Internal heating can create issue with the thermal safety of glass, either by adding more heat into the glass from convection from the localised heating of air, or by direct radiant heating.

DIRECT RADIANT HEATING

Radiators and other radiant heating devices will impart energy directly in to the glass, which will directly affect the resulting temperature of the internal pane, and by heat transfer through the insulating glass unit, the external pane as well.
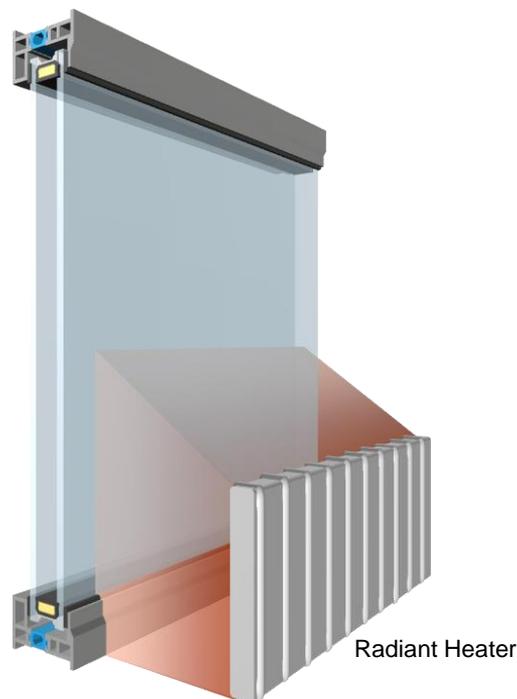

Radiant Heater

Figure 1 - Illustration of Radiant Heater

The thermal energy emitted by radiators will be dependent on the materials, design and temperature. The energy output, assessed in accordance with EN 442-1:2014 [1], can be used for thermal safety assessments. In the absence of known data, for the purposes of a thermal safety assessment, the energy output, Φ_h, can be estimated using the following relationship, modified from EN 442-1:2014, and considering distance to the glass;

$$\Phi_h = \frac{K_m \cdot (\Delta T)^n}{d}$$

Where, K_m area dependant coefficient,

ΔT Temperature difference between the radiator and the glazing internal surface,

n Heating element coefficient (estimated at 1.265),

d distance between glazing and radiator,

The area dependant coefficient can be estimated from the following equation;

$$K_m = 1.45 \cdot A^{0.5}$$

Where, A Radiator area

To illustrate the potential energy incident on the glazing, an example for a 1 m^2 area radiator at 75°C is shown below;
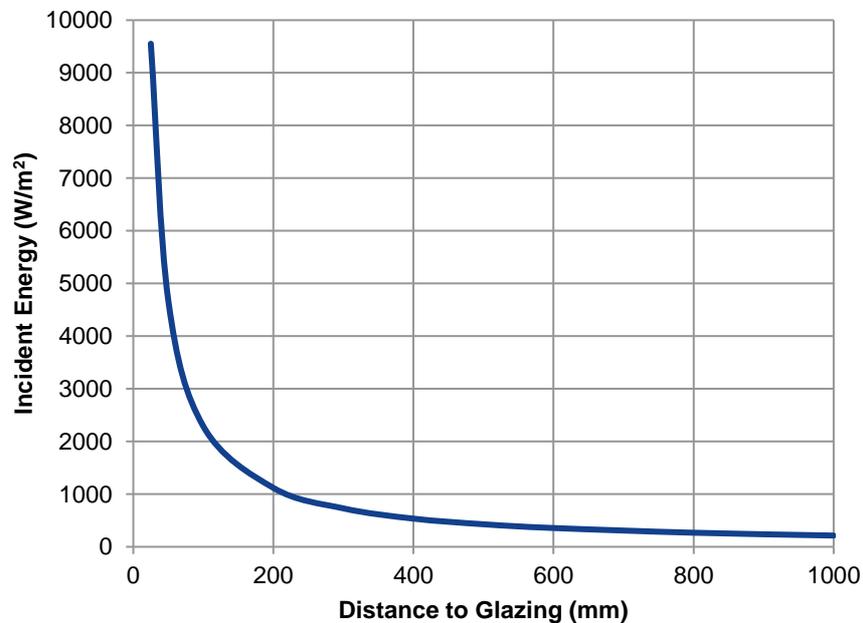

Figure 2 - Incident Radiation on Glass Due to Presence of Heater

As stated, these values should be considered as estimates only, and if more accurate information is available from HVAC engineers, this should be used in preference.

