Such earthing shall be in accordance with the following requirements:

(a) The terminal shall be mechanically and electrically continuous with the exposed conductive part to be earthed.

(b) The protective earthing conductor shall be capable of being removed from the terminal without—

(i) reducing the effectiveness of the bolt, stud, or screw as a constructional medium in any way; or

(ii) causing any parts of the electrical equipment to lose their relative rigidity.

A stud that also serves for securing a terminal cover may be used for the connection provided that it complies with Items (c) and (d).

(c) The removal of any covers or parts that are likely to be removed to—

(i) obtain access to terminals; or

(ii) adjust the electrical equipment or parts thereof,

shall not disturb or reduce the effectiveness of the earthing connection.

(d) The bolt, stud or screw shall not be used to—

(i) fix the electrical equipment in position; or

(ii) adjust the position of the electrical equipment or any part of it.

5.6 EQUIPOTENTIAL BONDING

5.6.1 General

Equipotential bonding is intended to minimize the risks associated with the occurrence of voltage differences between exposed conductive parts of electrical equipment and extraneous conductive parts.

Such voltage differences can arise from a range of sources including the following:

(a) A fault external to the installation, either on an incoming extraneous conductor (such as a water or gas pipe, etc.) or on the supply neutral and protective earthing system.

(b) Distribution system load current in the soil passing through a swimming pool.

(c) Telecommunication system voltages on equipment adjacent to exposed conductive parts.

(d) Lightning discharges either directly within the installation or effecting the incoming extraneous conductor or the supply mains.

5.6.2 Arrangement

5.6.2.1 *General*

Equipotential bonding arrangements shall be provided in accordance with Clauses 5.6.2.2 to 5.6.2.6 to avoid any potential differences that may occur between electrical equipment connected to the electrical installation earthing system and any conductive piping (including taps etc.) that may independently be in contact with the mass of earth (see Figures 5.7 and 5.8 for arrangement details).

Additional equipotential bonding requirements apply for:

(a) Patient areas of hospitals, medical and dental practices and dialyzing locations, in accordance with AS/NZS 3003.

(b) Explosive atmospheres, in accordance with Clause 7.7.

(c) Telecommunications installations, in accordance with AS/NZS 3015.

(d) Film, video and television sites, in accordance with AS/NZS 4249.

(e) Photovoltaic arrays, in accordance with AS/NZS 5033.

* (f) Grid connected inverters, in accordance with AS/NZS 4777.1.

(g) Generating systems, in accordance with Clause 7.3.

(h) Separated circuits, in accordance with Clause 7.4.

5.6.2.2 *Conductive water piping*

Conductive water piping that is both—

(a) installed and accessible within the building containing the electrical installation; and

(b) continuously conductive from inside the building to a point of contact with the ground,

shall be bonded to the earthing system of the electrical installation.

Any equipotential bonding of conductive water piping shall be effected by means of an equipotential bonding conductor connected to the main earthing conductor or earth terminal or bar.

The connection of the bonding conductor to the conductive water piping shall be as close as practicable to the entry of the conductive water piping to the building.

NOTES:

1 The main earthing conductor may be continued beyond the earth electrode connecting device to form the equipotential bonding conductor to the conductive water piping. A separate connection to the earth electrode does not constitute a connection to the main earthing conductor and does not comply with this Clause.

