

Safe Heating in Hospitals

Introduction

With such a wide range of activities and purpose-designed spaces, effective heating of hospitals requires a thorough appraisal of the needs of each space and a solution that meets the needs of that space. Included in that appraisal is the need to assess risk of injury from heating equipment.

Any hospital that is open to the public, which includes privately run establishments as well as NHS hospitals, has a Duty of Care to ensure that visitors are not exposed to unnecessary risk. As well as general Health & Safety liabilities, operators of such buildings are vulnerable to compensation claims from any injury that can be shown to have been caused by neglect. This includes neglecting to carry out a proper risk assessment and take all reasonable measures to minimise risk.

For these reasons, a thorough risk assessment, followed by appropriate actions, will not only establish a safer environment, it may also reduce public liability insurance premiums.

Risks that need to be assessed and minimised, in relation to heating systems, include exposure to hot surfaces on radiators and associated pipework and the danger of someone being injured by a sharp edge or corner. Other design considerations include energy efficiency, heating performance, aesthetics and ease of use.

Considerations for heating Hospitals

The design of hospitals and the equipment used in them is driven by guidance from NHS Estates. In a report commissioned by NHS Estates, the Centre for Healthcare Architecture and Design (CHAD) provides the following guidance:

The heating, ventilation and air conditioning systems should be logically designed to operate efficiently and provide local control where required. Set out thermal and ventilation requirements and performance standards (refer to specific guidance as appropriate).

Issues to consider:

- maximising the use of natural ventilation
- minimising the use of heating
- minimising the use of cooling
- surface temperatures of radiators
- zoning, draining and cut-off controls

The Chartered Institution of Building Services Engineers recommends temperatures for the following areas of hospitals.

Bedheads/wards 22–24°C

Circulation spaces (wards) 19–24°C

Consulting/treatment rooms 22–24°C

Nurses stations 19–22°C

Operating theatres 17–19°C

In specifying heating equipment for hospitals, the following factors should be considered:

- Risk from hot surfaces and sharp edges
- Positioning of radiators
- Ease of use
- Aesthetics
- Robustness
- Sizing of radiators
- Heating performance and energy efficiency
- Maintenance and cleaning

Minimising risk

Each of these spaces needs to be considered and assessed in the light of the activities carried out within the space. In each case, the design of the heating system should take account of the most vulnerable people that may use the space – the ‘worst case scenario’. Any public and patient areas must certainly be provided with safe heating.

In designing for the worst case scenario, account needs to be taken of the vulnerability of children and older people to burns from hot surfaces and injury from sharp edges during a fall. It is important to assume that any publicly accessible area could be visited by these more vulnerable members of society.

On several occasions the Health & Safety Executive has expressed concern about the continuing high number of burning incidents from hot surfaces in a range of premises. Typically, these hot surfaces would be conventional radiators, with a surface temperature of as much as 75°C, and associated pipework. At these temperatures, serious burns can be caused within seconds.

Those at risk include elderly people, people with mental illness, people with reduced sensitivity to temperature and those who cannot react quickly enough to prevent injury when they touch a hot surface. Burns can also be caused when an individual falls against a hot surface and is physically unable to move

because of a disability or because they have been trapped by the furniture arrangement.

The susceptibility of older or injured people to losing their balance and falling over also dictates that attention is paid to the design of radiators, ensuring there are no sharp corners that can cause serious injury.

Avoiding hot surfaces

There are a number of measures that can be taken to reduce the risk of burns from hot surfaces.

Radiant panels

This type of low surface temperature heat emitter uses low temperature water and a very large surface area for transferring the heat to the space – in the form of a radiant panel mounted on the wall. However, these are relatively impractical for most areas of a hospital because they need to occupy a substantial area of the wall to be effective, and are quite expensive in terms of capital costs and installation. In many older properties, the ability of the walls to support the significant weight of a radiant panel would also need to be assessed.

