

FLOOR AND CEILING HEATING SYSTEMS

A look at the requirements for the installation of electric floor and ceiling heating systems, together with the associated risks.

By Geoff Cronshaw

THE 17TH Edition of the Wiring Regulations (BS 7671:2008) introduced additional sections on special locations in 2008 that were not previously included in the 16th Edition. Among the special locations introduced were requirements for floor and ceiling heating systems contained in section 753 of BS 7671:2008.

Risks

The obvious risks associated with floor and ceiling heating systems are penetration of the heating element by nails, drawing pins, screws, etc., pushed through the ceiling surface.

Similarly, there are concerns that underfloor heating installations can be damaged by carpet gripper nails, etc. To protect the building structure and provide precautions against fire, there are requirements to avoid overheating of the floor or ceiling heating system.

Protection against electric shock

As you would expect the protective measures of obstacles, placing out of reach, non-conducting location and protection by earth-free local equipotential bonding are not permitted. These measures are contained in Sections 417 and 418 of BS 7671:2008 and are not for general application. The protective measures of section 417 provide basic protection only, and are for application in installations controlled or supervised by skilled or instructed persons. The fault protective provisions of Section 418 are special and, again, subject to control and effective supervision by skilled or instructed persons. In addition the protective measure of electrical separation (section 413) is not permitted.

Regulation 753.411.3.2

Where the protective measure is automatic disconnection of supply, >

< heating units without exposed-conductive-parts, must have a metallic grid, with a spacing of not more than 30mm, (as an exposed conductive part) installed above the floor heating elements or under the ceiling heating elements. The grid must be connected to the protective conductor of the electrical installation and the heating system protected by an RCD with a rated residual operating current not exceeding 30mA for fault protection. A note below regulation 753.411.3.2 limits the rated heating power to avoid unwanted tripping of the RCD.

Regulation 753.415.1

A circuit supplying heating equipment of Class II construction or equivalent insulation must be provided with additional protection by use of an RCD with a rated residual operating current not exceeding 30mA.

RCDs

An RCD is a protective device used to automatically disconnect the electrical supply when an imbalance is detected between live conductors. In the case of a single-phase circuit, the device monitors the difference in currents between the line and neutral conductors. If a line-to-earth fault develops, a portion of the line conductor current will not return through the neutral conductor. The device monitors this difference, operates and disconnects the circuit when the residual current reaches a preset limit, the residual operating current ($I_{\Delta n}$). An RCD on its own does not provide protection against overcurrents. Overcurrent protection is provided by a fuse or a circuit-breaker. However, combined RCD and circuit breakers are available and are designated RCBOs.

Special locations

There are special requirements where electric floor-heating systems are installed in special locations such as locations containing a bath or shower – specified in the following extract from 701.753:

"For electric floor-heating systems, only heating cables according to relevant product standards or thin sheet flexible heating elements according to the relevant equipment standard shall be erected provided that they have either a metal sheath or a metal enclosure or a fine mesh metallic grid. The fine mesh metallic grid, metal sheath or metal enclosure shall be connected to the protective conductor of the supply circuit. Compliance with the latter requirement is not required if the protective measure SELV is provided for the floor heating system.

"For electric floor heating systems the protective measure 'protection by electrical separation' is not permitted."

First characteristic numeral	Second characteristic numeral
(a) Protection of persons against access to hazardous parts inside enclosures (b) Protection of equipment against ingress of solid foreign objects	Protection of equipment against ingress of water

No.	Degree of protection	No.	Degree of protection
0	(a) Not protected (b) Not protected	0	Not protected
1	(a) Protection against access to hazardous parts with the back of the hand (b) Protection against foreign solid objects of 50 mm diameter and greater	1	Protection against vertically falling water drops
2	(a) Protection against access to hazardous parts with a finger (b) Protection against solid foreign objects of 12.5 mm diameter and greater	2	Protected against vertically falling water drops when enclosure tilted up to 15°. Vertically falling water drops shall have no harmful effect when the enclosure is tilted at any angle up to 15° from the vertical
3	(a) Protection against contact with tools, wires or such like more than 2.5 mm thick (b) Protection against solid foreign objects of 2.5 mm diameter and greater	3	Protected against water spraying at an angle up to 60° on either side of the vertical
4	(a) As 3 above but against contact with a wire or strips more than 1.0 mm thick (b) Protection against solid foreign objects of 1.0 mm diameter and greater	4	Protected against water splashing from any direction
5	(a) As 4 above (b) Dust-protected (dust may enter but not in amount sufficient to interfere with satisfactory operation or impair safety)	5	Protected against water jets from any direction
6	(a) As 4 above (b) Dust-tight (no ingress of dust)	6	Protected against powerful water jets from any direction
	No code7		Protection against the effects of temporary immersion in water. Ingress of water in quantitites causing harmful effects is not possible when enclosure is temporarily immersed in water under standardized conditiions
	No code8		Protection against the effects of continuous immersion in water under conditions agreed with a manufacturer

Table 1: IP characteristic numerals

Protection against burns and overheating

In floor areas where contact with skin or footwear is possible, the surface temperature of the floor shall be limited (for example, 35°C).

