A FLOOR OR ceiling heating system functions by warming the floor or ceiling of a room. These objects then warm the air in the room. Some systems use electric heating panels to generate heat, which is radiated into rooms, other systems are thermal storage systems. The requirements apply to the installation of electric floor and ceiling heating systems which are erected both as direct acting heating or thermal storage systems. A thermal storage system is where heat from off-peak electricity is stored in concrete or similar material.

The Risks
The risks associated with floor and ceiling heating systems are generally that of 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.

**Definitions**

**Cold tail.** The interface between the fixed installation and a heating unit. See Figure 1.

**Heating unit.** Heating cable or flexible sheet heating element with rigidly fixed cold tails or terminal fittings which are connected to the terminal of the electrical installation

**Flexible sheet heating element.** Heating element consisting of sheets of electrical insulation laminated with electrical resistance material, or a base material on which electrically insulated heating wires are fixed. Figure 3.

**Heating-free area.** Unheated floor or ceiling area which is completely covered when placing pieces of furniture or kept free for built-in furniture. See Figure 6.

**Requirements and Recommendations**

The increased risks of shock or fire with such systems are recognized in BS 7671 which, in the 17th Edition, will place additional requirements, in Section 753, which supplement or modify the general requirements in Parts 1 to 6.

There are no comparable requirements in BS 7671:2001 (The Sixteenth Edition). However Guidance Note 7, Special Locations, includes recommendations in Chapter 14 for floor and ceiling heating systems.

Where a floor or ceiling heating system is installed in a bathroom, swimming pool or other basin, the requirements of

![Figure 3: Flexible sheet heating element](Photograph courtesy of MK Electric Ltd)

![Figure 4: A 30 mA RCBO being installed](Photograph courtesy of MK Electric Ltd)

<table>
<thead>
<tr>
<th>Concerning</th>
<th>Regulation (16th)</th>
<th>Regulation (17th)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1避火以及机械损伤，当加热电缆通过或靠近易燃材料时。</td>
<td>554-06-01</td>
<td>554.4.1</td>
</tr>
<tr>
<td>2 避免损坏到加热电缆，需要直接埋在土壤，混凝土或水泥垫层或其他材料中。</td>
<td>554-06-02</td>
<td>554.4.2</td>
</tr>
<tr>
<td>3 加热电缆应完全嵌入，不会在移动时损坏。</td>
<td>554-06-03</td>
<td>554.4.3</td>
</tr>
<tr>
<td>4 加热电缆的温度不得超过规定的值。注意第16版给出了具体温度，而第17版则引用了制造商的限值。</td>
<td>554-06-04</td>
<td>554.4.4</td>
</tr>
</tbody>
</table>
Section 601 (Section 701 in the 17th) and Section 602 (Section 702 in the 17th) will also apply.

The requirements being prepared in Section 753 will not apply to wall heating systems or to outdoor floor and ceiling heating systems.

**General Requirements**

BS 7671 includes general requirements for heating conductors and cables in Regulation Group 554-06 (16th) and these will appear in 554.4 (17th). These requirements are summarized in Table 1.

**Supplementary Requirements**

The requirements being prepared in Section 753 will not apply to wall heating systems or to outdoor heating systems’.

1. **Protection against electric shock**

The protective measures of obstacles, placing out of reach, non-conducting location and earth-free local equipotential bonding are, as would be expected, not permitted. Additionally, the protective measure of electrical separation is not permitted.

Where the protective measure of automatic disconnection of supply is used, as it will be in almost all cases, the floor or ceiling heating system must be protected by a 30 mA RCD.

Heating elements fall into two categories, those that have a suitable conductive covering, such as a metal sheath and those without. Where a heating element has a conductive sheath, this sheath must be connected to the protective conductor of the circuit. Where a heating element does not
have an earthed covering or sheath, a suitable conductive covering, such as a grid with a spacing of not more than 30 mm, must be provided on site, it must be installed above the floor heating elements or below the ceiling heating elements and be connected to the protective conductor.

Heating elements can have a capacitance to earth which may result in unwanted tripping of the RCD. Limiting the rated heating power to 7.5 kW at 230 V or 13 kW at 400 V downstream of the RCD may avoid unwanted tripping.

Where a circuit supplies heating equipment of Class II construction, a 30 mA RCD must, nonetheless still be provided.

2 Protection against thermal effects

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

The temperature of heating units should not exceed 80 degrees C and this should be achieved by designing the system appropriately, installing the system appropriately or using suitable protective devices.

Connections. Heating units should be connected to the electrical installation via cold tails or suitable terminals. A heating unit must be inseparably connected to its cold tail by means such as by welding, brazing or by compression jointing techniques.

Fault conditions. Under fault conditions, a heating unit may cause higher temperatures or arcs. Measures such as installing a metal sheet close to easily ignitable parts of the building structure should be employed.

3 Selection and erection (See Figure 6)

Flexible sheet heating elements should comply with BS EN 60335-2-96 and heating cables should comply with the BS 6351 series of standards.

4 Operational conditions and external influences

Ceiling heating units should have a degree of protection of not less than IPX1 and floor heating elements for installation in a concrete floor or similar should have a degree of protection not less than IPX7 and have suitable mechanical properties.

5 Identification and notices

The installer shall provide a plan for each heating system containing the following details:

1 Manufacturer and type of heating unit
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, drawing or picture
7 Position/depth of heating unit
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 capacitance.

The plan must be fixed to or adjacent to the distribution board of the heating system.
Section 8 describes advice to be provided by the installer for the user of the installation.

**6 Mutual detrimental influences**

Heating units must not cross expansion joints of the building or structure.

**7 Wiring systems. Heating-free areas**

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 proper emission of heat. See Figure 6. Account shall be taken of the increase in temperature and of its effect upon the cables, including cold leads (circuit wiring) and control wiring installed in heated zones.

The installer shall advise the client and all other contractors that no penetrating means such as screws, rivets, nails, etc shall be used in an area where floor or ceiling heaters are being installed.

**8 Information from the contractor for the user of the installation**

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

1. description of the construction of the heating system, especially the installation depth from finished floor level of the floor heating units
2. 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
3. data on the control equipment used with relevant circuit diagrams and the dimensioned position of floor temperature and weather conditions sensors, if any
4. data on the type of heating units and their maximum operating temperature

The designer/installer of the heating system shall hand over an appropriate number of instructions for use to the owner or his 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:

1. description of the heating system and its function
2. operation of the heating installation in the first heating period in case of a new building, e.g. regarding drying out
3. operation of the control equipment for the heating system in the dwell area and the complementary heating zones as well, if any
4. information on the restriction on placing of furniture or similar
   - additional floor coverings, e.g. carpets with a thickness of >10 mm, may lead to higher floor temperatures which can adversely affect the performance of the heating system
   - pieces of furniture solidly covering the floor and/or built-in cupboards shall only be placed on heating-free areas
   - 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
5. information on restrictions on placing of furniture or similar
6. 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
7. dimensioned position of complementary heating zones and placing area
8. statement that in 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.