Underfloor heating

For spaces with high ceilings, such as atria and lecture theatres in teaching hospitals, underfloor heating may be an appropriate solution, but in smaller spaces radiators are generally a more cost-effective, responsive and efficient option.

Reduced flow temperatures

In existing installations, reducing flow temperatures to standard radiator systems will reduce risk but will also reduce performance to a level where the heating is ineffective, as the system will have been designed for higher flow temperatures.

Heat sources at high level

Locating sources of heat at high level is another option but, as warm air rises, this tends to reduce the effectiveness of the heating because most of the heat will be concentrated at ceiling height. Destratification fans can be used to force the warmer down into the space, but this can cause uncomfortable draughts and increases running costs by using more electricity. The capital costs of such an installation are also higher.

Guarding hot surfaces

In any building with a conventional 'wet' heating system, with perimeter radiators served by central boiler plant, by far the most practical solution to prevent contact with hot surfaces is to guard the heated areas with a physical barrier.

Such guarding measures need to be part of the design of the system, rather than ad hoc measures that may not provide complete protection. Temporary measures such as putting furniture in front of radiators are not considered acceptable under Health & Safety regulations.

Low surface temperature radiators (LSTs)

The most effective way of guarding hot surfaces is to use radiators that are designed to eliminate the risk of burns by incorporating a casing that covers all hot surfaces. Low surface temperature radiators (LSTs) are designed to do just that, providing a safe, cool-touch solution. The casing of a cool-touch LST covers the pipework as well as the radiator, so that all hot surfaces are concealed and exposed surfaces remain at a safe temperature of no more than 43°C.

Radiators in public areas should also be encased down to floor level so that young children cannot gain access to hot surfaces from below.

Avoiding sharp edges

As mentioned above, another consideration is the risk of people falling onto the radiator and injuring themselves from the impact. There is also a risk that visually impaired people may injure themselves by bumping into or brushing against radiators. Conventional radiators tend to have sharp edges that can cause serious injury. The outer casing of an LST radiator must be designed to avoid sharp edges, using rounded corners and edges to minimise the risk of injury.

Positioning of radiators

With any type of radiator, positioning is important in achieving optimum performance. The standard approach is to position radiators below windows, as this is the area of maximum heat loss from a building. This also helps to prevent condensation forming on cold windows.

As insulation standards improve with the use of the latest thermally efficient double or even triple glazing, in line with the requirements of Approved Document L2 of the Building Regulations, this is less of a consideration, so positioning needs to be considered in relation to the thermal insulation of each building.

Accessibility is an important issue for public areas, so it is important to ensure ease of access for people using wheelchairs and walking frames. Useful

advice is provided by Approved Document M of the Building Regulations, which states: "Corridors and passageways in the entrance storey should be sufficiently wide to allow convenient circulation by a wheelchair user. Consideration should be given to the effects of local obstruction by radiators and other fixtures". This condition is satisfied if "elements such as columns, radiators and fire hoses, do not project into the corridor, or where this is unavoidable, a means of directing people around them, such as a visually contrasting guard rail, is provided".

Greater flexibility in positioning of radiators is achieved through the use of slim line radiators that protrude only a short distance into the room or corridor. Low water content radiators (discussed below) are particularly compact and therefore more versatile from a positioning perspective.

In some cases, depending on the nature of the building fabric, it may prove beneficial to use built in radiators, recessed into walls so no intrusion into the heated space.

Ease of use

As noted by CHAD, heating should provide local control where required. In non-public areas, effective temperature control is achieved through the use of thermostatic radiator valves (TRVs). In public areas, where there is a risk of tampering, heating controls should be accessible only to staff and easy to operate with clear, unambiguous figures and symbols.

Aesthetics

Décor is an important consideration for any publicly used space and, as a highly visible element of a room, radiators need to be designed to complement the rest of the décor. LST radiators offer a high level of flexibility in this respect as the casing can be adapted to a wide range of spaces and shapes and supplied in a diversity of colours. Or the casing can be designed to blend with other decorative or architectural features so that it is barely visible.

