

# ENCLOSURE OF CONNECTIONS

Faulty electrical connections (joints and terminations) may attain high temperatures or emit arcs or hot particles, resulting in the risk of fire or other harmful thermal effects to surrounding materials. Therefore, irrespective of nominal voltage, BS 7671 requires every electrical connection, except a connection in a protective conductor, to be contained within an enclosure meeting certain requirements. This includes connections in extra-low voltage circuits.

Regulation 526-03-02 calls for every electrical connection in a live conductor or a PEN conductor to be made within one of the following, or a combination of them:

- i) a suitable accessory, such as a lighting switch or a socket-outlet, complying with the appropriate British Standard
- ii) an equipment enclosure (such as that of a luminaire, distribution board, item of switchgear, or a box forming part of a conduit system) complying with the appropriate British Standard
- iii) a suitable enclosure of material complying with the relevant glow-wire test requirements of BS 6458-2.1 – *Fire hazard testing for electrotechnical products. Test methods. Glow-wire test*
- iv) an enclosure formed or completed with building material considered to be non-combustible when tested to BS 476-4 – *Fire tests on building materials and structures. Non-combustibility test for materials*
- v) an enclosure formed or completed by part of the building structure, having the ignitability characteristic 'P' as specified in BS 476-5 – *Fire tests on building materials and structures. Method of test for ignitability (withdrawn but still referred to in BS 7671).*

The types of enclosure in (i) and (ii) should be familiar. However, the requirements for the enclosures in (iii), (iv) and (v) are not so straightforward. For those who wish to have more detail, further information will be found in Topic C156-3 of the Electrical Safety Council Technical Manual (formerly the NICEIC Technical Manual).

### Suitability for external influences

An enclosure for electrical connections must be selected and erected such that it provides adequate protection against mechanical damage such as impact, and any other external influences likely to be encountered at its point of installation (such as ambient temperature, presence of solid foreign objects, presence of water, etc). Regulation 526-03-01 refers.

### Enclosure of cable cores and non-sheathed cables

Regulation 526-03-03 requires the cores of sheathed cables from which the sheath has been removed, and non-sheathed cables at the termination of conduit, trunking or ducting, to be enclosed as required by Regulation 526-03-02. The application of these requirements, as far as the cores of sheathed cables are concerned, is illustrated in Figure 1.

### Adequacy of space within enclosures

Enclosures for connections should be selected so that they afford sufficient depth and otherwise provide adequate space for the connections and conductors. The practical difficulties of terminating larger conductors, especially solid aluminium cable cores, should not be overlooked. Where necessary, when making-off large steel wire armoured cables for instance, it may be necessary or desirable to use generously proportioned enclosures or additional spreader boxes to alleviate the problems associated with cable stiffness, bending radii and the dressing of sector shaped conductors.

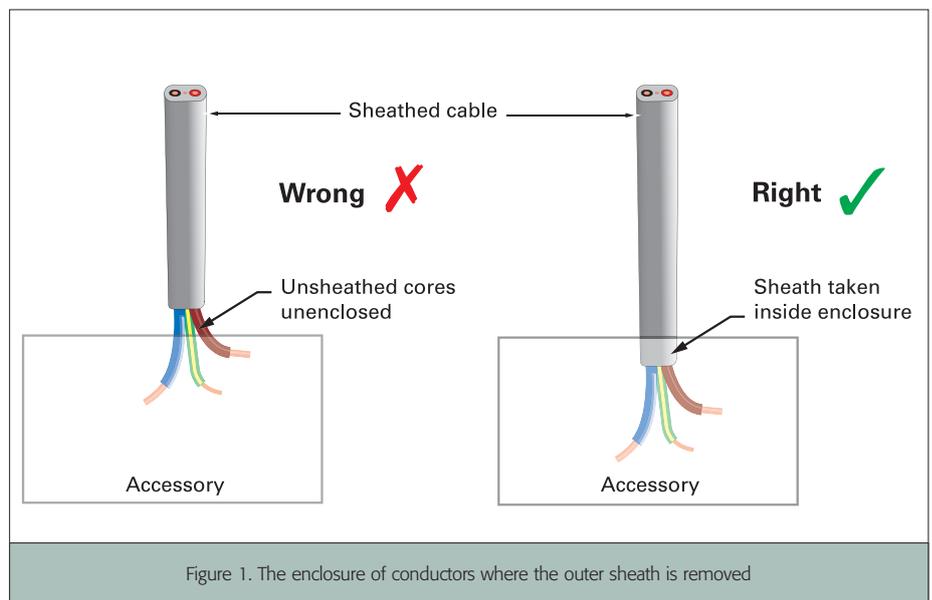


Figure 1. The enclosure of conductors where the outer sheath is removed

### Protection against direct contact

An enclosure relied upon for protection against direct contact (contact of persons or livestock with live parts) must comply with the relevant requirements of Section 412 and Regulation Group 471-05 of BS 7671.

This means that, with certain exceptions, the enclosure must provide at least a degree of protection of IP2X or IPXXB (protected against access to live parts with a finger) or, in the case of a readily accessible horizontal top surface, IP4X (protected against access to live parts with a 1 mm diameter wire). In addition, opening of the enclosure must be possible only by use of a tool or key, unless one of the permitted alternatives to this is provided, in accordance with indent (ii) or (iii) of Regulation 412-03-04.

