

In order to determine the amount of radiating surface necessary to maintain the MRT at 72 F, assume the surface temperature of the hot plates to be installed to be 200 F, which is approximately the temperature they would have if heated by steam.

The 2016 sq ft total area of the surfaces of the room multiplied by 130.9, which is the emission in Btu per square foot per hour necessary to maintain a body surface temperature of 83 F, gives a total desired emission of 263,890 Btu per hour. It is necessary to supply enough radiant heating surface to increase the total actual mean radiant heat emission by the room from 228,310, as shown in Table 2, to the 263,890 Btu desired. The additional heat needed is the difference between these figures, or 35,580 Btu. Since, from Table 1, the emission per square foot at 200 F is 309 Btu, the required radiant heating surface needed is $\frac{35,580}{309} = 115$ sq ft. The effect of this surface suitably placed

would be to raise immediately the mean radiant temperature to the required degree and to maintain it at that value as long as the surfaces remained at the values assumed.

In the solution of this particular example, the radiation loss from the human body was selected as 217 Btu per hour, which is that taking place under optimum comfort conditions, with a body surface temperature of 83 F in a uniform environment at 72 F. The mean radiant temperature necessarily was 72 F. If the optimum BET of 72 deg Fahr is desired, an air temperature of 72 F also must be maintained. If it is desired to maintain a lower air temperature than this, a mean radiant temperature greater than 72 F must be selected and the radiation loss from the individual must be recalculated from Equation 1.

The calculation may be simplified by preparing tables showing, at the usual temperatures, the area of hot surface required to bring each square foot of actual wall surface at various temperatures up to a general standard of from 60 F to 70 F. It would then be necessary only to multiply the respective areas by the appropriate factors, and to add the results, to obtain the required total.

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PROBLEMS IN PRACTICE

1 ● Where did radiant heating derive its name?

The term radiant heaters was introduced about 28 years ago to designate flat heating surfaces made to give off practically all their heat by radiant ether waves instead of relying on convected warm air.

2 ● What is actually meant by radiant heating and what are its underlying principles?

The term radiant heating now applies to methods of heating where, instead of heating the air in a room to a predetermined temperature, flat heating surfaces are placed in a room so that the average effective temperature of walls, ceiling, glass and floor surfaces exposed to the body is just sufficient to prevent the body losing too much heat by radiation. It takes into consideration that the body generates more heat than it requires, so that it does not require any heat from without. The surplus heat, however, must be given off according to the physiological requirement of the body.

3 ● What kind of heating surfaces are in general use?

The heating units may have flat iron surfaces heated with steam or hot water and placed in side walls or under windows, or they may be supported on the ceiling and suitably decorated and connected as ordinary steam or hot water radiators. Hot water pipes may be embedded in the floor, walls or ceiling, and when in the floors they may be covered with concrete and wood blocks or other suitable material; the finish of the surface being more important than the composition of the material. When in the ceiling or walls, they can be covered with plaster to harmonize with the rest of the room. Electrical radiant heaters are made by embedding resistance elements in porcelain, or electric conductors may be woven into thick paper and fastened to the walls and ceilings, electric wires may be woven with tapestry to form portable screens for local heating.

4 ● What surface temperatures are generally used?

Where hot water pipes are embedded in plaster, the surface temperature varies from 90 to 130 F. Where flat iron plates are used these may vary from 140 to 220 F. With electric resistances embedded in porcelain the surface temperature may vary from 200 to 500 F. High surface temperatures are not recommended.

5 ● What kind of heat rays are commonly generated for radiant heating?

All heat rays are generally assumed to be the same as light rays; they travel at the speed of light, but they are invisible and longer. The rays used in heating are 0.00005 to 0.0001 in. long, compared with invisible red rays of about 0.000027 in.

6 ● When and why does the human body feel cold?

The body feels cold not only when it loses heat at a greater rate than it can generate it but also when heat is abstracted from the body disproportionately. Since the human body generates more heat than is necessary, it is only necessary to provide conditions that will regulate the correct ratio of losses; the provision of suitable radiant heating surfaces is one way to establish these conditions.

7 ● Is the heat generated in the body affected by action? If so, does it vary greatly?

Yes. With hard work or energetic exercise, the total heat generated in the body may be 5 to 6 times that generated when it is at rest.

8 ● Why is the heat loss from the body by radiation important?

The heat loss by radiation is proportional to the fourth power of the temperature difference between the surface of the body and the average surface temperature of the surrounding walls, windows, etc.; whereas, for convection losses, it is only proportional to the 1.25 power.