SAN Electro Heat

Member of the NIBE Group

Calculation of temperature control in enclosures

What's needed:
1. The dimensions of the enclosure (height, width, depth) (m)
2. The enclosure position (e.g. single enclosure, enclosure in row) according to calculation formula, enclosure surface area A (m²)
3. The enclosure material (metal, plastic) heat transfer coefficient from table, k (W/m² K)
4. The temperature difference between desired enclosure interior temperature Ti (°C) and the expected ambient temperature Tu (°C) (e.g. day - night, summer - winter, climate zones) ΔT (K=Kelvin)
5. The stray power (self-warming) of all installed components during operation (e.g. transformers, relays, semiconductors) P_V (W)

Calculation and selection of parameters: enclosure surface area - heat transfer coefficient - temperature difference

1. Enclosure surface area from dimensions

2. Enclosure position (plan view) acc. to VDE 0660 part 500

	Formular for cabinet surface area A (m²)
	H = height - W = width - D = depth
Single enclosure free on all sides	A = 1.8 x H x (W + D) + 1.4 x W x D
Single enclosure, wall mounted	A = 1.4 x W x (H + D) + 1.8 x D x H
First or last enclosure in free standing row	A = 1.4 x D x (H + W) + 1.8 x W x H
First or last enclosure in wall mounted row	A = 1.4 x H x (W + D) + 1.4 x W x D
Middle enclosure in free standing row	A = 1.8 x W x H + 1.4 x W x D + D x H
Middle enclosure in wall mounted row	A = 1.4 x W x (H + D) + D x H
Middle enclosure in wall mounted row with covered top	A = 1.4 x W x H + 0.7 x W x D + D x H

Example.: Enclosure free on all sides, 2000mm high / 800mm wide / 600mm deep. A = 1.8 x 2.0 x (0.8 + 0.6) + 1.4 x 0.8 x 0.6 = 5.712m²

3. Enclosure material and its heat transfer coefficient k (W/m² K)

Steel sheet, painted	k~5.5W/m² K
Steel sheet, stainless	k~4.5W/m² K
Aluminium	k~12W/m² K
Aluminium, double-walled	k~4.5W/m² K
Polyester	k~3.5W/m² K

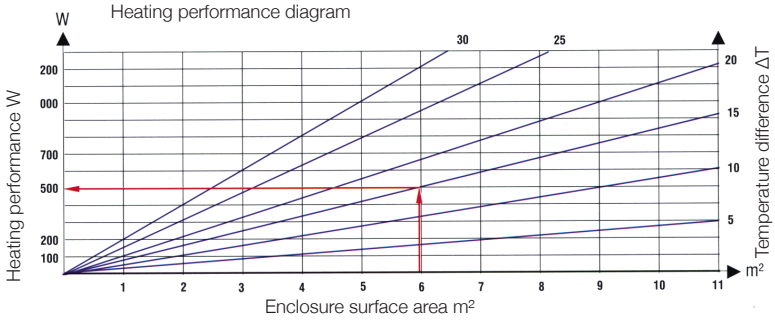
4. Temperature difference ΔT (K=Kelvin)

ΔT = Ti - Tu

i.e. the temperature difference between interior and exterior temperatures.

Calculation formula for required heating performance (heater):
Required heating performance P_H (W) = enclosure surface area A (m²) x heat transfer coefficient k (W/m² K) x temperature difference ΔT (K)
Example.: W = 5.712m² x 5.5W/m² K x 15K = 471.24W
Result: Heater with 500W heating performance is required. If enclosure is situated outdoors the calculated heating performance must be doubled!

Or choose required heating performance from diagram:

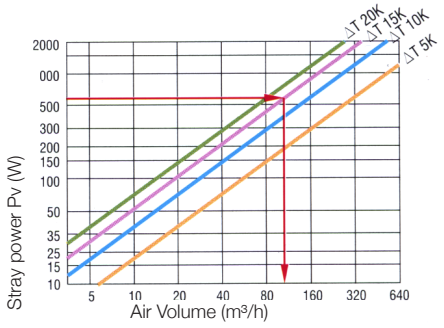


5. In case of continuous stray power P_V (W) (self-warming) this must be deducted from the calculated heating performance.

Choose required cooling performance from diagram:
Or calculate using formula for required cooling performance (filter fan):

Required air volume V (8m³/h) = $\frac{\text{installed stray power Pv(W)}}{\text{temperature difference ΔT (K)}}$ x air constant f* (3.3m³K/Wh)

Example.: V = $\frac{600W}{15K}$ x 3.3m³K/Wh = 132m³/h



*f(0-100)=3.1m³ K/Wh, f(100-250)=3.2m³K/Wh, f(250-500)=3.3³K/Wh, f(500-750)=3.4m³K/Wh, f(750-1000)=3.5m³K/Wh

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