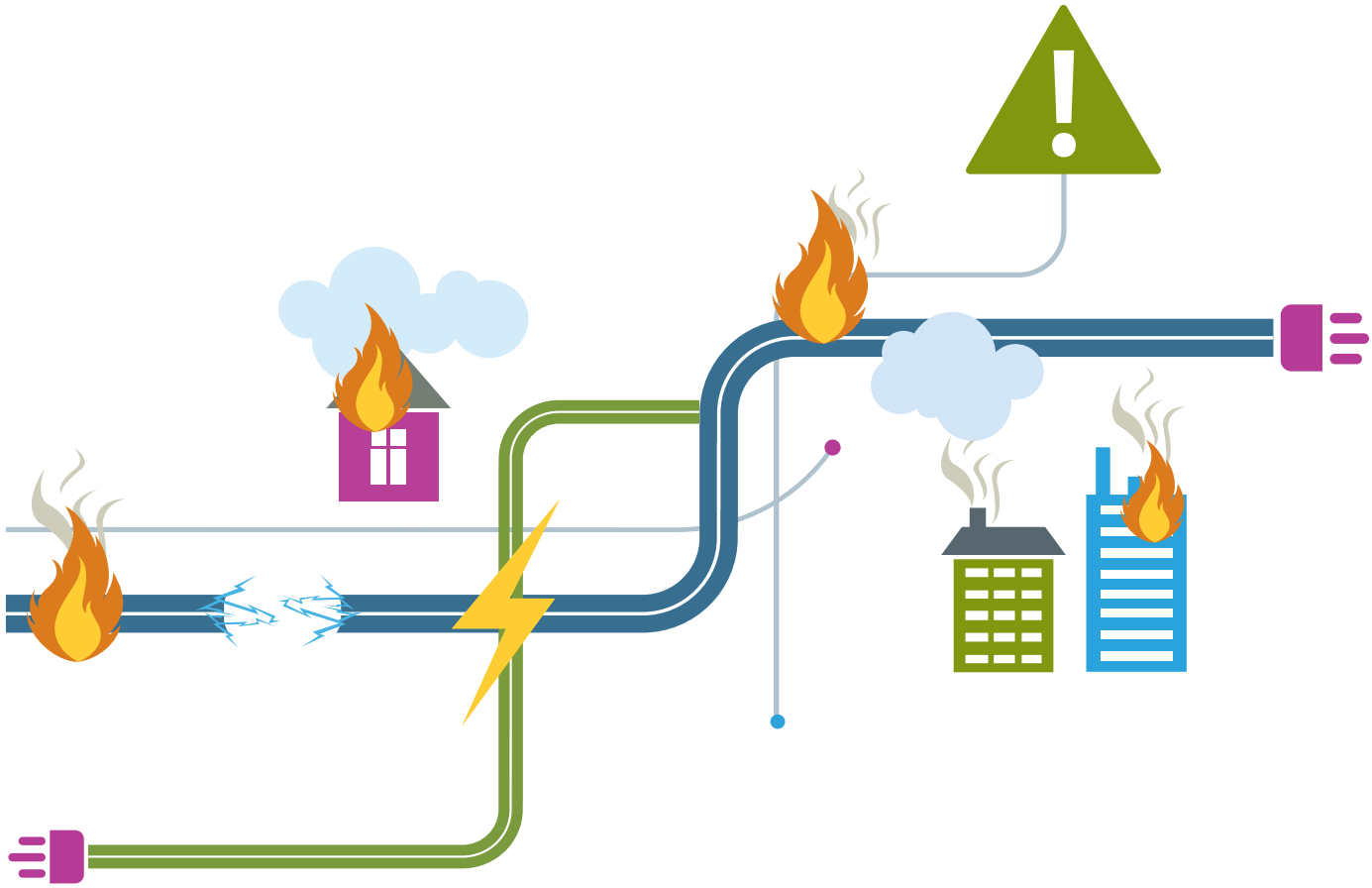
The trade association for energy infrastructure & systems

BEAMA TECHNICAL BULLETIN

DC PV CONNECTORS/COUPLERS



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ABOUT BEAMA

BEAMA is the UK manufacturing trade association for the electrotechnical sector, providing leadership, expertise and independent influence in the areas of product safety, performance, energy efficiency, digitalisation and sustainability. Our activities span a broad spectrum of technology groups, from energy networks through to electrical infrastructure and service technologies in the built environment.

