No need to make waves
By John Ware

The IEE’s technical helpline continues to receive regular questions about Section 602 – Swimming Pools, which include queries on the zonal concept and earthing and bonding. This article is intended to provide guidance that, it is hoped, will prove helpful.
A SWIMMING POOL will often form part of a sports complex, however, these days, swimming pools are becoming commonplace and are often installed for home use.

The increased risk associated with swimming pools is that of electric shock due to a reduction of body resistance because a person is wet and, also, the possibility that a person is in contact with Earth potential. Because of this risk, additional requirements for safety above and beyond the general requirements placed by BS 7671 apply to basins of swimming pools and paddling pools and their surrounding zones. The additional requirements are detailed in Section 602 of BS 7671.

Zonal concept
The basins of swimming pools and their surrounding areas are divided into zones A, B and C for shock protection purposes and for the purpose of selecting suitable equipment.

Protection against electric shock
In zones A and B, protection against electric shock must be achieved by one of the following:

- SELV. The SELV nominal voltage must not exceed 12V a.c. or 30V d.c. and the safety source must be installed outside of zones A, B and C.

- If floodlights are required in zones A or B, each floodlight must be supplied at an open-circuit voltage not exceeding 18V from its own transformer or from its own winding of a multi-secondary transformer including the earthing terminal of socket-outlets and extraneous-conductive-parts. (Regulation 413-02-27 refers).

Local supplementary bonding is required in zones A, B and C to connect together all extraneous-conductive-parts (which could include metal handrails, pipes, exposed steelwork, etc) and the protective conductor of all exposed-conductive-parts, irrespective of whether the conductive parts are simultaneously-accessible. If a metallic grid is installed, it must be connected to the supplementary bonding – but note that there is no requirement to provide such a grid.

Supplementary equipotential bonding must not be connected to SELV circuits.

Protective Multiple Earthing
Protective Multiple Earthing (PME) is an earthing arrangement commonly used by electricity distributors for their distribution networks where the supply neutral conductor provides the function of both neutral conductor and protective conductor (A TN-C-S system). Where PME is used, the public supply neutral conductor is referred to as the PEN (combined protective and neutral) conductor or CNE (combined neutral and earth) conductor and to improve the security of the earthing arrangements, the neutral conductor is earthed at several
points (multiple-earthed). The Electricity Safety, Quality and Continuity Regulations (ESQCR) 2002 permit an electricity distributor to provide a consumer with an earthing terminal which is connected to the supply neutral conductor.

A distributor may decide not to provide a PME earthing terminal for an installation such as that of a swimming pool. Where, however, a PME earthing terminal is provided, BS 7671 does not preclude its use for an installation that includes a swimming pool, but the installation designer may decide not to employ it because of the possibility of perceived electric shock within the installation or the possible danger from a broken PEN conductor.

**Perceived electric shock**
A small voltage difference may exist, under normal operating conditions, between the PME earthing terminal at the origin of an installation and ‘true’ Earth potential. The potential difference is due to the voltage drop

<table>
<thead>
<tr>
<th>Zone</th>
<th>Minimum degree of protection</th>
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<tbody>
<tr>
<td>A</td>
<td>IPX8</td>
</tr>
<tr>
<td>B</td>
<td>IPX5</td>
</tr>
<tr>
<td></td>
<td>IPX4 where water jets are not likely to be used for cleaning</td>
</tr>
<tr>
<td>C</td>
<td>IPX2 for indoor pools</td>
</tr>
<tr>
<td></td>
<td>IPX4 for outdoor pools</td>
</tr>
<tr>
<td></td>
<td>IPX5 where water jets are likely to be used for cleaning</td>
</tr>
</tbody>
</table>

The zonal concept for a particular swimming pool
in the PEN conductor caused by load current returning to the source of the supply through the PEN conductor which has a certain impedance. The small voltage, above Earth potential could, under certain conditions such as reduced body resistance due to the presence of water, create the possibility of a perceived electric shock for a person simultaneously in contact with a conductive part (for example, a handrail that is connected to the supplementary bonding) and ‘Earth potential’ (for example, an uninsulated, wet, solid floor). Electricity distributors have in the past received complaints of perceived electric shock by persons in such locations.

In order to avoid the risk of perceived electric shock, the installation within the location containing a swimming pool may be made part of a TT system. In such a system, the exposed-conductive-parts and the extraneous-conductive-parts within the location are separated from the PME earthing terminal and the installation in the location is configured to meet all the associated requirements of BS 7671 applicable to a TT system including being connected to earth by a suitable installation earth electrode.

**Broken PEN conductor**

Under very exceptional circumstances, the supply PEN conductor connection to an installation could be lost due to a failed joint. Where the phase conductor remains unbroken, a risk of electric shock from exposed-conductive-parts and extraneous-conductive-parts could foreseeably arise. In most installations, the main equipotential bonding plays an important role in protecting against the danger from the loss of a PEN conductor.

**External influences and accessibility**

Each item of electrical equipment in the electrical installation must be selected and erected to take account of the external influences at the particular place where it is installed (Section 522 refers). In a swimming pool environment the presence of water (Regulation 522-03) and corrosive or polluting substances (Regulation 522-06) are of particular concern. The general requirements of Section 522 are supplemented by the additional requirements placed in
Section 602, which require that the minimum degrees of protection are as indicated in the table in this article.

All electrical equipment must be accessible, for example, luminaries should not be mounted over water unless suitable access is available.

**Types of socket-outlet**

A socket-outlet must be either:

- An industrial type complying with BS EN 60309-2; or

- A shaver socket-outlet complying with BS EN 60742(1) Chapter 2 Section 1.

**Zones A and B**

Switchgear, controlgear and accessories are not to be installed. Only current-using equipment specifically designed for a swimming pool application may be installed. Socket-outlets may be installed in zone B providing they are more than 1.25m from the border of zone A, at least 0.3m above the floor, protected by a 30mA RCD or by electrical separation with the safety isolating transformer installed outside of the zones.

The only wiring permitted in zones A and B is that necessary to supply equipment in those zones. Wiring systems using metal conduit, trunking or exposed metallic sheaths is not permitted. Exposed earthing or bonding conductors must not be used; neither must metal enclosures or metal junction boxes.

**Zone C**

Except for instantaneous water heaters, equipment in zone C must be protected by a 30 ma RCD, SELV, or electrical separation.

A socket-outlet, switch, accessory is permitted in zone C but must be protected by electrical separation, SELV, a 30 mA RCD. Shaver socket-outlet complying with BS EN 60742(1) Chapter 2 Section 1 are permitted. Cords of cord-operated switches are permitted in zone C.

**Electric heating embedded in the floor**

Electric heating embedded in the floor is permitted in zones B or C and must either incorporate a metallic sheath or be covered by an earthed metallic grid. In either case, the sheath or the grid must be connected to the local supplementary bonding.

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(1) BS EN 60742 has been superseded by BS EN 61558-2-5.
NOTE: The dimensions are measured taking account of walls and fixed partitions

Extract from BS 7671, Fig 602A- zone dimensions for swimming pools and paddling pools

NOTE: The dimensions are measured taking account of walls and fixed partitions

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