Selection Calculations

Selection Procedure
This section describes the basic selection procedure for ventilation and cooling indicated in the usage procedure for the cooling fan.

Specifications and Conditions of the Equipment
Clarify what the interior temperature (°C) should be adjusted to in the equipment design.

Heat Generation within the Equipment
Calculate the sum total of heat generation from the heat generating products inside the equipment.

Calculate Required Air Flow
Calculate the required air flow based on the generated amount of heat, the degree decrease, and the point at which the ambient temperature became apparent.

Selection of Cooling Fans
Select a cooling fan according to the required air flow. Obtain the air flow of the cooling fan when it is installed based on the air flow – static pressure characteristics of the cooling fan and the pressure losses of the equipment. Generally, calculating the equipment pressure loss is difficult, so select a cooling fan in which the maximum air flow is 1.3 to 2 times of your required air flow.

Selection Calculations

Selection Calculations/Cooling Fans

Selection Example – Ventilation and Cooling of Control Box –

Specifications of Control Box

<table>
<thead>
<tr>
<th>Item</th>
<th>Code</th>
<th>Specifications</th>
</tr>
</thead>
<tbody>
<tr>
<td>Installation Environment</td>
<td></td>
<td>Factory Floor</td>
</tr>
<tr>
<td>Control Box</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Size</td>
<td>W</td>
<td>Width 700 mm</td>
</tr>
<tr>
<td>Height</td>
<td>H</td>
<td>Height 1,000 mm</td>
</tr>
<tr>
<td>Depth</td>
<td>D</td>
<td>Depth 400 mm</td>
</tr>
<tr>
<td>Surface Area</td>
<td>S</td>
<td>2.37 m²</td>
</tr>
<tr>
<td>Material</td>
<td></td>
<td>SPCC</td>
</tr>
<tr>
<td>Overall Heat Transfer Coefficient</td>
<td>U</td>
<td>5 W/(m²K)</td>
</tr>
<tr>
<td>Permissible Temperature Rise</td>
<td>ΔT</td>
<td>20°C</td>
</tr>
<tr>
<td>Total Heat Generation</td>
<td>Q</td>
<td>450 W</td>
</tr>
<tr>
<td>Power Supply</td>
<td></td>
<td>50 Hz 220 VAC</td>
</tr>
</tbody>
</table>

(1) Calculating the Required Air Flow
This section describes a way to obtain this figure using calculations and an easy way to obtain it using a graph.

Obtaining by Calculations
\[ V = 1 + 0.07 \times (Q + ΔT × S) \times S_f \]
\[ = 1 + 0.07 \times (450 + 20 - 5 \times 2.37) \times 2 \]
\[ = 1.07 \text{ m}^3/\text{min} \]

When the required air flow is calculated, you must consider internal pressure loss. Generally, the pressure loss within the control box is unknown, so the air flow at the operating point is assumed to be 50% of the maximum air flow, taking into account a safety factor \( S_f = 2 \).

Obtaining by Graph
① Calculate the intersection point A of the amount of heat generation \( Q \) and the allowable temperature rise \( ΔT \) of 20°C.
② Draw a horizontal axis from the intersection point A (starting point).
③ Calculate the intersection point B of the horizontal line and surface area \( S = 2.37 \text{ m}^2 \).
④ The required air flow (approx. 0.5 [m³/min]) can be obtained by drawing a vertical line from intersection point B as shown on the graph.
⑤ From the reasons described above, the required air flow 1.00 [m³/min] can be derived by taking into account a value twice the safety factor \( S_f = 2 \).

Selection Flow Chart for Cooling Fans

Clarify the required conditions of the equipment
Clarify what the interior temperature (°C) should be adjusted to based on the warranty operating temperature of the internal parts and components of the equipment.

Calculate the amount of heat
Calculate the amount of heat generated internally from the rated output power and efficiency of the heat generating products inside the equipment.

Calculate the required air flow
Calculate the required air flow in order to set the desired temperature.

Selection of Cooling Fans
Select a cooling fan that has a maximum air flow that is 1.3 to 2 times of your required air flow.

Selection Example – Ventilation and Cooling of Control Box

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