The association has a strong history in the development and implementation of standards to promote safety and product performance for the benefit of manufacturers and their customers.

This publication highlights practical safety considerations for DC photovoltaic (PV) connectors/couplers, including common causes of overheating and fire, compatibility requirements, installation workmanship, relevant standards and safe disconnection practices.

This publication has been produced by BEAMA's Building Electrical Systems Sector and specifically by BEAMA's Accessories Technical Committee.

Details of other BEAMA Guides can be found on the BEAMA website www.beama.org.uk

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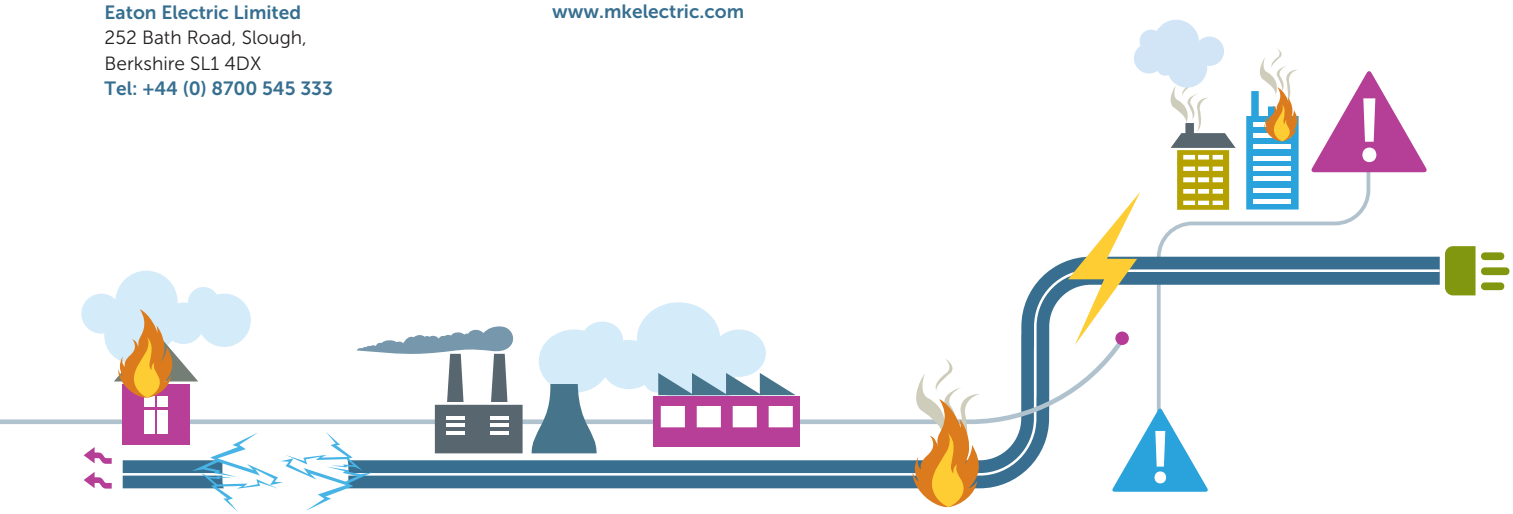

