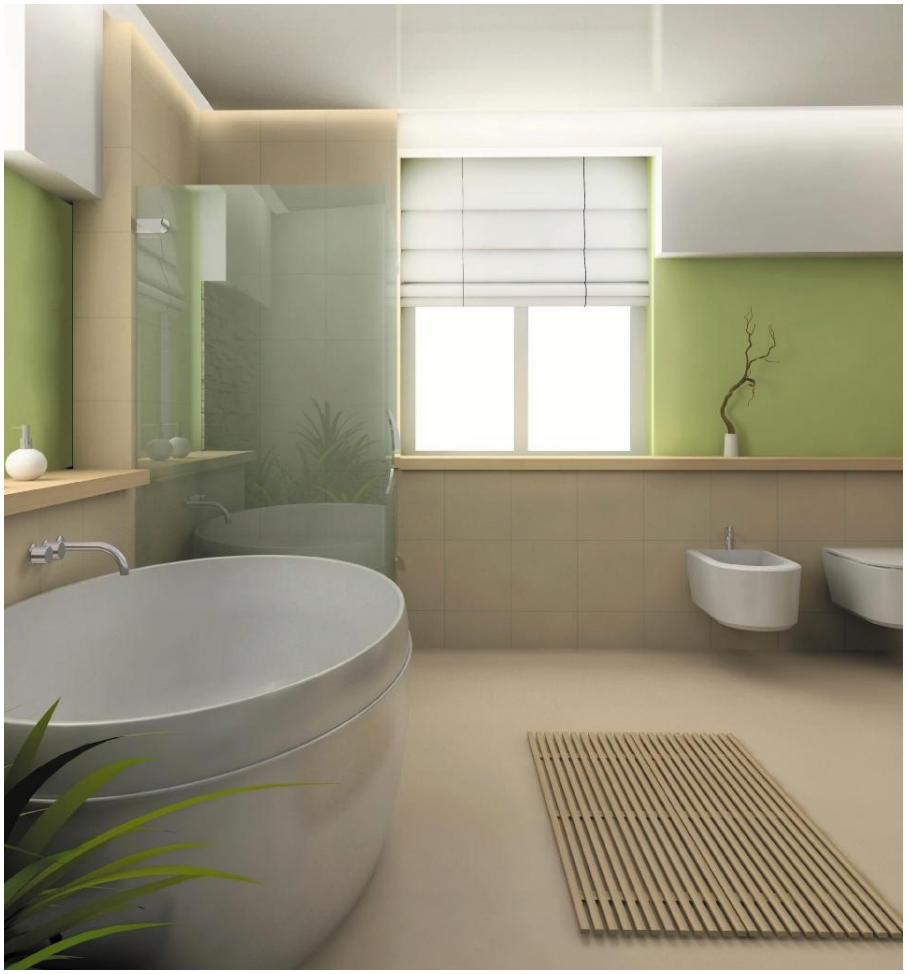


Equipotential Bonding

by Geoff Cronshaw

Introduction

BS 7671: 2001 (incorporating Amendments No 1: 2002 and No 2: 2004) has requirements for protection against electric shock, and lists a choice of five basic measures which shall be used to protect against indirect contact. Protection by earthed equipotential bonding and automatic disconnection of supply is the most common measure. Its purpose is that under earth fault conditions, voltages between simultaneously accessible parts are not of such magnitude and duration as to be dangerous.

Main equipotential bonding

Regulation 413-02-02 requires main equipotential bonding to be carried out. Its importance is often underestimated (see Figure 1). An earth fault in the current-using equipment produces a fault current (I_f) which flows along the circuit protective conductor and back to the source. A small proportion of the current may flow through the main equipotential bonding conductor directly to earth, and then back to the source.

The potential difference between the equipment exposed-conductive-part and the simultaneously accessible extraneous-conductive-part is:

$$U_f = I_f R_2$$

Where:
I_f is the fault current
R_2 is the resistance of the circuit protective conductor.

(Ignoring any reactance of the circuit protective conductor, and any small effect of current flowing in the main equipotential bonding conductor)

The effect of connecting the main equipotential bonding conductor to the extraneous-conductive-part is to minimise U_f. Without this conductor, the potential difference would approximate to the voltage drop produced by I_f along the full length of the earth return path, and this could be significantly greater than ($I_f R_2$). Therefore, failure to install all necessary main equipotential bonding conductors within an installation will certainly increase the shock risk associated with indirect contact.

Installation of main equipotential bonding conductors

IEE Guidance Note 5 recommends that main equipotential bonding conductors should be kept as short as practicable and be routed to minimise the likelihood of damage or disturbance to them. The connections to gas, water and other services entering the premises must be made as near as practicable to the point of entry of each service, on the consumer's side of any insulating section or insert at that point or any meter. Any substantial extraneous-conductive-part which enters the premises at a point remote from the main earthing terminal or bar must also be bonded to this terminal or bar.

