

Electrical design considerations for the electrical supply to hot tubs

OBJECTIVE

The onset of unseasonably hot, sunny weather this Spring combined with many more people being at home because of the Covid-19 lockdown saw an increased demand for the installation of hot tubs and spas, in both indoor and outdoor locations. This brought with it an increase in the number of questions posed about the requirements for the electrical supply to such equipment.

What is a hot tub?

Whirlpool baths and whirlpool spas¹ or hot tubs, as they more commonly known in the UK, are typically a complete item of electrical equipment the construction of which is covered by an electrical product standard in much the same way as a cooking appliance or fridge-freezer. They are neither a swimming pool nor a bath intended for bathing for sanitary purposes.

Hot tubs are designed to be supplied via either a factory-fitted plug and a socket-outlet or permanently connected to the fixed installation. Hot tubs suitable for installation and use indoors or outdoors are available.

This article considers the requirements for the electrical supply of hot tubs and similar appliances and does not consider the choice of hot tub or spa pool systems in relation to the water regulations or infection control. Guidance on this may be found in the Health and Safety Executive publication HSG282 - *The control of legionella and other infectious agents in spa-pool systems*. The publication may be downloaded free-of-charge from the HSE website.

Requirements of the product standard

The electrical requirements for whirlpool baths and whirlpool spas are given in BS EN 60335-2-60: 2003+A12: 2010 - *Household and similar electrical appliances - Safety: Particular requirements for whirlpool baths and whirlpool spas*.

¹ The primary difference between a whirlpool bath and a whirlpool spa is that the former is intended to be drained after usage whereas the latter is not. See definitions given in BS EN 60335-2-60.

Despite the title, this standard is also applicable to similar appliances intended to be used by laymen (that is, ordinary persons as defined in BS 7671) in hotels, fitness centres and similar places (see Clause 1). A note to Clause 1 of BS EN 60335-1:2012+A2:2019 *Household and similar electrical appliances - Safety - Part 1: General requirements* clarifies that a household environment includes the dwelling and its associated buildings etc. including the garden.

Additionally, BS EN 17125:2018 details safety requirements and test methods applicable to domestic spas, whirlpool spas and hot tubs.

In the most part BS EN 60335-2-60 relates to the construction of whirlpool baths and whirlpool spas. However, it also contains a number of clauses which have a direct bearing on their installation. Furthermore, in many cases it states that the technical intent of these clauses must be included in the installation instructions provided by a manufacturer of an appliance covered by the standard.

Table 1 shows the requirements within the standard that are of interest when considering the supply arrangements for a hot tub.

Electrical supplies for hot tubs

General requirements

Any supply arrangement used to supply a hot tub must be suitable for the environment in which it is installed.

A hot tub may be designed to take a supply from either a socket-outlet circuit or from a dedicated final circuit. In either case, the general requirements of BS 7671 apply to the installation of the supply arrangement.

In all cases, additional protection must be provided by an RCD having a rated residual operating current not exceeding 30 mA.

Where the appliance is supplied via a socket-outlet, or where installed outdoors by any other arrangement, and the rated current does not exceed 32 A this is a specific requirement of Regulation 411.3.3.

Where the above is not the case it should be noted that Regulation 415.1.1 states that the use of RCDs having a rated residual operating current not exceeding 30 mA is recognised as providing additional protection in the event of failure of the provision for basic and/or fault protection and for carelessness of users.

Table 1 Requirements of BS EN 60335-2-60 with a bearing on electrical supply arrangements