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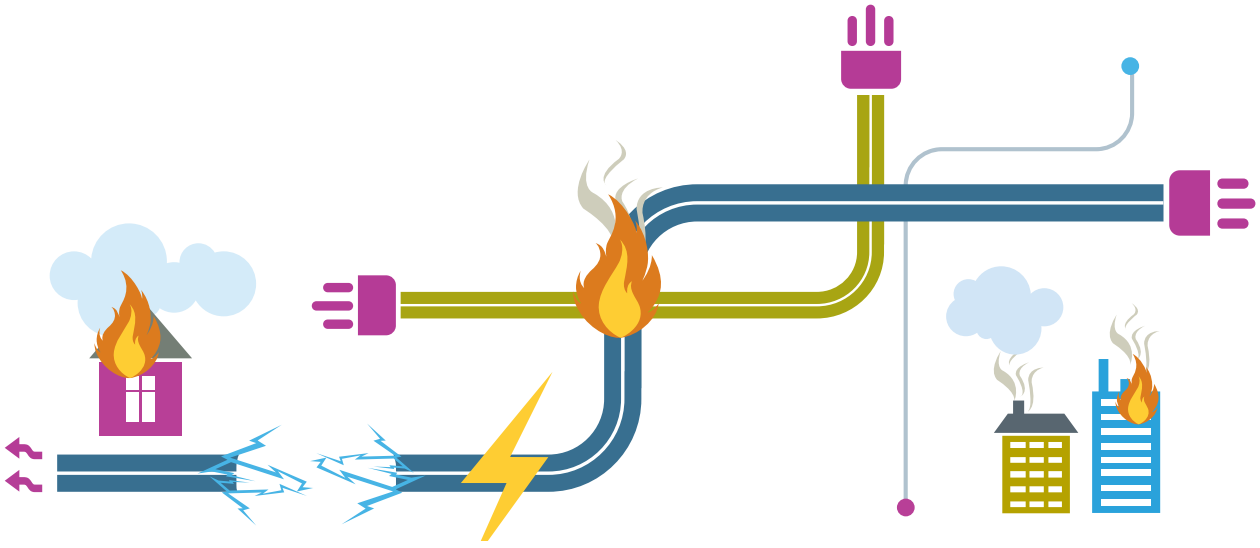

1. INTRODUCTION

This publication highlights practical safety considerations for DC photovoltaic (PV) connectors/couplers, including common causes of overheating and fire, compatibility requirements, installation workmanship, relevant standards and safe disconnection practices.

This publication is based on the following documents:

- BS EN 62852:2015+A1:2020 **Connectors** for DC-application in photovoltaic systems. Safety requirements and tests
- Draft for Public Comment (DPC) of BS EN IEC 62852 ED2 **PV coupler** for DC-application in photovoltaic systems - Safety requirements and tests*
- BS 7671:2018+A4:2026 IET Wiring Regulations, 18th Edition Amendment 4

The current edition of BS EN 62852 uses the term 'connector'. The DPC of BS EN IEC 62852 ED2 uses the term 'coupler' and 'connector'. The DPC of BS EN IEC 62852 ED2 uses the following definitions:

- **PV coupler –** a means enabling the connection and disconnection of two cables, or of a cable and a component, and consisting of a PV pin connector and a PV socket connector from the same manufacturer.
- **Connector –** a component which terminates conductors for the purpose of providing connection to and disconnection from a suitable mating component.

The coupler described in the DPC of BS EN IEC 62852 ED2 must be distinguished from the standardized plug and socket design for DC PV systems covered in IEC 63678 ED1 (Standardized plug and socket design for DC photovoltaic (PV) systems) which was under preparation at the time of producing this publication.

* The content of a Draft for Public Comment is subject to change.

2. COMMON CAUSES OF FIRES

Fires can be caused by loose or defective connections. This can include poorly secured terminals, inadequate torque, improper crimping, use of incorrect tools for crimping, and connecting connectors/couplers from different manufacturers.

Insulation damage and moisture penetrating cracks or poorly sealed connectors/couplers can lead to short-circuits which can lead to fires.

The cause of a fire is rarely due to cable failure, they are most frequent where the conductor is connected to the hardware, DC isolators, combiner boxes and connectors/couplers. This is all associated with installation mistakes and choice of incorrect equipment.

The DPC of BS EN IEC 62852 ED2 includes a new requirement in subclause 5.3.2 that provides clarification on compatibility between different makes of couplers.

"5.3.2 Non-intermateability of PV couplers.

Both parts of the PV couplers, pin connector and socket connector, according to this standard **shall be from the same product family of the same manufacturer.** The requirements in this standard do not cover requirements which are necessary for testing of combinations of connectors from different manufacturers. This is applicable also for connector manufacturer which might have an agreement to inform each other about modifications."

This subclause is not present in the current edition of BS EN 62852:2015+A1:2020.

The belief that "MC4" DC connectors/couplers are universally compatible is not correct. "MC4" DC connectors are plug-and-socket type connectors commonly used on the DC side of PV systems to connect PV modules, string cables, combiner boxes and inverters. The term "MC4" is widely used in the solar industry, but it is important to note that it originated as a specific manufacturer's product name and is not itself an international standard designation.

