

Guidance for installers when making connections in consumer units

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The UK's electrical safety experts



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Introduction

In recent years there have been an increasing number of reports of fires involving consumer units. The increase in such reports is due to a number of factors, including the effects of poor workmanship, a progressively deskilled electrical contracting trade, increased surveillance activities by fire and rescue services and product evolution.

As a first step to improve the situation, a requirement has been included in Amendment 3 of *BS 7671* published in 2015 such that consumer units and similar switchgear assemblies shall either have their enclosure manufactured from non-combustible material or be enclosed in a cabinet or enclosure constructed of non-combustible material.

At the BSI/IET working group set up to look at consumer unit fires, interested parties agreed to conduct further research into the use of the types of terminal found in consumer units and to provide guidance to assist installers to make effective and electrically sound connections.

This guidance produced by Electrical Safety First and BEAMA, provides practical advice and guidance on achieving safe and reliable connections for devices and terminal bars within consumer units and similar switchgear.

Guidance is provided on the **cable preparation** required to enable a safe and reliable connection to be made based on factors relating to the conductor.



Fig 1. Consumer unit with plastic enclosure after a fire caused by a loose neutral termination

Introduction

Recommendations are made with respect to the selection of the best **type of tool** to be used in order to provide sufficient tightness of screw terminals.

This guidance does not comment on the suitability or otherwise of the construction of the terminals, which is outside of its scope.

Manufacturers have to facilitate the termination of a range of conductors in their products. Note , in Fig 2 below, the diverse range of conductor terminations even before meter tails and final circuits are terminated.

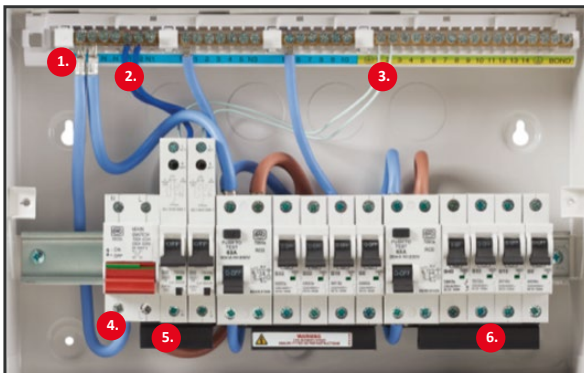


Fig 2. Assembled consumer unit.

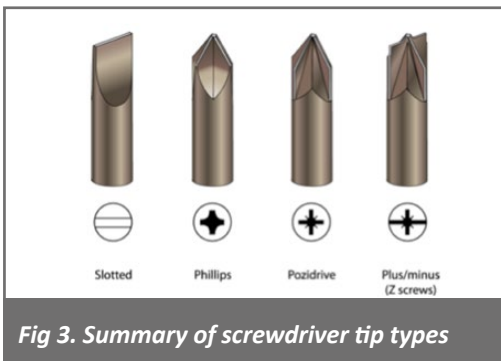
1. Crimped ferrule
2. Multi-strand conductor
3. Small diameter RCBO functional earth lead
4. Large diameter neutral cable in main switch
5. Large diameter conductor and busbar connection in same terminal of main switch
6. Busbar connection into outgoing terminal of RCD and supply side of circuit-breakers

Best practice

Tools

- Make sure that all tools used are in good condition.
- Use sharp cutters, strippers, knives. Blunt tools can be more dangerous than sharp and produce an inferior cut.
- Choose a screwdriver that correctly fits the screwhead (*Fig 3*) – consumer unit manufacturers can advise on this.
- Choose a screwdriver that is appropriate to the size of the screw.
- Only those power tools specifically designed for use as torque drivers should be used to tighten electrical connections – ordinary battery drills are not suitable for this purpose.
- Impact screwdrivers are not suitable for threaded terminals as found in consumer units and associated devices; their use may result in unsafe electrical connections.

Where torque drivers are employed they must be used in accordance with manufacturers' instructions, set to the correct torque, subjected to regular checks of their accuracy and recalibrated when required.



Best practice

Workmanship

- Cut conductors so that the end is as square as possible.
- Strip insulation sufficient to allow conductor(s) to enter terminal fully and ensure that insulation is not trapped in the termination (see Fig 4) – many manufacturers give a recommended strip length.