Extraneous-conductive-parts should preferably be bonded using individual main equipotential bonding

conductors. Alternatively, two or more such parts may share a main equipotential bonding conductor, but where this arrangement is employed the conductor should be continuous, i.e. disconnection of the conductor from one extraneous-conductive-part must not interfere with or endanger the security of the bonding of the other part(s).

Regulation 547-02-01 and Table 54H of BS 7671 gives sizing requirements for main equipotential bonding conductors. However, it is recommended that the electricity distributor or supplier should be asked to confirm their agreement to the proposed size(s) it is intended to install.

Regulation 514-13-01(ii) requires a permanent label to be fixed at or near the point of connection of every main equipotential bonding conductor to an extraneous-conductive-part.

Supplementary equipotential bonding

BS 7671 also has requirements for supplementary equipotential bonding, which includes installations and locations of increased shock risk such as rooms containing a bath or shower, as shown in Figure 3.

Where supplementary equipotential bonding is applied in a particular location within an installation, e.g. a bathroom, it has the effect of re-establishing the equipotential reference at that location for all the exposed-conductive-parts and extraneous-conductive-parts which are bonded together locally. This further reduces any potential differences that may arise between any of these parts during an earth fault.

Further information.

For more information on earthing and bonding refer to IEE Guidance Note 5. Also a new IEE Guidance Note 8 specifically on earthing and bonding is due to be published shortly by the IET. ■

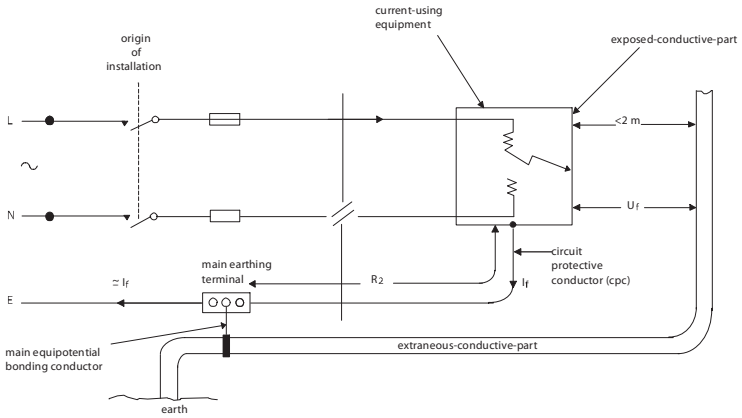


Figure 1: Illustration of main equipotential bonding

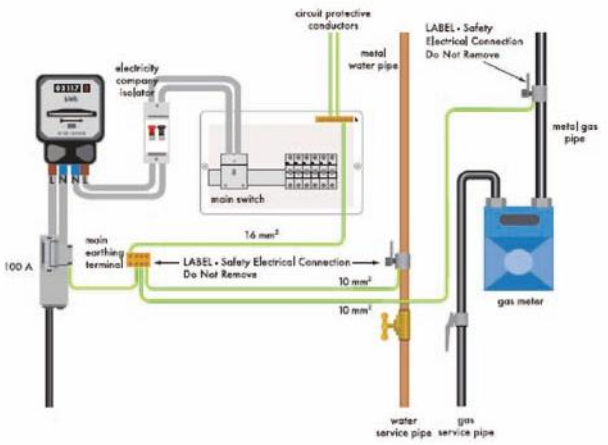
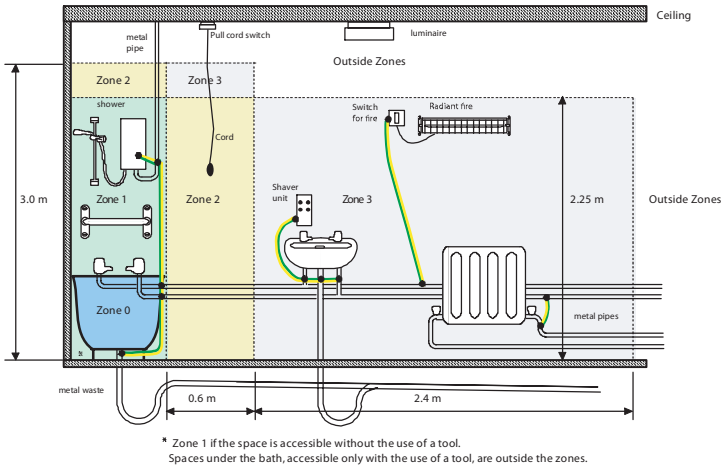


Figure 2: PME supply (TN-C-S system) Schematic of earthing and main equipotential bonding arrangements. Based on 25 mm² tails and selection from Table 54G. Note: An isolator is not always installed by the electricity distributor.



* Zone 1 if the space is accessible without the use of a tool.
Spaces under the bath, accessible only with the use of a tool, are outside the zones.

Note 1: The protective conductors of all power and lighting points within the zones must be supplementary bonded to all extraneous-conductive-parts in the zones, including metal waste, water and central heating pipes, and metal baths and metal shower basins.

Note 2: Circuit protective conductors may be used as supplementary bonding conductors.

Figure 3: Supplementary bonding in a bathroom - metal pipe installation with soldered joints providing reliable electrical continuity