Slim line radiators, discussed above, offer a compact and discrete solution that will suit the aesthetic requirements of many areas where floor space is at a premium.

Robustness

While standard LST radiators are suitable for most areas, those located in areas prone to vandalism and knocks by trolleys, such as the A&E department and in corridors, need to be more resilient. For these areas, casings should be specified for extra strength and impact resistance.

Sizing of radiators

Choosing the right size of radiator is essential for optimising performance. A radiator that is too small for the space will not achieve the required temperature on cold days. One that is too big will achieve the required temperature more quickly but could waste energy doing so if the thermostatic temperature controls do not react quickly enough, or if the radiator is a high mass unit which reacts slowly.

The size of radiator is determined by the volume of the room, the desired temperature and the level of insulation of the room – the latter determining the heat output in watts per cubic metre required to maintain the temperature. The table below gives a rough guide to the watts per cubic metre (W/m³) needed relating to different levels of insulation.

The calculation used as an example below is just a rough guide. Any engineer will carry out a detailed and specific heat loss calculation and design the system accordingly.

INSULATION	Watts/m ³	
	Room temp 20°C	Room temp 24°C
Excellent	45	55
Good	65	75
Average	85	95
Poor	100	115

Worked example

Using these figures is clearly illustrated by a worked example for a room with excellent insulation, measuring 3m long x 3m deep and 2.5m high. The desired temperature is 24°C and the water temperatures are 80°C flow and 60°C return.

Calculate the volume of the room by multiplying length x depth x height:

$$3 \times 3 \times 2.5 = 22.5\text{m}^3$$

For excellent insulation and a desired temperature of 24°C, the W/m³ = 55

Multiply the room volume by the W/m³ = 22.5 x 55 = 1237.5W

Thus the required output is 1237.5W but a correction factor needs to be applied to take account of the water temperatures being used in the building, in this case 80°C flow and 60°C return. The correction factor is determined by the Euronorm standard EN442 and for these flow and return temperatures it is 0.9. To arrive at the final output of the radiator the figure derived above (1237.5) is divided by the correction factor (0.9), giving an output of 1375W. A radiator with this output is then selected.

AVERAGE CORRECTION FACTORS ACCORDING TO EN442 - 75/65/20

Tv	Tl	Tr>20	25	30	35	40	45	50	55	60	65	70	75	80	85
90	20	0.63	0.69	0.75	0.81	0.87	0.94	1.00	1.07	1.13	1.20	1.27	1.34	1.41	1.48
	24	0.54	0.59	0.65	0.71	0.77	0.83	0.90	0.96	1.03	1.09	1.16	1.23	1.29	1.36
85	20	0.57	0.63	0.69	0.75	0.81	0.87	0.94	1.00	1.07	1.13	1.20	1.27	1.34	
	24	0.48	0.54	0.59	0.65	0.71	0.77	0.83	0.90	0.96	1.03	1.09	1.16	1.23	
80	20	0.51	0.57	0.63	0.69	0.75	0.81	0.87	0.94	1.00	1.07	1.13	1.20		
	24	0.43	0.48	0.54	0.59	0.65	0.71	0.77	0.83	0.90	0.96	1.03	1.09		
75	20	0.46	0.51	0.57	0.63	0.69	0.75	0.81	0.87	0.94	1.00	1.07	1.13	1.20	
	24	0.37	0.43	0.48	0.54	0.59	0.65	0.71	0.77	0.83	0.90	0.96	1.03	1.09	EXAMPLE
70	20	0.41	0.46	0.51	0.57	0.63	0.69	0.75	0.81	0.87	0.94				
	24	0.32	0.37	0.43	0.48	0.54	0.59	0.65	0.71	0.77	0.83				
65	20	0.35	0.41	0.46	0.51	0.57	0.63	0.69	0.75	0.81					
	24	0.27	0.32	0.37	0.43	0.48	0.54	0.59	0.65	0.71					
60	20	0.30	0.35	0.41	0.46	0.51	0.57	0.63	0.69						
	24	0.23	0.27	0.32	0.37	0.43	0.48	0.54	0.59						
55	20	0.26	0.30	0.35	0.41	0.46	0.51	0.57							
	24	0.18	0.23	0.27	0.32	0.37	0.43	0.48							
50	20	0.21	0.26	0.30	0.35	0.41	0.46								
	24	0.14	0.18	0.23	0.27	0.32	0.37								
45	20	0.16	0.21	0.26	0.30	0.35									
	24	0.13	0.17	0.22	0.26	0.31									
40	20	0.10	0.14	0.18	0.23	0.27									
	24	0.12	0.16	0.21	0.26										
35	20	0.06	0.10	0.14	0.18										
	24	0.08	0.12	0.16											
30	20	0.03	0.06	0.10											
	24	0.05	0.08												

