Enclosure Cooling

You need to cool down

Heat inside an enclosure can decrease the life expectancy of controlling units such as your PLC, HMI, AC drives and other items. Excessive heat can cause nuisance faults from your electrical and electronic components: for example, overloads tripping unexpectedly. Heat will also change the expected performance of circuit breakers and fuses, which can cause whole systems to shut down unexpectedly. So, if you have any electronic equipment or other heat sensitive devices, you may need cooling.

What causes all that heat?

There are basically two sources that can cause the enclosure’s internal temperature to rise above the ratings of the control equipment.

Internal Sources

The same items that can be damaged by heat may also be the source of the heat. These include items such as:

- Power supplies
- AC Drives/inverters
- Transformers
- Communication products
- Battery back-up systems

External Sources

Other sources of heat that can cause the internal temperature of your enclosure to rise above a desired level involve the external environment. These include items such as:

- Industrial ovens
- Foundry equipment
- Solar heat gain
- Blast furnaces

Get the heat out

How do you get the heat out of your enclosure and away from those critical components? There are four basic cooling methods.

Natural Convection Cooling

If the ambient temperature outside the enclosure is cooler than the inside of the enclosure, then the heat can be dissipated into the atmosphere by radiating it through the surface of the enclosure and through the use of louvers or grilles with filters.

Forced Convection Cooling

If you have clean and cool ambient air outside of the enclosure, then a simple forced-air system may be adequate. A system such as a filter fan and the associated grille with the appropriate filter may be an acceptable option.

Closed Loop Cooling

A system that will keep the ambient air separate from the internal enclosure air is needed if the environment is harsh, there are wash-down requirements, heavy dust and debris or the presence of airborne chemicals, and the ambient temperature is as high as or higher than the desired internal temperature. Air conditioners and heat exchangers are examples of closed loop systems.

Vortex Coolers

Vortex coolers create a stream of cold air from a supply of filtered compressed air. The cold air is injected into the enclosure, displacing warm air which is exhausted back through the vortex cooler. While not a closed-loop system, they can be used in the same harsh environments since the cold air injected into the enclosure is filtered.
Enclosure Cooling – Selecting a Fan or Air Conditioner

Fan selection
To select the proper size (CFM) fan for your forced air cooling solution, you need to determine the amount of heat to be removed (in watts) and determine the Delta T (Max. allowable internal enclosure temperature °F – Max. outside ambient temperature °F).

\[
CFM = \frac{3.17 \times P_{\text{watts}}}{\Delta T \; ^\circ F} \\
\Delta T = \text{Max. allowable internal enclosure temperature °F} - \text{max. outside ambient temperature °F}
\]

Stego offers an online Cooling Calculation Tool to help you calculate the required airflow rate for your application.

Air conditioner and vortex cooler selection
To select the proper size air conditioner or vortex cooler, the worst-case conditions should be considered, but take care not to choose an oversized unit.

There are two main factors in choosing an uninsulated metal NEMA rated enclosure located indoors:
- Internal heat load
- Heat load transfer

Internal Heat Load

Internal heat load is the heat generated by the components inside the enclosure. This can be determined by a few different methods. The preferred method is to add the maximum heat output specifications that the manufacturers list for all the equipment installed in the cabinet. This is typically given in Watts, so use the following conversion:

\[
\text{BTU per Hour} = \text{Watts} \times 3.413
\]

Example: The Watt-loss chart for the GS3 Drives shows that a GS3-2020 AC drive has a Watt-loss of 750 watts.

\[
\text{BTU per Hour} = 750 \times 3.413 \\
= 2559 \text{ BTU/H}
\]

Heat Load Transfer

Heat load transfer is the heat lost (negative heat load transfer) or gained (positive heat load transfer) through the enclosure walls with the surrounding ambient air. This can be calculated by the following formula:

\[
\text{Heat load transfer (BTU/H)} = 1.25 \times \text{Surface area (sq. ft.)} \times (\text{max. outside ambient air °F} - \text{max. allowable internal enclosure temperature °F})
\]

Surface Area (sq. ft.) = \(2 \times (H \times W) + (H \times D) + (W \times D)\) / 144 sq. inches

Note: 1.25 is an industry standard constant for metal enclosures; 0.62 should be used for plastic enclosures.

