For other luminaire types, it may be necessary to estimate the heat gain for each component as a fraction of the total lighting heat gain by using judgment to estimate heat-to-space and heat-to-return percentages.

Because of the directional nature of downlight luminaires, a large portion of the short-wave radiation typically falls on the floor. When converting heat gains to cooling loads in the RTS method, the solar radiant time factors (RTF) may be more appropriate than nonsolar RTF. (Solar RTF are calculated assuming most solar radiation is intercepted by the floor; nonsolar RTF assume uniform distribution by area over all interior surfaces.) This effect may be significant for rooms where lighting heat gain is high and for which solar RTF are significantly different from nonsolar RTF.

ELECTRIC MOTORS

Instantaneous sensible heat gain from equipment operated by electric motors in a conditioned space is calculated as

$$q_{em} = 2545(P/E_M)F_{UM}F_{LM} \tag{2}$$

where

q_{em} = heat equivalent of equipment operation, Btu/h
P = motor power rating, hp
E_M = motor efficiency, decimal fraction <1.0
F_{UM} = motor use factor, 1.0 or decimal fraction <1.0
F_{LM} = motor load factor, 1.0 or decimal fraction <1.0
2545 = conversion factor, Btu/h·hp

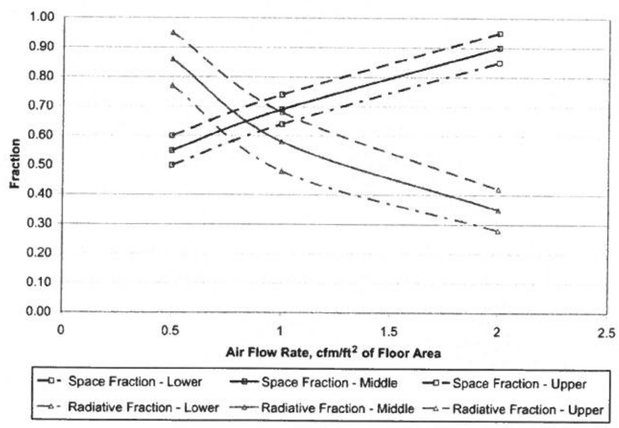

Fig. 3 Lighting Heat Gain Parameters for Recessed Fluorescent Luminaire Without Lens
(Fisher and Chantrasrisalai 2006)

The motor use factor may be applied when motor use is known to be intermittent, with significant nonuse during all hours of operation (e.g., overhead door operator). For conventional applications, its value is 1.0.

The motor load factor is the fraction of the rated load delivered under the conditions of the cooling load estimate. In Equation (2), it is assumed that both the motor and driven equipment are in the conditioned space. If the motor is outside the space or airstream,

$$q_{em} = 2545PF_{UM}F_{LM} \tag{3}$$

When the motor is inside the conditioned space or airstream but the driven machine is outside,

$$q_{em} = 2545P\left(\frac{1.0 - E_M}{E_M}\right)F_{UM}F_{LM} \tag{4}$$

Equation (4) also applies to a fan or pump in the conditioned space that exhausts air or pumps fluid outside that space.

Table 4 gives minimum efficiencies and related data representative of typical electric motors from ASHRAE *Standard* 90.1-2007. If electric motor load is an appreciable portion of cooling load, the motor efficiency should be obtained from the manufacturer. Also, depending on design, maximum efficiency might occur anywhere between 75 to 110% of full load; if under- or overloaded, efficiency could vary from the manufacturer's listing.

Overloading or Underloading

Heat output of a motor is generally proportional to motor load, within rated overload limits. Because of typically high no-load motor current, fixed losses, and other reasons, F_{LM} is generally assumed to be unity, and no adjustment should be made for underloading or overloading unless the situation is fixed and can be accurately established, and reduced-load efficiency data can be obtained from the motor manufacturer.

Radiation and Convection

Unless the manufacturer's technical literature indicates otherwise, motor heat gain normally should be equally divided between radiant and convective components for the subsequent cooling load calculations.

APPLIANCES

A cooling load estimate should take into account heat gain from all appliances (electrical, gas, or steam). Because of the variety of appliances, applications, schedules, use, and installations, estimates can be very subjective. Often, the only information available about

Table 3 Lighting Heat Gain Parameters for Typical Operating Conditions

Luminaire Category	Space Fraction	Radiative Fraction	Notes
Recessed fluorescent luminaire without lens	0.64 to 0.74	0.48 to 0.68	• Use middle values in most situations • May use higher space fraction, and lower radiative fraction for luminaire with side-slot returns • May use lower values of both fractions for direct/indirect luminaire • May use higher values of both fractions for ducted returns
Recessed fluorescent luminaire with lens	0.40 to 0.50	0.61 to 0.73	• May adjust values in the same way as for recessed fluorescent luminaire without lens
Downlight compact fluorescent luminaire	0.12 to 0.24	0.95 to 1.0	• Use middle or high values if detailed features are unknown • Use low value for space fraction and high value for radiative fraction if there are large holes in luminaire's reflector
Downlight incandescent luminaire	0.70 to 0.80	0.95 to 1.0	• Use middle values if lamp type is unknown • Use low value for space fraction if standard lamp (i.e. A-lamp) is used • Use high value for space fraction if reflector lamp (i.e. BR-lamp) is used
Non-in-ceiling fluorescent luminaire	1.0	0.5 to 0.57	• Use lower value for radiative fraction for surface-mounted luminaire • Use higher value for radiative fraction for pendant luminaire

Source: Fisher and Chantrasrisalai (2006).