2 Item (b) above includes any conductive path through an item of equipment, e.g. a water heater.

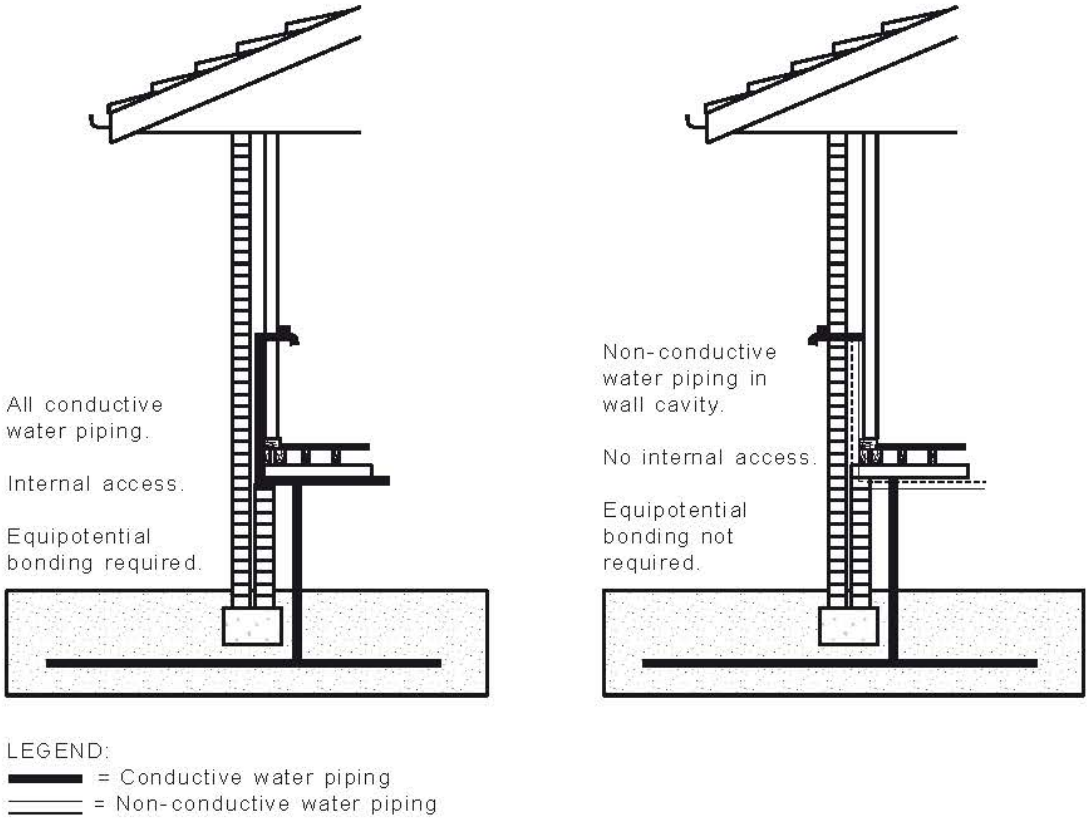


FIGURE 5.7 EXAMPLES OF EQUIPOTENTIAL BONDING OF CONDUCTIVE WATER PIPING

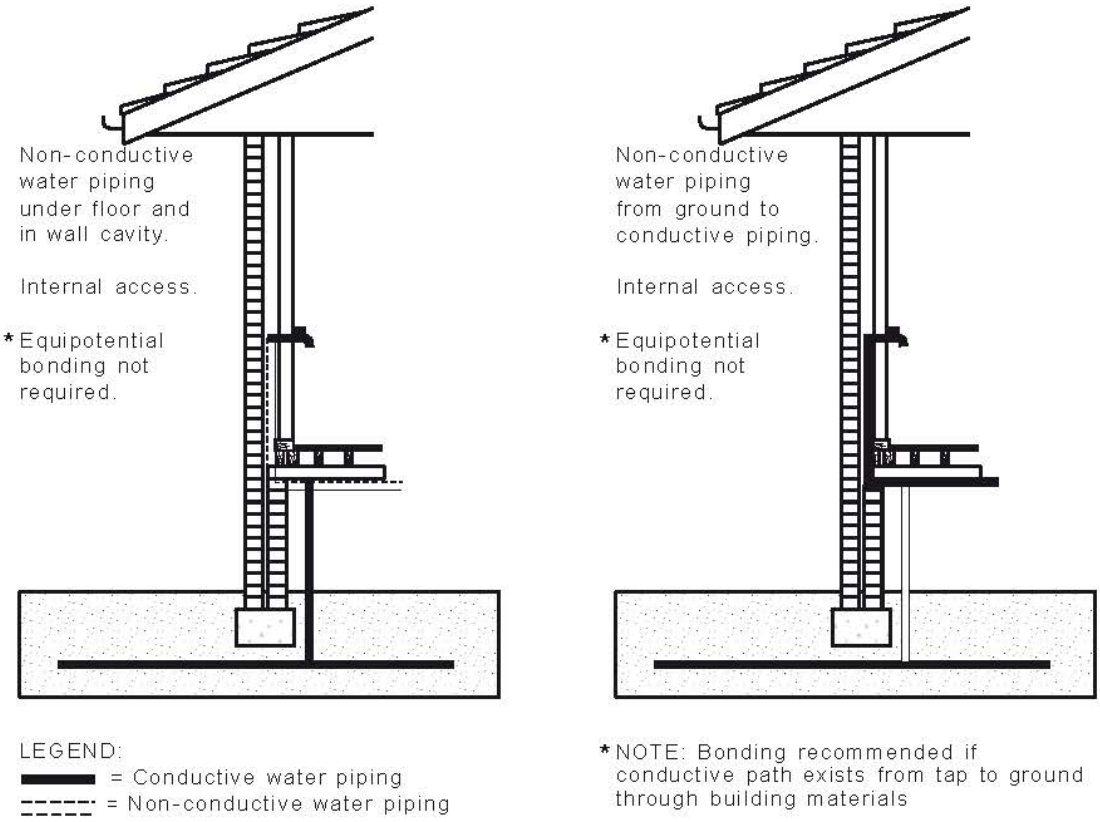


FIGURE 5.8 EXAMPLES OF EQUIPOTENTIAL BONDING OF CONDUCTIVE WATER PIPING (WITH EXCEPTION)

5.6.2.3 *Other conductive piping systems*

Conductive piping systems associated with fire sprinklers, gas, water or flammable liquid that are unavoidably in contact with the exposed conductive parts of wiring enclosures, cable components or other electrical equipment shall be connected to such equipment by means of an equipotential bonding conductor.

Exception: Bonding need not be provided where the piping system is effectively earthed by connection to an associated item of electrical equipment, e.g. pipes connected to electric hot water systems.

5.6.2.4 *Conductive cable sheaths and conductive wiring enclosures*

The conductive sheath, armour or conductive wiring enclosure of conductors operating at above extra-low voltage shall comply with one of the following:

(a) The conductive sheath, armour or conductive wiring enclosure of conductors shall be bonded to any conductive pipes containing flammable agents, such as gas or oil, with which they are in contact. The bonding shall be arranged to prevent appreciable voltage differences at points of contact.

or

(b) Where it is impracticable to achieve the bonding specified in Item (a), the conductive cable sheath, armour or conductive wiring enclosures shall be separated from any non-earthed conductive pipes containing flammable agents. This separation shall overlap the points of crossing by 25 mm in all directions and be—

(i) a rigid spacing of 25 mm in air; or

(ii) a 6 mm thickness of durable insulating material.