To avoid overheating of floor or ceiling heating systems in buildings, at least one of the following measures shall be applied to limit the temperature and the heating zone to a maximum of 80°C:

- Appropriate design of the heating system;
- Appropriate installation of the heating system;
- Use of protective devices.

Heating units shall be connected to the electrical installation via cold tails or suitable terminal fittings.

Heating units shall be inseparably connected to the cold tails, e.g. by welding, brazing or by compression jointing techniques.

Heating units must not cross expansion joints.

As the heating unit may cause higher temperatures or arcs under fault conditions, special measures to meet the requirements of Chapter 42 should be taken when the heating unit is installed close to easily ignitable building structures, such as placing on a metal sheet, in metal conduit or at a distance of at least 10mm in air from the ignitable structure.

Standards

Flexible sheet heating elements should comply with BS EN 60335-2-96 and heating cables should comply with IEC 60800.

External influences

Any wiring system or equipment selected and installed must be suitable for its location and able to

operate satisfactorily without deterioration during its working life.

Heating units for installation in ceilings shall be at least IPX1 and heating units for installation in floors of concrete or similar material shall be not less than IPX7 with appropriate mechanical properties.

The IP classification code BS EN 60529:2004 describes a system for classifying the degrees of protection provided by the enclosures of electrical equipment. The degree of protection provided by an enclosure is indicated by two numerals. The first numeral indicates protection of persons against access to hazardous parts inside enclosures or protection of equipment against ingress of solid foreign objects. The second numeral indicates protection of equipment against ingress of water (see Table 1, facing). More information on the IP classification code is given in IET Guidance Note 1 – Selection and Erection.

Operational conditions

Precautions shall be taken not to stress the heating unit mechanically; for example, the material by which it is to be protected in the finished installation shall cover the heating unit as soon as possible.

Identification

The designer of the installation/heating system or installer shall provide a plan for each heating system, containing the following details:

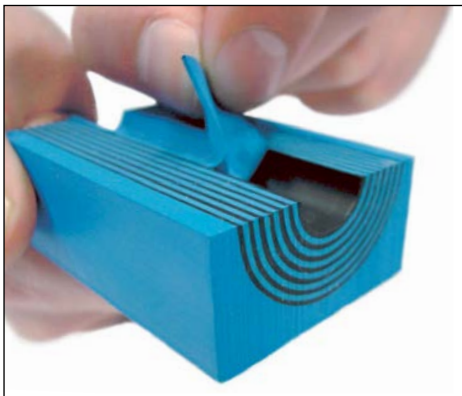
1. Manufacturer and type of heating units;
2. number of heating units installed;
3. length/area of heating units;
4. rated power;
5. surface power density;
6. layout of the heating units in the form of a sketch, a drawing or a picture;
7. position/depth of heating units;
8. position of junction boxes;
9. conductors, shields and the like;
10. heated area;
11. rated voltage;
12. rated resistance (cold) of the heating units;
13. rated current of overcurrent protective devices;
14. rated residual operating current of RCD;
15. the insulation resistance of the heating installation and the test voltage used;
16. the leakage current.

The plan shall be fixed to, or adjacent to, the distribution board of the heating system.

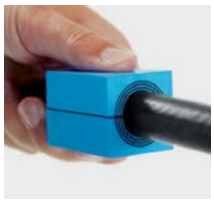
Heating-free areas

Where heating units are installed, there shall be heating-free areas where drilling and fixing by screws, nails and the like are permitted. The installer shall inform other contractors that no penetrating means, such as screws for door stoppers, shall be used in the area where floor or ceiling heating units are installed.

It may be necessary to provide areas of floor or ceiling that are unheated, e.g. where fixtures to the floor or ceiling would prevent the



World Leader in Cable and Pipe Seals





EFFICIENT SEALING SOLUTIONS

- Quick and easy to install
- Global certifications and ratings
- Adaptable to cables of different sizes
- Always available from local stocks
- Capacity for future expansion

The Roxtec sealing system protects against flood, gas, fire, smoke, blast, dust and vermin. It also provides solutions for hazardous locations (Ex) as well as for EMC, bonding and grounding. Designed to ensure engineering performance, jobsite flexibility and operational reliability, it is frequently specified in major projects in different demanding industries. No wonder we are the global leader within modular-based cable and pipe seals.

Roxtec LTD
Unit C 1, Waterfold Business Park, Bury, BL9 7BQ Lancashire, United Kingdom
TEL +44 161 7615280, FAX +44 161 7636065
info@uk.roxtec.com, www.roxtec.com

Roxtec



There are concerns that underfloor heating installations can be damaged by carpet gripper nails and suchlike

proper emission of heat.