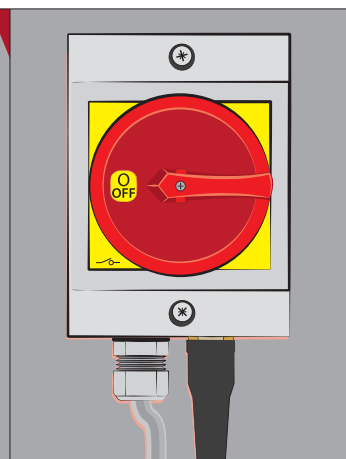
Clause	Requirement	Commentary on BS 7671 related requirements
6.1	Portable appliances to be of Class II or Class III construction. Stationary appliances to be of Class I, II or III construction.	Class II and Class III equipment does not have nor require an earth connection to maintain safety.
6.2	In respect of external influences classification, whirlpool baths and whirlpool spas to be rated at least IPX5. Other appliances shall be rated at least IPX4. A note to this clause states that parts of appliances intended for mounting outside the room in which the appliance is installed may be rated IPX0.	This aligns with the requirements of Regulation 701.55 for current-using equipment installed in zone 1 of a location containing a bath or shower.
7.12.1.	The installation instructions to state the substance of the following: <ul style="list-style-type: none"> parts containing live parts, except parts supplied with safety extra-low voltage not exceeding 12 V, must be inaccessible to a person in the bath or tub; earthed appliances must be connected permanently to fixed wiring; parts incorporating electrical components, except remote control devices, must be located or fixed so that they cannot fall into the bath or tub; the appliance should be supplied through a residual current device (RCD) having a rated residual operating current not exceeding 30 mA. the installation instructions to give details on how to follow the wiring rules, for example, specifying that parts are installed in the correct zone and that equipotential bonding is carried out. 	<p>This aligns with the requirement of Regulation 701.411.3.3. in respect of additional protection by RCD.</p> <p>In some cases, such RCD protection may be integral to the product. Even where this is the case, the requirements of BS 7671 for additional protection of the circuit supplying the appliance must still be met.</p> <p>For indoor installations, a hot tub should be installed in accordance with the relevant requirements of Section 701 of BS 7671 in respect of the zoning dimensions given therein, and similarly, a hot tub installed in the proximity of a swimming pool or other basin should be installed in compliance with the relevant requirements of Section 702 in respect of its specific zoning dimensions.</p>
24.102.	Class III appliances shall be provided with a safety isolating transformer classified as at least IPX4.	
25.1.	Class I appliances to only be provided with means for permanent connection to fixed wiring.	As such, it can be seen that Class I appliances may only be permanently connected and not supplied via a plug and socket-outlet arrangement (see also clause 7.12.1).
27.2.	Class I appliances to be provided with a terminal for the connection of external equipotential bonding conductors.	

Such additional protection is specified in a number of sections within Part 7 of BS 7671 where an electrical supply is taken to circuits serving equipment installed outdoors and as such it is logical for such protection to be provided for hot tubs so located.

Where installed outdoors, any equipment such as a socket-outlet or isolator and any associated enclosures should provide a degree of protection of at least IPX5 in order to protect against water jets as might be encountered when filling and/or cleaning the hot tub.

Minimum recommended distances between hot tub and point of supply (isolator or socket-outlet) vary between manufacturers, however any specific requirement of BS 7671, such as those applicable for a location containing a bath or shower, must be met in all cases.

▶ Fig 1 Weatherproof isolating switch



Hot tubs supplied by a socket-outlet

Those appliances designed to be supplied from a socket-outlet will have a current demand sufficiently low to permit such means of connection and may additionally be of a type which is suitable for temporary use and which can be dismantled or deflated for storage when not required for use.

In the case of ring final circuits specifically, Regulation 433.1.204 states that the requirements for co-ordination between live conductors and protective device are deemed to be met where the current-carrying capacity (I_z) of the conductors is not less than 20 A and the load current in any part of the circuit, such as an appliance connected to an individual socket-outlet on a more-less permanent basis, is unlikely to exceed this current for extended periods of time.

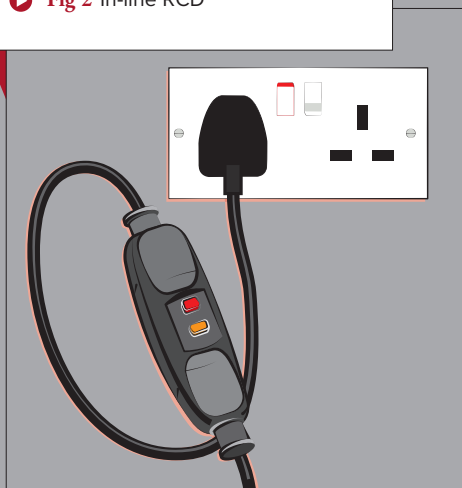
Hot tubs are available, often marketed as ‘13 Amp plug & play’ hot tubs for which a supply could be taken from a socket-outlet forming part of a ring final circuit or suitably rated radial socket-outlet circuit, whether pre-existing where suitably located or installed specifically for that purpose.

It should be noted that Appendix 15 of BS 7671 advises that a dedicated radial final circuit should be provided for appliances that have a rated power exceeding 2 kW (8.7 A at 230 V).

In either case, the instructions for connection provided by the manufacturer should be taken into consideration.

The use of a factory-fitted in-line RCD is recommended for the plug and socket arrangements.

