Safe Heating in Prisons and Secure Accommodation

Introduction

Prisons, detention centres and other forms of secure accommodation present particular challenges for the specifier and installer of building services equipment. As an accessible element of the heating system, the design and positioning of the radiator requires particularly careful attention.

Radiators for secure accommodation need to be extremely robust to withstand harsh treatment. In addition they must not offer the opportunity for creating make-shift weapons, nor should they provide detainees with a place of concealment or an opportunity for self-harm.

Considerations for heating Prisons and Secure Accommodation

Heating a prison cell and the common areas of a prison is essentially the same as other spaces, except for the special considerations that need to be given to the design of radiators. Frequently, the heating will be supplied by a conventional 'wet' heating system, comprising radiators served by central boiler plant.

The Chartered Institution of Building Services Engineers recommends the temperature for prison cells should be in the range 19°C to 21°C. General areas of a prison will usually be designed to similar temperature set points.

Radiator design

Radiators for prisons and secure accommodation need to address the following considerations:

- Potential for harm
- Potential for vandalism
- Potential for make-shift weapons
- Potential for concealing drugs and weapons
- Efficient performance and sustainability
- Need for small footprint

Minimising risk of harm

There are several ways in which a conventional radiator can facilitate prisoners harming themselves and other inmates. Prison operators have a duty of care to ensure that any such risks are minimised.

The surface temperature of a conventional radiator will typically be around 75°C, which can cause serious burns from just a few seconds contact. This provides the potential for prisoners to deliberately burn themselves or to force others into direct contact with the hot surfaces.

To avoid this, all hot surfaces should be guarded by a specially designed casing that prevents access to any hot surfaces. Such guarding measures need to be part of the design of the system, rather than ad hoc measures that may not provide complete protection and will be more vulnerable to vandalism (see below) than purpose built cool touch radiators with an integral casing. This is achieved by the use of low surface temperature (LST) radiators, specially designed for this sort of application.

Low surface temperature radiators incorporate a casing that covers all hot surfaces, 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.

The design of many conventional radiators includes sharp corners and edges, which again can be used for causing harm. LST radiators casings, therefore, should not only eliminate contact with hot surfaces but must also provide a smooth, curved design with no sharp edges.

Experience has shown that suicidal prisoners can be very inventive in finding ways to hang themselves from fittings within cells. Even a radiator mounted at floor level or just above can be used as an anchor point for a rope or sheet looped around a higher suspension point. For this reason, LST radiators for prisons are designed with no ligature points, so they cannot be used for anchoring a make-shift noose.

In many cases, depending on the design of the building, fully encased built in radiators will overcome many of these potential problems.

Vandalism

Prisons are volatile environments where violence can erupt at any time. Prisoners are also inclined to harbour resentment against the prison authorities and may be inclined to cause damage to the building and its fittings.

For these reasons, radiators in prisons should be protected by a strong, robust casing that can withstand considerable physical violence. The casing must incorporate very strong front panels and be locked in place with tamper-proof fixings so it cannot be easily removed. Ad hoc radiator covers, with a separate fixing to the wall, are vulnerable to easy removal. In contrast, purpose built LST radiators with an integral casing provide a resilient solution that makes it extremely difficult to remove the casing without special tools.

Graffiti is a less violent form of vandalism but still needs to be addressed. Casing surfaces should be scratch resistant and use an easy clean finish so that any graffiti is easily removed.

Weapons

If removed from their casing, radiator grilles offer a relatively sharp edge that can be used as a make-shift weapon. For this reason grilles must be securely fitted to the casing with no accessible leverage points for removing them. The mesh of the grille needs to be small enough to prevent items being inserted into the mesh to gain leverage for forcing the grille from its mounting. A fine mesh also limits the potential for concealment of illicit items (see below).

A robust design, as described above, which conceals all pipework as well as the radiator, will prevent access to pipework that can also be wrenched from its fittings and used as a weapon.

Concealment

There are many items that prisoners may want to conceal from prison officers, ranging from weapons to drugs. To prevent the radiator being used as a place for concealment, all radiators must be completely enclosed, down to floor level, with a fine mesh.

Performance

Prisoners are entitled to a comfortable environment and any discomfort will increase the risk of resentment and resultant disruption. It is essential, therefore, that the radiators achieve the required temperature and maintain it. In association areas, the heating must also respond quickly to fluctuating heat gains caused by changes in occupancy. Running costs must also be considered, and many prison operators are charged with meeting stringent energy targets, so it is important that the heating system operates efficiently.

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.

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.

Sustainability

Sustainability is an important consideration in the design of new social housing projects and attaining the requirements will include meeting energy targets and using recyclable products wherever possible.

Compact design

Floor space is usually at a premium in prisons so the radiator should have as small a footprint as possible to minimise its intrusion into the space. Built in radiators will often provide the most appropriate solution, where the nature of the building fabric allows. However, radiators are often used for drying clothes in prison cells, so if this is a requirement a design that allows clothes to be placed on top safely may be the preferred choice, using a slim line design that also offers high security.

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/m^3) 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.

	Watts/m^3	
INSULATION	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 x 3 x 2.5 = 22.5m^3

For excellent insulation and a desired temperature of 24°C, the W/m^3 = 55
Multiply the room volume by the W/m^3 = 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	[illegible]	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			
	24	0.37	0.43	0.48	0.54	0.59	0.65	0.71	0.77	0.83	0.90	0.96			
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												

EXAMPLE

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.

Maintenance

Once an efficient system has been designed and installed it will require regular maintenance to ensure that efficiency continues. 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 by authorised personnel, while also meeting the security criteria outlined above. Maintenance should also be as quick as possible because of the need to remove prisoners from cells while maintenance is being carried out.

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 care homes, schools, hospitals 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-H_2O), 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-H_2O 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.