Once you have determined your Internal Heat Load and the Heat Load Transfer, you can choose the proper size unit by calculating the needed cooling capacity.

\[
\text{Cooling capacity (BTU/H)} = \text{Internal Heat Load} \pm \text{Heat Load Transfer}
\]

Fan Selection Example
A NEMA 12 Hubbell Wiegmann N12302412 enclosure (30" high x 24" wide x 12" deep) contains a GS3-2020 AC drive (20 HP 230 volt) that has a maximum operating temperature of 104°F and is located in a warehouse that has a maximum outside ambient air temperature of 92°F.

Power to be dissipated is stated in the specifications of the GS3-2020 and is found to be 750 watts, so \(P = 750 \text{ watts}\)

\[
\Delta T = \text{Max. operating temperature for the GS3-2020} - \text{Max. ambient air temperature of 92°F}
\]

\[
\Delta T = 9 \degree F
\]

\[
\text{CFM} = \frac{3.17 \times 750 \text{ watts}}{9 \degree F}
\]

\[
\text{CFM} = 198
\]

Choose a Stego 018740-30 230VAC FPI filter fan with a 118740-00 exhaust grille to provide 220 CFM or a Stego 018840-00 230VAC FPO filter fan with a 118840-30 intake grille to provide 243 CFM.

Air Conditioner Selection Example
A NEMA 12 Hubbell Wiegmann N12302412 enclosure (30" high x 24" wide x 12" deep) contains a GS3-4030 AC drive (30 HP 460 volt) that has a maximum operating temperature of 104°F and is located in a warehouse that has a maximum outside ambient air temperature of 115°F.

Power to be dissipated is stated in the specifications of the GS3-4030 and is found to be 1290 watts.

\[
\text{Internal heat load:}
\]

\[
\text{BTU per Hour} = 1290 \times 3.413
\]

\[
\text{BTU per Hour} = 4403 \text{ BTU/H}
\]

\[
\text{Heat load transfer:}
\]

\[
\text{Heat load transfer (BTU/H)} = 1.25 \times 19 \text{ sq. ft.} \times (115\degree F - 104\degree F)
\]

\[
\text{Heat load transfer (BTU/H)} = 261.25 \text{ BTU/H}
\]

\[
\text{Cooling capacity:}
\]

\[
\text{Cooling capacity (BTU/H)} = 4403 + 261.25
\]

\[
\text{Cooling capacity (BTU/H)} = 4664.25 \text{ BTU/H}
\]

In this example, you are able to determine that a 5000 BTU/H unit is needed. Select a TA10-050-16-12 Stratus air conditioner.

Note: The same calculation method is used for sizing Stratus vortex coolers. However, in this example the cooling requirements exceed the maximum capacity of the largest available vortex cooler. If the example application required the use of a vortex cooler instead of an air conditioner, two (2) TV35-025-4X units would be needed.
Industrial strength cooling options for your enclosure from AutomationDirect

- Both intake (FPI) and exhaust (FPO) fans are available.
- Exhaust fans and grilles available with air flaps or filters. Using air flaps on the exhaust reduces the number of filters to maintain.

Filter Fan Kits
- Easy filter change
- Outer door lock for outdoor models
- Impact resistant
- Weather/UV resistant -f1
- Flammability Rating: UL94V-0
- Adhesive mounting for non-screw installation (except outdoor models)
- Low noise
- 120VAC and 24VDC models available

Filter Fan Plus
- Easy filter change
- Hinged cover
- Impact resistant
- Weather/UV resistant-UL-f1
- Flammability Rating: UL94V-0
- Unique ratchet mechanism for no-screw installation
- Low noise
- 120, 230VAC and 12, 24, 48VDC models available

Hose-Proof Filter Fan Hoods
- Stainless steel hood with food-grade silicone seal
- Fits all Stego Filter Fan and Filter Fan Plus fans and exhaust grilles (except outdoor Filter Fans)
- Maintains an enclosure’s NEMA/UL Type 4 or 4X rating in washdown environments