▶ Fig 2 In-line RCD



Hot tubs supplied by a dedicated final circuit

Some hot tubs designed for multiple occupants or with additional features; and in particular swim spas, in which pumps are installed to provide a ‘tide’ to swim against; can have a current demand significantly higher than that which can be supplied via a conventional socket-outlet circuit arrangement such as those described in Appendix 15 of BS 7671. Some such products have a single-phase rating of up to 40 A.

Where current demand rules out supply via a socket-outlet circuit, a dedicated final circuit must be provided which meets all applicable general requirements of BS 7671. These will not be discussed in detail in this article as such factors must always be taken into consideration when designing any circuit.

There is no specific requirement in BS 7671 for a means of isolation or for switching off for mechanical maintenance to be provided at the ‘load’ end of a circuit for the supply of an appliance covered by a product standard as both functions may be provided by the protective device at the origin of the final circuit. However, many manufacturers will require such means to be fitted for the safety and convenience of those installing the hot tub and making the final electrical connection.

As is the case whenever it is intended to introduce a significant increase in current demand, an assessment of the suitability of the existing electrical supply capacity of the host electrical installation should be carried out. Where necessary, arrangements should be made with the relevant service provider to have the supply suitably upgraded.

Hot tubs installed indoors

In addition to the general requirements, where a hot tub is installed indoors, regardless of whether or not it is within a location already containing a bath or shower, any relevant requirements of Section 701 of BS 7671 in respect of the zoning dimensions given therein must be met.

It could be argued that hot tubs and spas installed indoors fall under indent (iv) of Regulation 701.55 (current-using equipment) which refers to ‘whirlpool units’.

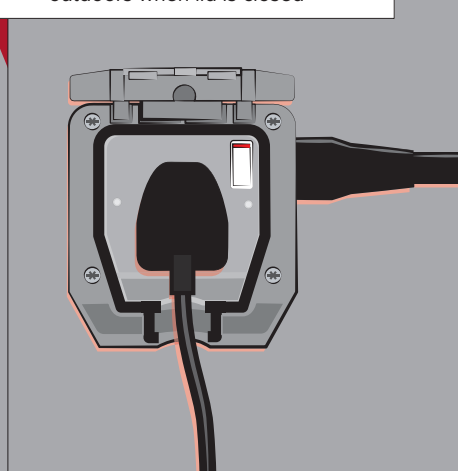
Hot tubs installed in a location containing a swimming pool

Spa pools are often installed in locations also containing a swimming pool. Where this is the case, they should be suitable for such a location and installed in accordance with any applicable requirements of Section 702 in respect of the zoning dimensions falling within the scope of that section.