Account shall be taken of the increase in ambient temperature and of its effect upon the cables, including cold tails (circuit wiring) and control wiring installed in heated zones.

Information from the contractor for the user of the installation

A description of the heating system shall be provided by the installer/contractor of the heating system to the owner of the building or his or her agent upon completion of the installation. The description shall contain at least the following information:

A. Description of the construction of the heating system, which must include the installation depth of the heating units;

B. location diagram with information concerning the distribution of the heating circuits and their rated power; the position of the heating units in each room; conditions which have been taken into account when installing the heating units,e.g. heating-free areas, complementary heating zones, unheated areas for fixing means penetrating into the floor covering;

C. data on the control equipment used, with relevant circuit diagrams and thedimensioned position of floor temperature and weather conditions sensors, if any;

D. data on the type of heating units and their maximum operating temperature.

The installer/contractor shall inform the owner that the description of the heating system includes all necessary information, e.g. for repair work.

The designer/installer/contractor of the heating system shall hand over an appropriate number of instructions for use to the owner or his or her agent upon completion. One copy of the instructions for use shall be permanently fixed in or near each relevant distribution board.

The instructions for use shall include at least the following information:

A. Description of the heating system and its function;

B. operation of the heating installation in the first heating period in the case of a new building, e.g. regarding drying out;

C. operation of the control equipment for the heating system in the dwelling area and the complementary heating zones as well, if any;

D. information on restrictions on placing of furniture or similar. Information provided to the owner shall cover the restrictions, if any, including: whether additional floor coverings are permitted, for example, carpets with a thickness of >10mm may lead to higher floor temperatures which can adversely affect the performance of the heating system where pieces of furniture solidly covering the floor and/or built-in cupboards may be placed on heating-free areas where furniture, such as carpets, seating and rest furniture with pelmets, which in part do not solidly cover the floor,

may not be placed in complementary heating zones, if any;

E. information on restrictions on placing of furniture or similar;

F. in the case of ceiling heating systems, restrictions regarding the height of furniture. Cupboards of room height may be placed only below the area of ceiling where no heating elements are installed;

G. dimensioned position of complementary heating zones and placing areas;

H. statement that, in the case of thermal floor and ceiling heating systems, no fixing shall be made into the floor and ceiling respectively. Excluded from this requirement are unheated areas.

Alternatives shall be given, where applicable.

Future developments at international level

The Wiring Regulations (BS 7671) are based on international standards. Work is ongoing at present at international level to extend the scope of Section 753. These proposals would apply to embedded electric heating systems for surface heating. They would also apply to electric heating systems for de-icing or frost prevention or similar applications, and would cover both indoor and outdoor systems.

This would include heating systems for: walls, ceilings, floors, roofs, drainpipes, gutters, pipes, stairs, roadways, non-hardened compacted areas (e.g. football fields and lawns). Heating systems for industrial and commercial applications complying with IEC 60519 and IEC 62395 would not be covered.

The draft covers issues such as surface temperatures and refers the reader to the appropriate IEC guide. Documentation is also covered and requires the designer to provide appropriate documentation about approved substances in the surroundings of the heating units.

For wall heating systems the draft contains additional requirements to protect against the effects of overheating caused by a short circuit between live conductors due to penetration of an embedded heating unit. In addition, the draft requires that electric heating systems shall be selected and erected so as to avoid any harmful influence between the heating system and any electrical or non-electrical installations envisaged.

Conclusion

It is important to be aware that this article only gives an overview of the installation of electric floor and ceiling heating systems. For more information refer to Section 753 of BS 7671:2008 incorporating Amendment 1. Also, it is important to point out that this future development work is still at a very early stage of development in IEC and therefore may not become an international standard.

ALAMY

FLIPSIDE

BECAUSE FACT IS STRANGER THAN FICTION

SPECIAL CHRISTMAS OFFER

The perfect Christmas gift for **YOUR** inquisitive **teenager!**

Fun, but also educational, **Flipside** makes the perfect Christmas gift for young teenagers interested in how science, engineering and technology underpin the world they live in.

- Amazing true stories
- Mind blowing facts
- The latest game reviews
- Films, music and sport

"YOU GET YOUR MONEY'S WORTH."
(PARENT, MIDLANDS)



Order today:

w: www.subscription.co.uk/flipside/005A **t:** 0844 543 8091 **Please quote 005A.**
To take advantage of this offer and to guarantee that your gift set arrives before Christmas please order by 6th December.

For more details about the gift subscription, prices and delivery times visit: www.FLIPSIDE.org.uk/gift

Your gift subscription will include:

- ✔ **FREE large 3D poster and glasses**
- ✔ Flipside magazine (8 issues per year)
- ✔ Free delivery to UK

IET Services Limited is registered in England Registered Office Savoy Place, London, WC2R 0BL Registration Number 909719 IET Services Limited is trading as a subsidiary of the Institution of Engineering and Technology, which is registered as a Charity in England & Wales (No 211014) and Scotland (No SC038698)