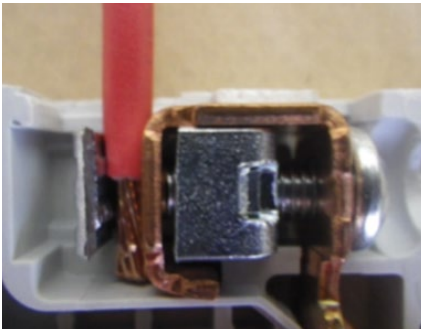


Fig 4. Termination made incorrectly as a result of insulation being trapped in the terminal clamp

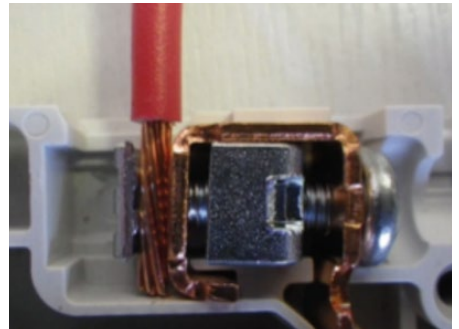


Fig 5. Termination made correctly

- Avoid damaging the conductors (Fig 6) or breaking strands (Fig 7) when removing insulation- many cable strippers have an adjustable depth of cut.

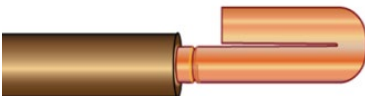


Fig 6. Conductor damaged during insulation stripping

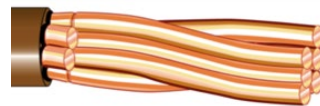


Fig 7. Strands broken during insulation stripping

Best practice

- Always arrange/shape conductors such that they do not place strain on the terminals – the importance of this rises as conductor size, and hence opposition to bending/shaping, increases.
- Where fitting one conductor only, double over the conductors of cross-sectional area 2.5 mm² or less in order to better fill the terminal (*Figs 8 and 9*) – circuit-breaker and RCBO terminals typically have a capacity to accommodate conductors of up to 16 mm² cross-sectional area.

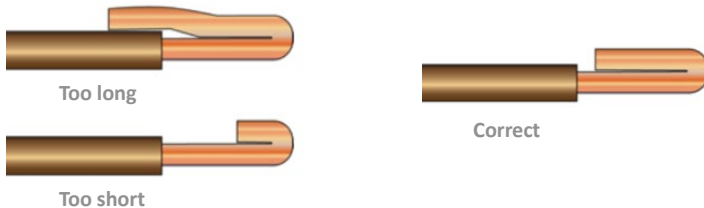


Fig 8. Correct and incorrect doubling over of a conductor

- Do not twist conductors installed in a single terminal together – this may result in work hardening and conductors snapping when untwisted to permit, for example, periodic testing.
- Ensure that conductors are correctly located in a terminal.

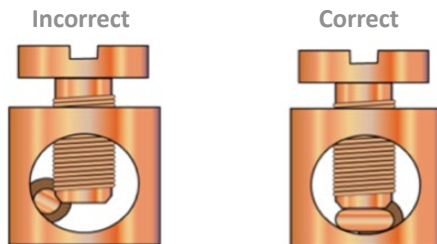


Fig 9. Improved termination after doubling over of a conductor

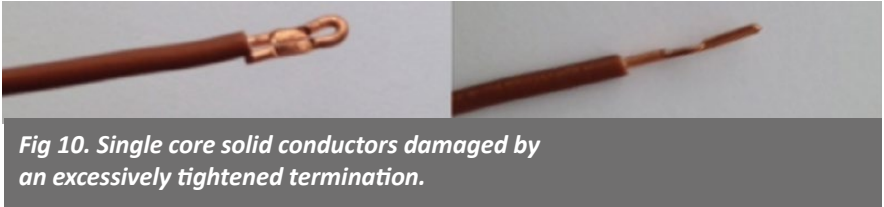
Best practice

- The manufacturer’s recommendations with respect to correct tightness must be followed

under-tightening will result in an excessively loose connection, and **over-tightening** may severely damage the conductors (*Fig 10*) causing them to snap when under minimal strain.