Fan Kits
- All models are 115V with an expected service life of 30,000 hours
- High-performance fan motors and finger guards
- Polycarbonate fire retardant plastic grilles, UL94-V0
- Durable, reusable filter mat included
- Patented "Click and Fit" system allows for rapid filter fan and exhaust filter installation without screws

For the latest prices, please check AutomationDirect.com.
Industrial strength cooling options for your enclosure from AutomationDirect

Heat Exchangers

- For NEMA 4 and 4X enclosures
- Closed loop cooling
- Energy efficient: uses approximately the same power as a filtered fan system
- 120VAC and 24VDC models available

Air Conditioning Units

- For NEMA 12, 4, 4X type enclosures
- Digital temperature controller
- Active condensate evaporation system
- High unit efficiency
- Tough industrial construction
- Compressor protection system

Enclosure Vortex Coolers

- For NEMA 12, 4, 4X type enclosures
- Operates on compressed air
- Stainless steel construction
- No moving parts, no maintenance required
- Vortex coolers can be “resized” for changing applications by simply replacing the generator inside the cooler. No need to purchase a new unit
- Replacing the vortex generator takes minutes

Made in the USA

Compact & 48VDC models now available

For the latest prices, please check AutomationDirect.com.
Filter Fan Plus

Air Flap Design
The Stego Filter Fan Plus series employs a new air flap design for the air outlet. The air flaps have less resistance to airflow than an exhaust filter, which allows the Filter Fan Plus system to achieve higher airflow while still preventing the ingress of contaminants. Curved air flaps react to small airflow volumes for maximum opening of flaps. Filter Fan Plus series fans are for indoor use only.

Ratchet Mounting
A ratchet mechanism is used for mounting, providing a high stability and tightness. No mounting screws needed. Prevents enclosure wall deformity when mounting. Solid locking ensures uniform seal.

Filter Fan Plus Models: FPI or FPO

FPI systems (airflow direction ‘in’) use a filter fan in the lower part of the enclosure, ensuring fresh air is fed into the enclosure. The air rises to the top of the enclosure, cooling the internal space and pushing the warm interior air through the exhaust grille near the top. This grille exhausts hot air more effectively, thanks to new air flap outlet technology.

In FPO systems (airflow direction ‘out’), the filter fan is located in the upper area of the enclosure to avoid heat buildups. The heat can be diverted quicker from the critical area. An intake grille with a filter in the lower part of the enclosure allows the colder air from the outside to enter.
Filter Fan Plus

Features
- FPI (airflow in) or FPO (airflow out) models
- Air flap outlet technology
- IP54 dust and splash waterproof
- Easy filter change with access provided via the hinged cover
- Impact resistant
- UV light resistant according to UL 746C (F1)
- Flame retardant: UL94 V-0
- Low noise
- 115 and 230VAC models available
- 12, 24, and 48VDC models available
- (4) 6-position ratchet lever mount mechanism will accommodate wall thickness 0.039 - 0.157in (1 - 4mm)

Construction
- Fan body is light gray plastic polycarbonate
- FPI model has an intake filter fan and an exit grille with air flaps
- FPO model has an exit fan with air flaps and an intake grille with filter
- Poured-in-place polyurethane gasket for better seal
- Mounts using built-in ratchet mechanism; no screws needed. (Hardware provided for optional screw mounting. Hole markings for screw mounting are indicated on mounting frame.)

Applications
Filter fans provide an optimum climate in enclosures with electrical/electronic components. The interior temperature of enclosures is reduced by channeling cooler filtered outside air into the enclosure, thus expelling heated internal air. The resulting air flow prevents formation of localized heat pockets and protects electronic components from overheating.

