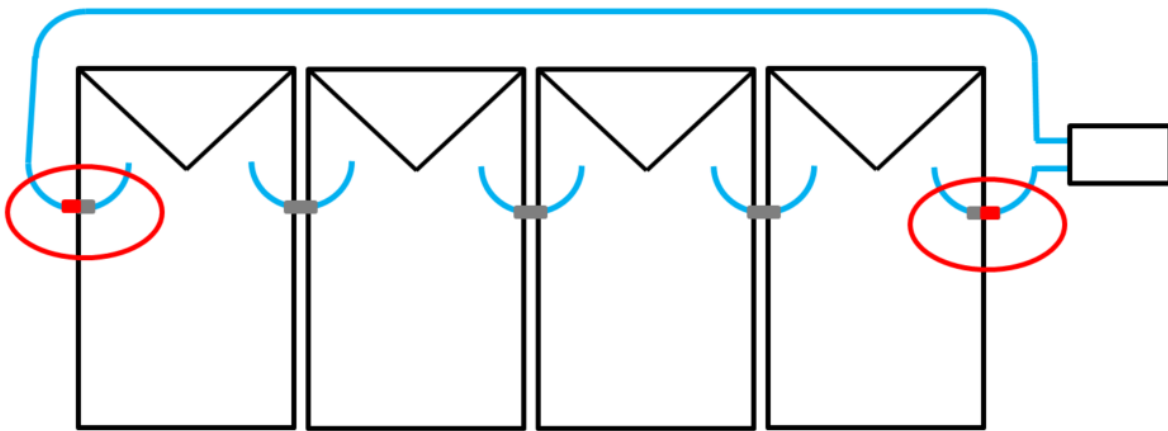


Figure 1

Identifying DC connectors

It is a clear requirement in the standard that only connectors of the same type from the same manufacturer can be mated together.

It is the responsibility of the licensed person to ensure all connectors comply with this requirement.

Tips to identify different d.c. connectors:

- 1. Look at the 'O' ring on the male POS connector.**
Some have different colours, some have two 'O' rings. If the 'O' ring on your panel doesn't match the connector you are fitting, then it is probably a mismatched connector.
- 2. Look at the screw nut on the cable gland at the end of the connector.**
The shape varies from brand to brand, this may be an indicator of a mismatched connector.
- 3. Look at the contour of the body mouldings.**
Manufacturers use the same design on both the POS and NEG connectors, this is easily recognisable as a mismatched connector.
- 4. If in doubt, verify the connector by looking at the small manufacturers logo or symbol on the connector body, if they match you can be sure they are from the same manufacturer.**

Examples of different d.c. connectors



Red 'O' ring



Black 'O' ring

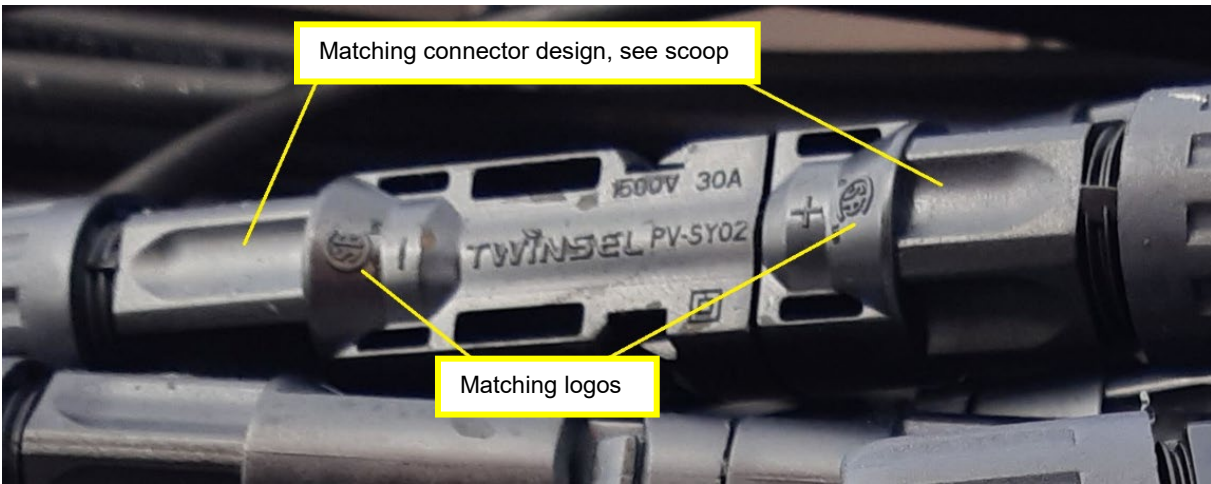


Logo 'TUV'