5.6.2.5 *Showers and bathrooms*

Any conductive reinforcing within a concrete floor or wall of a room containing a shower or bath shall be bonded to the earthing system of the electrical installation.

An equipotential bonding conductor, in accordance with Clause 5.6.3, shall be connected between the reinforcing material and any part of the earthing system.

* For a combined outbuilding, each structure within that outbuilding that contains a shower or bathroom shall contain its own individual bonding connection to the conductive reinforcing within that structure.

* Providing the reinforcement is electrically continuous across the whole of the combined outbuilding (refer to Note 3), one bonding conductor connecting the reinforcement to the earth bar or link of the switchboard that supplies all of the combined outbuilding is satisfactory.

NOTES:

1 This requirement is intended to avoid any potential differences that may occur between conductive material connected to, or in contact with, the electrical installation earthing system or earthed electrical appliances and the concrete floor or wall.

2 A conductive grille or reinforcement mesh laid in the floor and connected to the equipotential bonding conductor may also be used.

3 Conductive tie-wires used during construction of reinforced concrete structures are considered to be an adequate electrical bond between the conductive reinforcing components. Provided that the reinforcement is satisfactorily electrically connected together, one point of connection of the bonding conductor to the reinforcement is sufficient.

4 In existing electrical installations, the bonding requirement of this Clause for concrete floors and walls containing conductive reinforcing need not apply, but should be adopted wherever practicable.