Standards
- All models: IP54, VDE, EAC, CE, UL Type 12 when using supplied filter.
- UL Recognized - file: E234324

3.62 x 3.62 in
4.88 x 4.88 in
6.93 x 6.93 in
8.78 x 8.78 in
11.46 x 11.46 in
Filter Fan Plus

3.62 x 3.62 inch Cutout Size
- Storage temperature: -40 to 158° F (-40 to 70° C)
- Operating temperature: -4 to 158° F (-20 to 70° C)
- Connection type: 2 stranded wires, 11.8” (300mm) long, AWG 22
- Service life:
  - AC - 52,500 hrs @ 104° F (40° C)
  - DC - 70,000 hrs @ 104° F (40° C)
- Average arrestance: 84% with provided G3 (coarse) filter
- Replacement filter mats
  - G3 (coarse): 086330-00
  - G4 (medium): 086270-00
  - M5 (fine): 086300-00

### Filter Fan Plus - FPI System

<table>
<thead>
<tr>
<th>Part Number</th>
<th>Price</th>
<th>Description</th>
<th>Filter/ Air Flaps</th>
<th>Operating Voltage</th>
<th>Power Consumption (W)</th>
<th>Current Draw (mA)</th>
<th>Free Airflow (CFM)</th>
<th>Airflow with Grille &amp; Filters (CFM)</th>
<th>Max Static Pressure (Pa)</th>
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Note: Performance data (current draw, power consumption, free airflow with a grille and filters, sound level) for all AC fans is based on 60Hz.

### Filter Fan Plus - FPO System

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Note: Performance data (current draw, power consumption, free airflow with a grille and filters, sound level) for all AC fans is based on 60Hz.

See our website: www.AutomationDirect.com for complete engineering drawings.
## Filter Fan Plus - FPI System

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Filter Fan Plus - FPO System

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### Specifications
- **4.88 x 4.88 inch Cutout Size**
- **Part Number**: 018710-30
- **Price**: $67.00
- **Description**: Enclosure fan, G3 filter
- **Operating Voltage**: 230VAC
- **Power Consumption**: 19 W
- **Current Draw**: 83 mA
- **Free Airflow**: 31 CFM
- **Max Static Pressure**: 49 Pa
- **Sound Level**: 49 dB

### Notes
- **Performance data** (current draw, power consumption, free airflow with a grille and filters, sound level) for all AC fans is based on 60Hz.
**Filter Fan Plus**

**6.93 x 6.93 inch Cutout Size**
- Storage temperature: -40 to 158°F (-40 to 70°C)
- Operating temperature: -13 to 158°F (-25 to 70°C)
- Connection type: 3-pole clamp for AWG 14 (2.5 mm²), screw clamp torque 7.1 lb-in (0.8 N-m) max
- Service life:
  - AC - 65,000 hrs @ 104°F (40°C)
  - DC - 80,000 hrs @ 104°F (40°C)
- Average air flow: 84% with provided G3 (coarse) filter
- Replacement filter mats
  - G3 (coarse): 086350-00
  - G4 (medium): 086020-00
  - M5 (fine): 086050-00

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### Filter Fan Plus - FPI System

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<th>Price</th>
<th>Description</th>
<th>Filter/ Air Flaps</th>
<th>Operating Voltage</th>
<th>Power Consumption (W)</th>
<th>Current Draw (mA)</th>
<th>Free Airflow (CFM)</th>
<th>Airflow with Grille &amp; Filters (CFM)</th>
<th>Max Static Pressure (Pa)</th>
<th>Sound Level (dB)</th>
</tr>
</thead>
<tbody>
<tr>
<td>018720-30</td>
<td>$115.00</td>
<td>Enclosure fan</td>
<td>G3 filter</td>
<td>230VAC</td>
<td>45</td>
<td>196</td>
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<td>121</td>
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<td>018721-30</td>
<td>$169.00</td>
<td>Enclosure fan</td>
<td>G3 filter</td>
<td>48VDC</td>
<td>12</td>
<td>250</td>
<td>100</td>
<td>87</td>
<td>122</td>
<td>63</td>
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<td>018722-30</td>
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</tbody>
</table>

Note: Performance data (current draw, power consumption, free airflow with a grille and filters, sound level) for all AC fans is based on 60Hz.