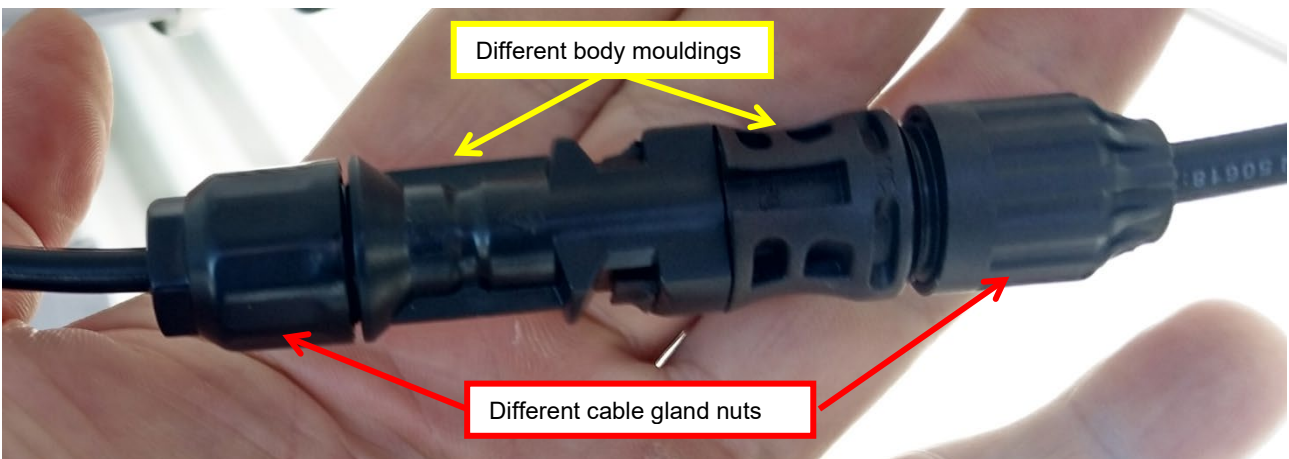


Logo MC4 brand

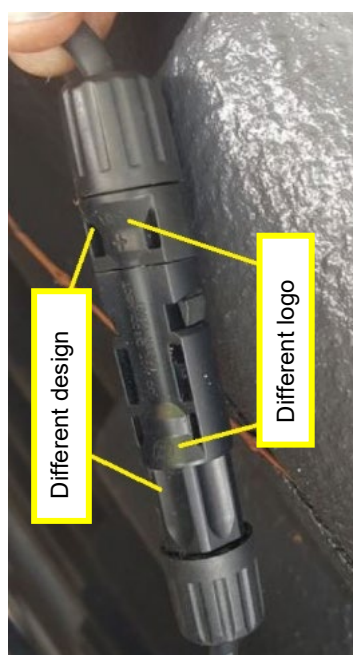
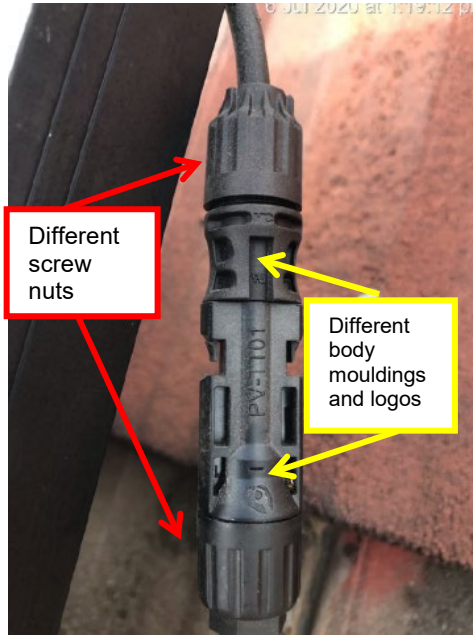
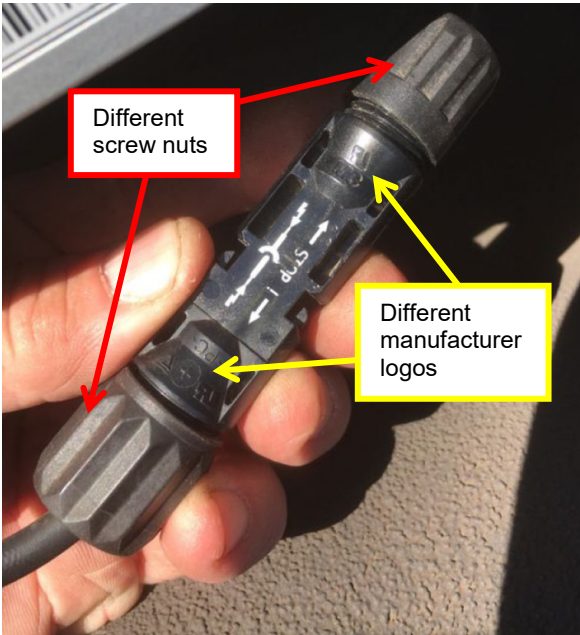
Example of a compliant, matching d.c. connector



Examples of mismatched d.c. connectors



Examples of mismatched d.c. connectors (cont.)



Expansion to previous requirement

The previous requirement specified that the plugs and sockets had to be the same type and from the same manufacturer.

This requirement allows different plugs and sockets from the same manufacturer to be connected together, provided the manufacturer has designed them to be mated together. An example of this is from connector manufacturer Staubli. Their d.c. connector brands MC4© and new version MC4-EVO2© have been designed and tested to be compatible for connection together.

Staubli instructions must be followed when mating these two connectors. The Staubli specifications state the MC4 has a maximum voltage of 1000 V DC whilst the MC4-EVO2 has a maximum voltage of 1500 V DC, the rated currents are the same. Therefore when used together the application must not exceed the lowest rated voltage of the connectors.



Who we are

ESV is Victoria's safety regulator for electricity, gas and pipelines.

Our role is to ensure that Victorian gas and electricity industries are safe and meet community expectations. We are also responsible for licensing and registering electricians, and educating the community about energy safety.

More information is available on the Energy Safe Victoria website: www.esv.vic.gov.au

Scott Beesley

ESV Compliance Officer, Renewable Energy

Electrical Installation Safety, Energy Safe Victoria

Scott.Beesley@energysafe.vic.gov.au