Average correction factor for boiler temperatures 82/71/21 °C = 1.15

The indicated outputs with ΔT 50 and ΔT 60 are the exact outputs. ΔT 50 output measured in accordance with EN 442 and ΔT 60 output calculated according to EN 442. An average correction factor is given in the table above for all other ΔT outputs, applicable for all dimensions.

If necessary, the radiator manufacturer will be able to assist with these calculations.

Heating performance and energy efficiency

Both public and commercial hospital operators need to take account of energy consumption and many NHS Trusts are trying to work to rigorous energy targets. For this reason, it is essential that the heating system is energy efficient as well as effective.

Most conventional perimeter heating fluctuates widely through the course of the day, starting at full output on a cold morning and gradually easing off as the ambient temperature rises. However, it is also important that the heating system reacts quickly to changes in the space temperature caused by other factors, such as variable occupancy of rooms or solar heat gains, especially in modern well insulated buildings. In an operating theatre, for example, internal heat gains from people and equipment will fluctuate greatly during the day.

The high water volume and high mass of conventional radiators makes them quite slow to respond in this respect. A more responsive, and therefore more efficient, solution is the use of low mass low water content heat emitters. These contain as little as 10% of the water content of a traditional radiator, so they buffer less heat and react at least three times faster to fluctuations in temperature. As a result, they heat up immediately if the temperature falls below the set-point and stop heating as soon as the set-point is exceeded. Independent testing by the Building Research Establishment has shown that

this can provide a saving in energy consumed of between 5% and 15% depending on outside weather conditions.

Maintenance and cleaning

Once an efficient system has been designed and installed it will require regular maintenance to ensure that efficiency continues and must be easy to keep clean. As well as servicing of boilers, radiators should be bled annually and visibly inspected for leaks or damage. Because of thermal air currents, there will also be a build up dust on grilles and these will require regular cleaning.

The chosen radiators should therefore be easy to access and maintain. With LST radiators, access should be as easy as possible without compromising on security. Useful features to look for are the ability to remove grilles separately from the casing for cleaning, as well as the ability to remove the casing completely without needing to drain the central heating system. This latter feature will also be useful when decorating is carried out.

About Jaga

Jaga offers a wide range of safe, cool-touch LST radiators, designed to minimise risk and comply with regulations without compromising on performance or style. Jaga's LST radiators are created through a combination of innovation, experience and engineering excellence, making them ideal for any project where safety is paramount.

Widely used in hospitals, care homes, schools and other applications where vulnerable people need protection from hot surfaces, Jaga's LST radiators include features such as low mass low water content (low-H₂O), impact resistance, anti-tamper fixings and dirt-repellent finishes. For ease of maintenance, casings can be removed and replaced without disturbing the heating elements.

The compact nature of Low-H₂O radiators allows them to be built into a wall recess or behind seating and other wall-mounted items to provide a powerful and efficient, yet unobtrusive LST heating solution.

Sustainability and the environment

Jaga has a policy of manufacturing ecologically sustainable products, using the minimum amounts of raw materials and energy in their construction, backed by the use of environmentally friendly paint shops without solvents and with total recovery. All Jaga products are fully recyclable.