### Extra-low voltage equipment

As previously indicated, the requirements of Regulation 526-03-02 for the enclosure of connections apply just as much to extra-low

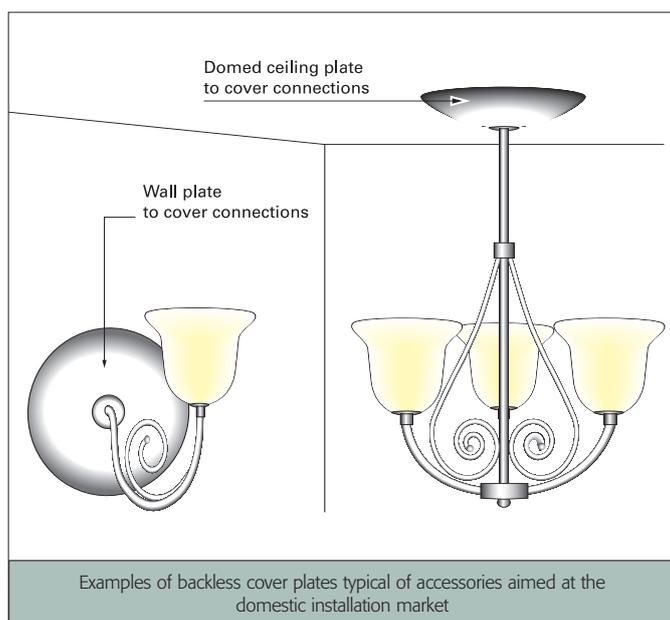
voltage (ELV) circuits as to higher voltage circuits. For a given power rating, the lower the voltage the higher the current, leading to a more rapid deterioration of any defective connection due to unwanted heating effects ( $I^2R$ ).

Particular care is needed when selecting ELV equipment for use in an installation. For example, some ELV luminaires and associated transformers have been found not to incorporate any means for the enclosure of terminations, despite such products complying with the appropriate Harmonized Standard. An item of equipment should not be selected for use unless the requirements of Regulation 526-03-02 (and other relevant regulations) will be met when the equipment is installed.

#### Backless equipment

When installing backless equipment, such as certain types of domestic-style luminaire, some of which are not designed to fit onto a standard back-box, attention is needed to enclosing the connections in a way that complies with Regulation 526-03-02.

A backless enclosure should not be completed by building materials that may not meet the requirements given in (iii), (iv) or (v) referred to earlier. Whilst some common building materials can be expected to comply (for example, concrete, stone or plasterboard are likely to meet the requirements in (iv)), confirmation would be required in the case of some others. Where there is doubt that a building material which would otherwise complete a backless enclosure would comply, the electrical connections should be screened away from the building material, such as by the use of a suitable proprietary electrical back-box.



## METALLIC CAPPING EMBEDDED IN A WALL – DOES IT HAVE TO BE EARTHED?

An obvious cause for concern when installing cables having a non-metallic sheath, such as thermoplastic (pvc) insulated and sheathed cables, on walls that will subsequently be plastered is the possible damage to the cables from the plasterer's trowel. A common method of protecting such cables against this kind of damage is by shielding them with plastic or metallic capping (see Fig 1), which also serves to secure the cables in place.

Where metallic capping is used for the above purpose, the question sometimes arises as to whether it is required to be earthed. The answer is that the capping need not be earthed, but care should be taken to remove any sharp edges on the capping that might damage the cables.

The reason why the capping is not required to be earthed is that Regulation 471-09-04 states that the use of cable having a non-metallic sheath installed in accordance with Chapter 52 of BS 7671 shall be deemed to afford satisfactory protection against both direct contact and indirect contact.



The use of capping to protect non-metallic sheathed cables from damage during the plastering of walls

Whilst capping may be used to protect cables from damage during construction, it does not provide adequate protection against penetration for cables located in other than the 'safe zones' envisaged by indent (iv) of Regulation 522-06-06.

## THERMAL INSULATION OF SPACES WHERE CABLES EXIST - CORRECTION

There is an error in the article on the above subject published in the previous (Winter) issue of Connections.

The error is on the fifth line of the first paragraph in the right hand column on page 36. The correction to be made is as follows: delete '0.725 times  $I_n$ ' and substitute ' $I_n$  divided by 0.725'.

The full text of the paragraph, with the correction duly made in the fifth line, is given below for ease of reference:

'For example, for a radial circuit, the derated current-carrying capacity of the cable, found at Step 1, is required to be not less than the nominal current ( $I_n$ ) of the overload protective device or, where that device is a rewirable fuse to BS 3036, not less than  $I_n$  divided by 0.725 (Regulations 433-02-01(ii) and 433-02-03 refer). Exceptionally, where the protective device for the radial circuit is not a fuse to BS 3036 or one of the types of protective device listed in Regulation 433-02-02 (which covers most common devices), it must also be checked that the current ( $I_2$ ) causing effective operation of the device does not exceed 1.45 times the derated current-carrying capacity of the cable. (Regulation 433-02-01(ii) refers).'