---

### Filter Fan Plus - FPO System

<table>
<thead>
<tr>
<th>Part Number</th>
<th>Price</th>
<th>Description</th>
<th>Filter/ Air Flaps</th>
<th>Operating Voltage</th>
<th>Power Consumption (W)</th>
<th>Current Draw (mA)</th>
<th>Free Airflow (CFM)</th>
<th>Airflow with Grille &amp; Filters (CFM)</th>
<th>Max Static Pressure (Pa)</th>
<th>Sound Level (dB)</th>
</tr>
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<tbody>
<tr>
<td>018820-00</td>
<td>$121.00</td>
<td>Enclosure fan</td>
<td>Air flaps</td>
<td>230VAC</td>
<td>45</td>
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<td>81</td>
<td>143</td>
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<td>250</td>
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<td>018822-00</td>
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<td>12</td>
<td>500</td>
<td>159</td>
<td>83</td>
<td>138</td>
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<td>018823-00</td>
<td>$177.00</td>
<td>Enclosure fan</td>
<td>Air flaps</td>
<td>12VDC</td>
<td>12</td>
<td>1000</td>
<td>164</td>
<td>82</td>
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<td>330</td>
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<td>162</td>
<td>60</td>
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<td>G3 filter</td>
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<td>38</td>
<td>330</td>
<td>126</td>
<td>87</td>
<td>139</td>
<td>53</td>
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<tr>
<td>118820-30</td>
<td>$24.50</td>
<td>Intake grille</td>
<td>G3 filter</td>
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</table>

Note: Performance data (current draw, power consumption, free airflow with a grille and filters, sound level) for all AC fans is based on 60Hz.
### Filter Fan Plus - FPI System

<table>
<thead>
<tr>
<th>Part Number</th>
<th>Price</th>
<th>Description</th>
<th>Filter/ Air Flaps</th>
<th>Operating Voltage</th>
<th>Power Consumption (W)</th>
<th>Current Draw (mA)</th>
<th>Free Airflow (CFM)</th>
<th>Airflow with Grille &amp; Filters (CFM)</th>
<th>Max Static Pressure (Pa)</th>
<th>Sound Level (dB)</th>
</tr>
</thead>
<tbody>
<tr>
<td>018730-30</td>
<td>$148.00</td>
<td>Enclosure fan</td>
<td>G3 filter</td>
<td>230VAC</td>
<td>64</td>
<td>278</td>
<td>190</td>
<td>150</td>
<td>154</td>
<td>64</td>
</tr>
<tr>
<td>018739-30</td>
<td>$154.00</td>
<td>Enclosure fan</td>
<td>G3 filter</td>
<td>115VAC</td>
<td>81</td>
<td>704</td>
<td>195</td>
<td>173</td>
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<tr>
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<td>Air flaps</td>
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</table>

Note: Performance data (current draw, power consumption, free airflow with a grille and filters, sound level) for all AC fans is based on 60Hz.

### Filter Fan Plus - FPO System

<table>
<thead>
<tr>
<th>Part Number</th>
<th>Price</th>
<th>Description</th>
<th>Filter/ Air Flaps</th>
<th>Operating Voltage</th>
<th>Power Consumption (W)</th>
<th>Current Draw (mA)</th>
<th>Free Airflow (CFM)</th>
<th>Airflow with Grille &amp; Filters (CFM)</th>
<th>Max Static Pressure (Pa)</th>
<th>Sound Level (dB)</th>
</tr>
</thead>
<tbody>
<tr>
<td>018830-00</td>
<td>$157.00</td>
<td>Enclosure fan</td>
<td>Air flaps</td>
<td>230VAC</td>
<td>64</td>
<td>278</td>
<td>316</td>
<td>165</td>
<td>172</td>
<td>65</td>
</tr>
<tr>
<td>018830-40</td>
<td>$148.00</td>
<td>Enclosure fan</td>
<td>G3 filter</td>
<td>230VAC</td>
<td>64</td>
<td>278</td>
<td>177</td>
<td>134</td>
<td>154</td>
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<tr>
<td>018839-00</td>
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<td>Air flaps</td>
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<td>81</td>
<td>704</td>
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<td>182</td>
<td>103</td>
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<td>Enclosure fan</td>
<td>G3 filter</td>
<td>115VAC</td>
<td>81</td>
<td>704</td>
<td>191</td>
<td>148</td>
<td>92</td>
<td>68</td>
</tr>
<tr>
<td>118830-30</td>
<td>$29.50</td>
<td>Intake grille</td>
<td>G3 filter</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note: Performance data (current draw, power consumption, free airflow with a grille and filters, sound level) for all AC fans is based on 60Hz.