CONVECTION HEATING

As well as radiant heaters, convection heaters, whether forced air or natural, can also impact the glazing by creating localised temperature increases. Any heating device of this type in the vicinity of the glazing should be considered, such as standard convection heaters, trench heaters and air conditioning units.
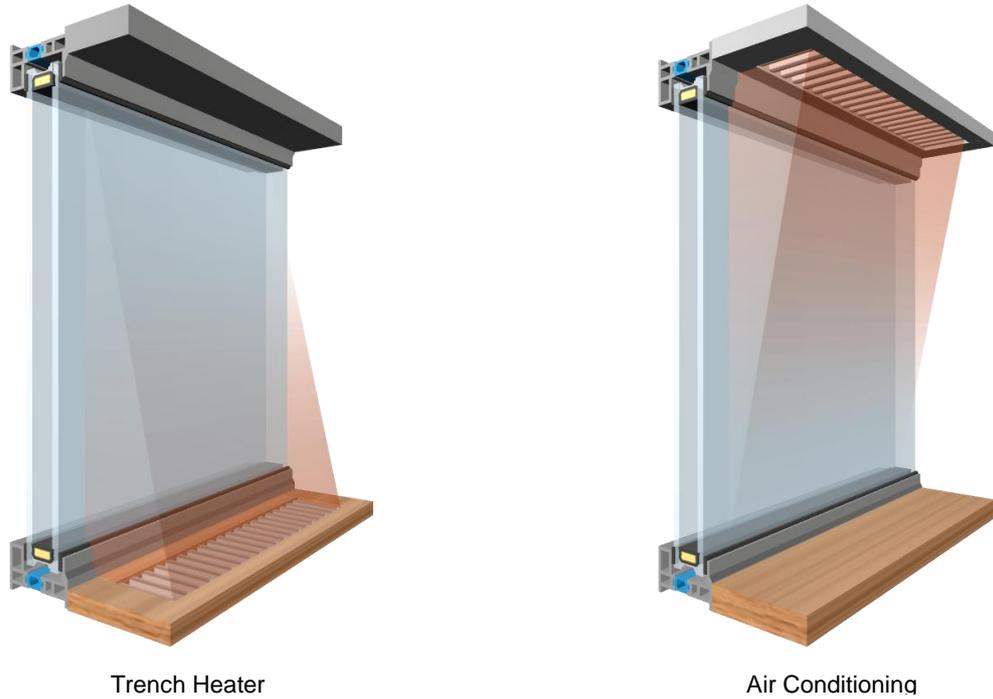
Trench Heater | Air Conditioning

Figure 3 - Illustration of Convective Heater

The impact on glazing is considered with an increase of the temperature of the inner pane and the outer pane with consideration to the heat transfer internally, externally, and across the cavity. The temperature rise is taken as the difference from ambient internal, typically 20°C.

INFLUENCE ON CALCULATED TEMPERATURE DIFFERENCES

The influence of internal heating on the calculated temperature differences modifies the basic temperature differences (ΔT_b), as below;

Outer Pane:
$$\Delta T_{b;1} = \frac{\Phi_s \cdot \alpha_{e1} \cdot (h_i + h_t) + (\Phi_s \cdot \alpha_{e2} + \Phi_h) \cdot h_t + h_e \cdot (h_i + h_t) \cdot \Delta T_d + h_i \cdot h_t \cdot \Delta T_i}{h_e \cdot h_i + h_e \cdot h_t + h_i \cdot h_t}$$

Inner Pane:
$$\Delta T_{b;2} = \frac{\Phi_s \cdot \alpha_{e1} \cdot h_t + (\Phi_s \cdot \alpha_{e2} + \Phi_h) \cdot (h_e + h_t) + h_e \cdot h_t \cdot \Delta T_d + h_i \cdot (h_e + h_t) \cdot \Delta T_i}{h_e \cdot h_i + h_e \cdot h_t + h_i \cdot h_t}$$

REFERENCES

[1] European Committee for Standardization, EN 442-1:2014 - Radiators and convectors - Technical specifications and requirements, CEN, 2014.