5.6.2.6 *Swimming and spa pools*

* **5.6.2.6.1** *Bonding arrangement*

An equipotential bonding conductor, in accordance with Clause 5.6.3, shall be connected between—

(a) the conductive pool structure and the pool equipotential bonding conductor connection point specified in Clauses 5.6.2.6.2 and 5.6.2.6.3;

(b) the items of electrical equipment specified in Clause 5.6.2.6.4;

(c) the conductive fixtures and fittings specified in Clause 5.6.2.6.5; and

(d) the earthing conductors associated with each circuit supplying the pool or spa, or the earthing bar at the switchboard at which the circuits originate.

The resistance of an equipotential bonding conductor connected between the items listed (a) to (d) shall not exceed 0.5 Ω.

* A bonding arrangement for pools and spas is provided in Figure 5.9.

5.6.2.6.2 *Conductive pool structures*

Where the pool structure is conductive, all extraneous conductive parts, including the reinforcing metal of the pool shell or deck, shall be connected to a pool equipotential bonding conductor connection point complying with Clause 5.6.2.6.3.

The connection point shall also be bonded to the earthing conductors associated with each circuit supplying the pool or spa, or the earthing bar at the switchboard at which the circuits originate.

* Where the pool structure is conductive, the connection point shall be installed and bonded to the installation earthing system regardless of other requirements specified in Clauses 5.6.2.6.4 and 5.6.2.6.5.

Exception: This requirement need not apply where the reinforcing metal of the pool shell or deck is electrically continuous (0.5 Ω) to the reinforcing metal within the concrete floor of the electrical installation, and that reinforcing metal has been bonded to the earthing system of the electrical installation as required in Clause 5.6.2.5.

NOTES:

1 Connections to the conductive reinforcement of the pool will generally be subject to the effects of water during the construction phase and to subsequent dampness.

2 Conductive tie-wires used during construction of reinforced concrete pools are considered to be an adequate electrical bond between the conductive reinforcing components. Provided that the reinforcement is satisfactorily electrically connected together, one point of connection of the bonding conductor to the reinforcement is sufficient.

* **5.6.2.6.3** *Pool equipotential bonding conductor connection point*

An equipotential bonding conductor connection point, as required by Clause 5.6.2.6.2, may be used as a connection point for the bonding arrangements required by Clauses 5.6.2.6.4 and 5.6.2.6.5.

The connection point shall be—

(a) located in a position that will be accessible with space for connections to be made after pool construction (e.g. located adjacent to the pool equipment);

(b) identified by marking of its location on the switchboard at which the circuits supplying the pool or spa originate, or other permanent location;

(c) designed and constructed in accordance with Clause 3.7;

(d) protected against mechanical damage in accordance with Clause 5.5.5.2; and

(e) protected against corrosion in accordance with Clause 5.5.5.3.

5.6.2.6.4 *Electrical equipment*

The following items associated with electrical equipment shall be equipotentially bonded:

(a) The exposed conductive parts of any electrical equipment in the classified pool zones.

(b) Any exposed conductive parts of electrical equipment in contact with the pool water, including water in the circulation or filtration system, e.g. filtration pumps and heating systems.

NOTES:

1 Where electrical appliances and luminaires are supplied as a separated circuit in accordance with Clause 7.4, all conductive parts of such electrical equipment are deemed to be separated from live parts by double insulation.

2 Underwater luminaire bezels should be made of plastics and any associated fixing screws be insulated or of insulating material.

* **5.6.2.6.5** *Conductive fixtures and fittings*

Where any items specified in Clauses 5.6.2.6.2 or 5.6.2.6.4 are required to be equipotentially bonded, the bonding shall be extended to any fixed conductive material (such as pool ladders, diving boards, conductive fences, pipework and reinforcing metal in a concrete slab) that is installed within arm's reach of the pool edge, and that is in contact with the general mass of earth either directly or indirectly.