In standards terminology, these products may be described as PV connectors, PV couplers, pin connectors and socket connectors. They are designed to provide a secure mechanical and electrical connection between PV cables, while maintaining proper insulation and environmental protection for outdoor use. Typical features include a crimped metallic contact, an insulated connector body, locking tabs to prevent accidental disconnection, cable glands or sealing components to maintain ingress protection, and polarity identification for positive and negative conductors.

* The content of a Draft for Public Comment is subject to change.

Correct selection and installation are critical. A compliant connection depends on using connector/coupler parts from the same manufacturer and product family, the correct conductor size, the manufacturer's approved crimping and assembly tools, and the manufacturer's installation instructions. Mixing visually similar connectors/couplers from different manufacturers can result in poor contact pressure, increased resistance, overheating, arcing or fire. For this reason, installers should not assume that all "MC4-type" connectors/couplers are interchangeable, even where they appear physically compatible.

Economic operators such as manufacturers and distributors that publicise 'universal compatibility' in their literature and website need to be informed of this. Similarly, installers of the PV arrays, which on some occasions may not be electrical contractors, need to be aware that not all "MC4-type" connectors/couplers are universally compatible.

Installers must ascertain the equipment used in an installation meets the relevant requirement for each component part. PV connectors/couplers must currently conform to BS EN 62852:2015+A1:2020.

Figure 1 – Examples of "MC4" connectors/couplers

3. CORRECT TOOLS AND INSTALLATION TECHNIQUE

Conformance with BS EN IEC 62852:2015+A1:2020 is only assured if the connector/coupler is assembled exactly according to the manufacturer's instructions. Using third-party, unapproved tools can compromise the safety of the connection and immediately void the product's certification and warranty. Poor installation techniques can lead to substandard connections which can cause a fire.

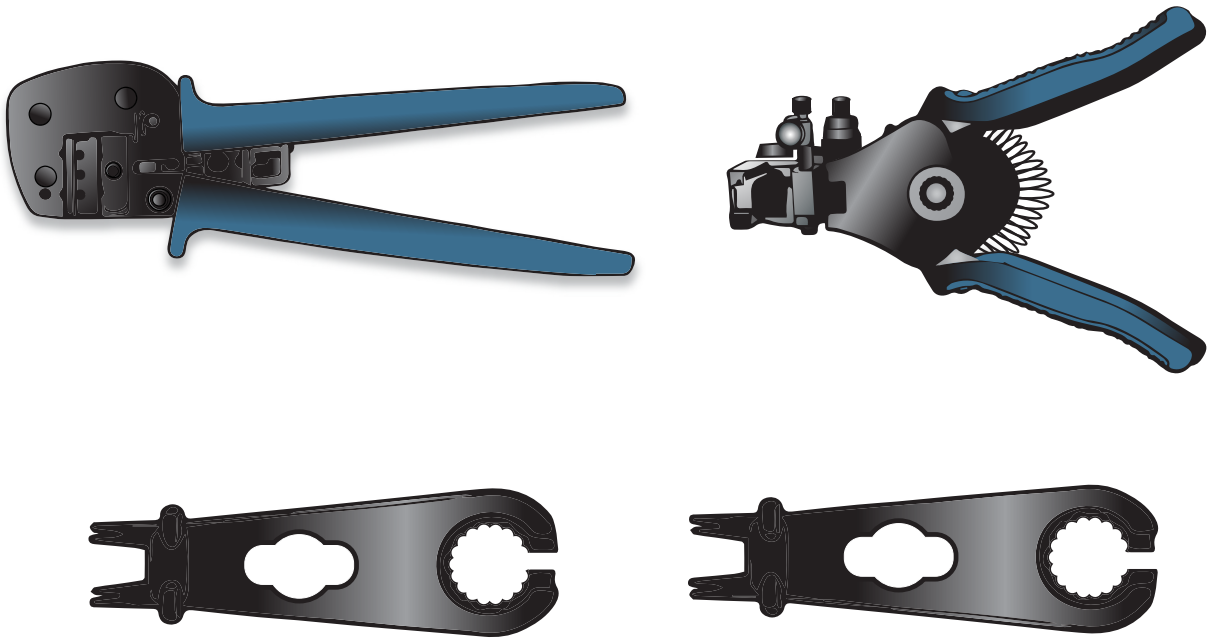

Figure 2 – Examples of crimping tools

4. IET WIRING REGULATIONS, 18TH EDITION AMENDMENT 4 (BS 7671:2018+A4:2026)

The following clauses of BS 7671 must be considered:

4.1 General

134.1.1 Good workmanship by one or more skilled or instructed persons and proper materials shall be used in the erection of the electrical installation. The installation of electrical equipment shall take account of manufacturers' instructions.

4.2 Wiring systems

712.521.101 Cables on the DC side shall be selected and erected so as to minimize the risk of earth faults and short-circuits. This shall be achieved by using one of the following:

(a) single-core cables having a non-metallic sheath, for example H1Z2Z2-K cables to BS EN 50618; or

(a) insulated (single core) conductors installed in individually insulated conduit or trunking.

Cable(s) shall not be placed directly on the surface of the roof.

NOTE: *Cables passing through the roof, and the use of a containment system attached to the roof, are not precluded.*

Other types of wiring system providing an equivalent degree of safety are not precluded.

4.3 Electrical connections

712.526.1 Each pair of connectors shall be electrically and mechanically compatible and suitable for the environment. It is recommended to check with each manufacturer that each pair of connectors be compatible.

712.526.101 Connectors for the DC side

Connectors shall be selected in accordance with BS EN 62852:2015+A1:2020. Connectors in a location accessible to persons other than skilled or instructed persons shall either be of a type which can only be disconnected by means of a key or a tool or be installed within an enclosure which can only be opened by means of a key or a tool.

5. BS EN 62852:2015+A1:2020

BS EN 62852:2015+A1:2020 applies to connectors for use in DC circuits of photovoltaic systems according to class II of IEC 61140:2001 with rated voltages up to 1500 V DC and rated currents up to 125 A per contact.

BS EN 62852:2015+A1:2020 sub-clause 5.9 Degree of protection (IP Code) requires a connector to have a degree of protection at least of IP55. This is the minimum IP allowed for PV connectors, however IP65, IP67 and IP68 are common, with several identified as IP68. The ingress protection is only reliable if the connectors are tightened correctly.

The current rating of PV connectors generally range from 30 A to over 69 A depending on the manufacturer and the gauge of the PV conductor used. The maximum voltages (1000 V to 1500 V) vary by product line.

Installers should make themselves aware of the current carrying capabilities of the PV connector with the associated cable size given by each manufacturer. Some PV connectors may allow 39 A on a 4 mm^2 cable, and others will require the use of 6 mm^2 cable to carry a similar current. The use of incorrectly sized cables can also result in premature failure and potentially result in a fire.

It is also worth noting that the connection requirements for solar array to inverter are different to that of battery storage circuits to inverter. In so much as the current flow in many cases can be higher than normally used and in some cases beyond the rated current allowed by BS EN 62852:2015+A1:2020.

In many cases the battery storage has a direct connection to the inverter and no connectors are required. In some installs the cable runs are very short and may be wired directly to terminals or use manufactures provided connectors.

6. SAFE DISCONNECTION OF DC PV CONNECTORS/COUPLERS

(a) **Turn off the main isolator:** Always switch off the DC isolating switch / switch disconnector or inverter or inverter overcurrent protection device to stop current flow. **Never unplug DC PV connectors/couplers under load,** as doing so creates a dangerous electrical arc that can damage the pins or cause a fire.

(b) **Verify the circuit:** Use a suitable test instrument to confirm that the voltage or the current is at zero. One method is by using a DC clamp meter (rather than multimeter) to indicate there is no current flowing before the disconnection of connectors/couplers. Test on a known current carrying string (or with the string under test turned on first), then ensure it has a zero current reading before disconnection.

(c) **Use the correct tool:** Always use a dedicated disconnect spanner to press the side locking tabs. Never pull by the wire or force them apart.

(d) **Isolate one conductor at a time:** Disconnect the DC PV connectors/couplers individually to avoid short circuits.

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