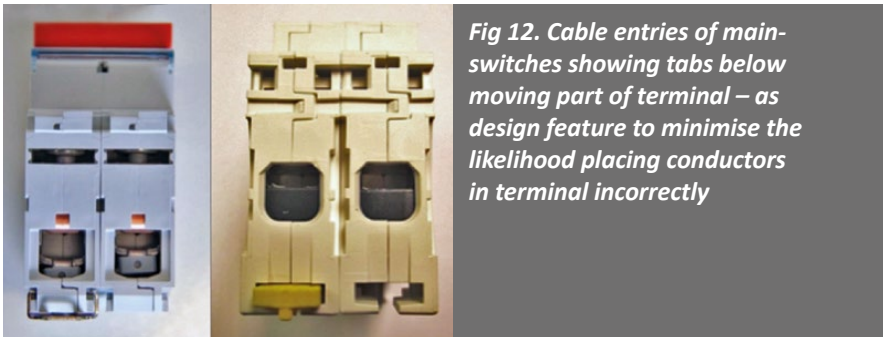
One way of achieving correct tightness is through the use of a torque screwdriver. Recommended torque values are available from manufacturers and some wholesalers.

BEAMA members are committed to providing torque settings with their products.



- Take care that conductors are not inadvertently placed on the wrong side of the clamping unit.

Some manufacturers incorporate features such as a tab below the moving part of the clamping unit to minimise the likelihood of conductors being incorrectly located (*see Fig 12*).



Best practice

- Always apply a pull test to each connection after it is made – ensure that the tug is not excessive.

The consumer unit and associated devices

- Devices such as circuit-breakers and RCBOs from different manufacturers must not be mixed unless documentation is obtained from the consumer unit manufacturer which confirms that the specific mixed arrangement is suitable for use. Further guidance on this can be found on the BEAMA website at www.beama.org.uk/resourceLibrary/safe-selection-of-devices-for-installation-in-assemblies-.html
- Do not exceed the terminal capacity of a device – In general it is not recommended to place more than three conductors in any one terminal.
- All terminations within the consumer unit, including those made during factory assembly, should be checked at original installation and at every subsequent periodic inspection- this is now required by *BS 7671*.
- Care should be taken to ensure conductors are not trapped or do not apply stress to the terminations when the front cover is fitted to a consumer unit.
- Ensure that all devices are engaged correctly on the DIN rail.
- Ensure that busbar tangs/fingers are located correctly in the terminal (*see Fig 13*).

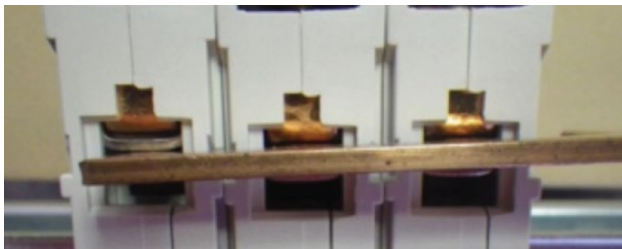


Fig 13. Circuit-breaker on left-hand side incorrectly installed with busbar tang/finger outside the termination clamp

Best practice

Terminating conductors into neutral and earth bars

- Care should be taken when stripping conductors so that excessive bare conductor does not protrude excessively beyond the rear of the bar and, in any case, does not permit the bare conductor to touch the inside surface of the enclosure.
- The functional earth of an RCBO should be placed in the same terminal as the associated protective conductor and should be placed behind the protective conductor to minimise the risk of damage.
- If a neutral bar has been subjected to overheating due to a loose connection, it is not recommended to reuse the terminal. The consumer unit manufacturer should be consulted as to what action is required.

Best practice

Terminating meter tails into the main switch or RCCB

Meter tails should be prepared as shown in the series of diagrams in *Fig 14* below.