NOTES:

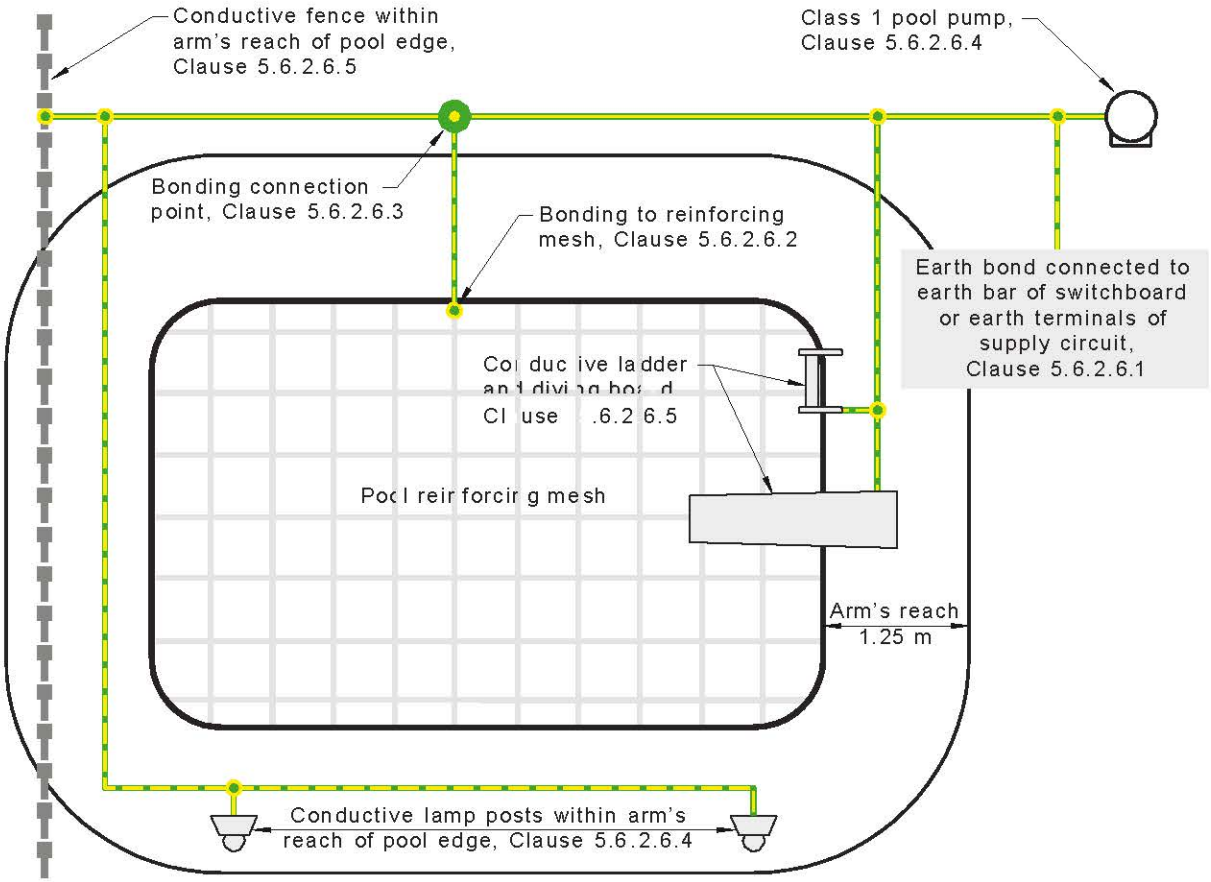
1 The general mass of earth itself may not provide a low enough impedance to operate a protective device or be suitable as an electrical bond.

2 Refer to Clause 1.4.16 and Figure 1.1 for the zone of arm's reach and Clause 1.4.60 for the definition of equipotential bonding.

Exception:

1 *Where any fixed conductive material (such as pool ladders, diving boards, etc.) is installed within arm's reach of the pool edge and is electrically continuous (0.5 Ω) to the reinforcing metal of a concrete slab into which it is installed, and where that reinforcing metal is electrically continuous with the reinforcing metal of the pool shell or deck, then no additional bonding is required.*

2 *This requirement need not apply to fixed conductive parts and fittings that are not part of electrical equipment and have no individual accessible part greater than 100 mm in any dimension.*



* FIGURE 5.9 EXAMPLE OF BONDING ARRANGEMENT FOR POOLS AND SPAS