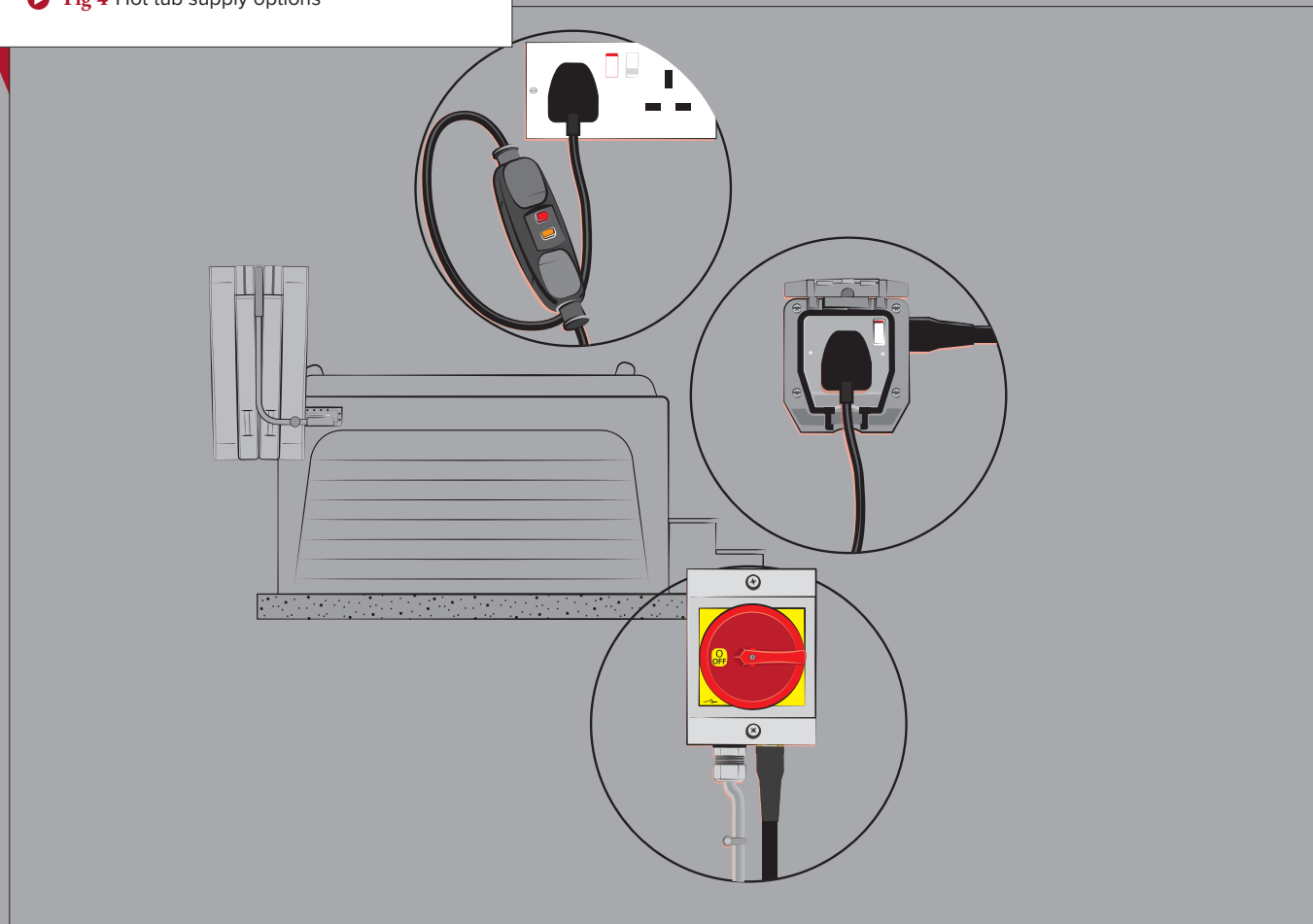
Hot tubs installed outdoors

Hot tubs are often installed outdoors, for example in the garden and on the patio of the premises. Where this is the case, they should be installed in accordance with any applicable requirements of the general rules of BS 7671 and in particular the requirements for additional protection.

▶ Fig 3 Socket-outlet suitable for use outdoors when lid is closed



▶ Fig 4 Hot tub supply options



Hot Tubs and TN-C-S Supplies

The NICEIC Technical Helpline is often asked whether a hot tub installed outdoors may be supplied from a circuit taken from an installation forming part of a TN-C-S system, often referred to as a PME Supply.

Neither the *Electricity Safety, Quality and Continuity Regulations* nor the guidance given in Engineering Recommendation G12/4 – *Requirements for the Application of Protective Multiple Earthing to Low Voltage Networks* published by the Energy Networks Association places any restrictions in respect of the connection of a hot tub to a PME supply.

G12/4 does offer several alternatives in respect of the connection of a swimming pool to a PME supply and it is sometimes suggested, erroneously, that hot tubs should be treated in the same manner as a swimming pool. However, it is clear that hot tubs fall outside of the scope of Section 702 of BS 7671 (see Regulation 702.11). So, unless, as stated previously in this article, a hot tub outdoors is installed within the zones of a swimming pool, only the general rules of that standard are applicable.

Summary

Any likely increased risk of electric shock associated with the use of a hot tub should have been mitigated in the product design and hence the product standard. A hot tub, like any other electrical appliance, should be designed to be safe when installed and maintained in accordance with the manufacturer's instructions.

Any applicable general requirements of BS 7671 should be applied to the supply arrangements for hot tubs and spa baths. Where installed within a premises containing a bath or shower should also be met regardless of whether or not such a location also contains facilities for sanitary/hygiene reasons.

Although not falling within the scope of Section 702 specifically, where a hot tub is installed in a location containing a swimming pool any relevant requirements of Section 702 in respect of the zoning dimensions therein should be met.

Neither the *Electricity Safety, Quality and Continuity Regulations*, ENA Engineering Recommendation G12/4 nor BS 7671 places any restrictions on taking a supply for a hot tub from an installation forming part of a TNC-S (PME) system.

In all cases, additional protection by RCD having a rated residual operating current not exceeding 30 mA must be provided for the circuit supplying the hot tub.