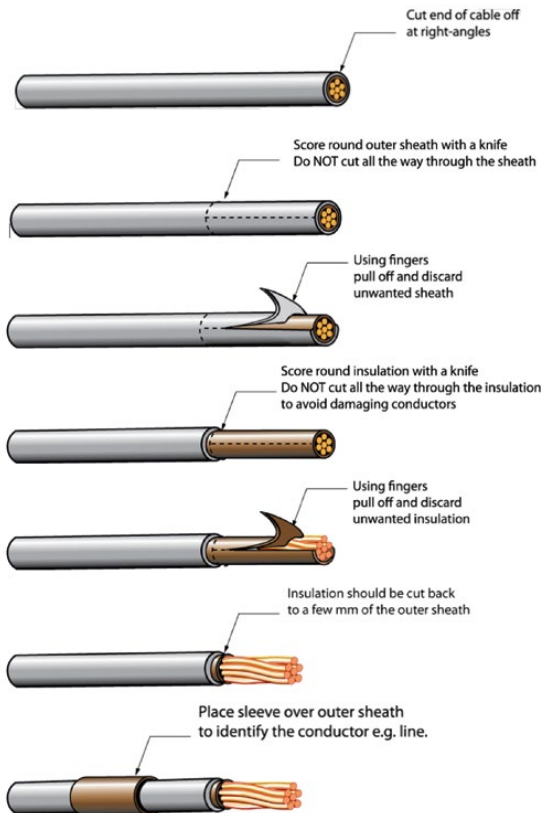


Fig 14. Correct preparation of meter tails

Best practice

During research carried out by Electrical Safety First, it was shown that the use of 19 stranded meter tails gave a more reliable connection than more conventional (7 stranded) tails. Accordingly, the use of 19 strand cable is recommended.

The same research also showed that flattening the strands of the conductor (*Fig 15*) prior to terminating resulted in a more reliable connection. It is essential that flattening using, for example, pliers should therefore be carried out.

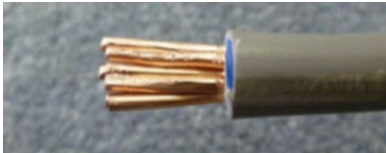


Fig 15. 16 mm² 7-strand meter tail with conductors cut to length and flattened prior to termination

The general advice given earlier in this guide to take measures to relieve the strain on, or disturbance of, terminations is particularly pertinent due to the larger physical size of meter tails, and hence increased opposition to bending of the tails. This may be achieved by for example:

- Dressing / shaping conductors prior to termination,
- Use of an internal clamping device (*Fig 16*),

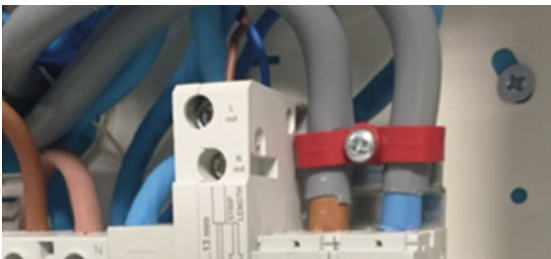


Fig 16. Example internal meter tail clamp

Best practice

- Securing the cables at point of entry by a stuffing gland (Fig 17),

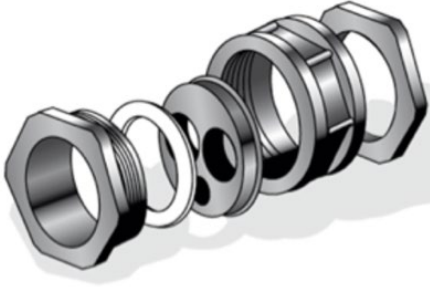


Fig 17. Stuffing gland for securing meter tails at point of entry

- By clipping the meter tails external to the consumer unit (Fig 18).

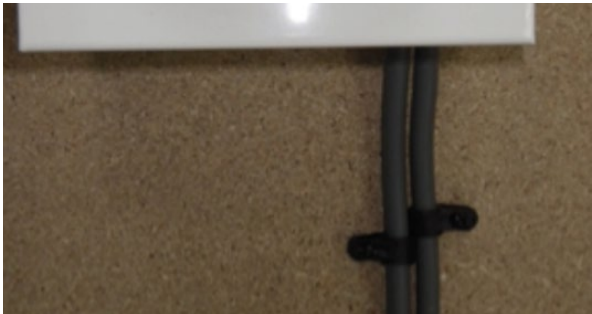


Fig 18. Meter tails secured by clips external to the consumer unit

Find out more

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Electrical Safety First is the UK charity dedicated to reducing deaths and injuries caused by electrical accidents. Our aim is to ensure everyone in the UK can use electricity safely.

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