- **8.78 x 8.78 inch Cutout Size**
- Storage temperature: -40 to 158°F (-40 to 70°C)
- Operating temperature: -13 to 149°F (-25 to 65°C)
- Connection type: 3-pole clamp for AWG 14 (2.5 mm²), clamping torque 7.1 lb·in (0.8 N·m) max
- Service life: 56,000 hrs @ 104°F (40°C)
- Average arrestance: 84% with provided G3 (coarse) filter
- Replacement filter mats
  - G3 (coarse): 086360-00
  - G4 (medium): 086280-00
  - M5 (fine): 086310-00
- **Filter Fan Plus - FPO System**
  - FPO intake grille designed to be used with the FPO fans listed above only.

For the latest prices, please check AutomationDirect.com.
**Filter Fan Plus**

**11.46 x 11.46 inch Cutout Size**
- Storage temperature: -40 to 158°F (-40 to 70°C)
- Operating temperature: -13 to 95°F (-25 to 35°C)
- Connection type: 3-pole clamp for AWG 14 (2.5 mm²), clamping torque 7.1 lb·in (0.8 N·m) max
- Service life: 76,000 hrs @ 104°F (40°C)
- Average arrestance: 84% with provided G3 (coarse) filter
- Replacement filter mats
  - G3 (coarse): 086370-00
  - G4 (medium): 086380-00
  - M5 (fine): 086320-00

### Filter Fan Plus - FPI System

<table>
<thead>
<tr>
<th>Part Number</th>
<th>Price</th>
<th>Description</th>
<th>Filter/Air Flaps</th>
<th>Operating Voltage</th>
<th>Power Consumption (W)</th>
<th>Current Draw (mA)</th>
<th>Free Airflow (CFM)</th>
<th>Airflow with Grille &amp; Filters (CFM)</th>
<th>Max Static Pressure (Pa)</th>
<th>Sound Level (dB)</th>
</tr>
</thead>
<tbody>
<tr>
<td>018740-30</td>
<td>$198.00</td>
<td>Enclosure fan</td>
<td>G3 filter</td>
<td>230VAC</td>
<td>95</td>
<td>413</td>
<td>255</td>
<td>220</td>
<td>99</td>
<td>62</td>
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<tr>
<td>018749-30</td>
<td>$215.00</td>
<td>Enclosure fan</td>
<td>G3 filter</td>
<td>115VAC</td>
<td>90</td>
<td>783</td>
<td>232</td>
<td>200</td>
<td>73</td>
<td>61</td>
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<tr>
<td>118740-00</td>
<td>$93.00</td>
<td>Exhaust grille</td>
<td>Air flaps</td>
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<td></td>
<td>FPI exhaust grille designed to be used with the FPI fans listed above only.</td>
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</table>

Note: Performance data (current draw, power consumption, free airflow with a grille and filters, sound level) for all AC fans is based on 60Hz.

### Filter Fan Plus - FPO System

<table>
<thead>
<tr>
<th>Part Number</th>
<th>Price</th>
<th>Description</th>
<th>Filter/Air Flaps</th>
<th>Operating Voltage</th>
<th>Power Consumption (W)</th>
<th>Current Draw (mA)</th>
<th>Free Airflow (CFM)</th>
<th>Airflow with Grille &amp; Filters (CFM)</th>
<th>Max Static Pressure (Pa)</th>
<th>Sound Level (dB)</th>
</tr>
</thead>
<tbody>
<tr>
<td>018840-00</td>
<td>$209.00</td>
<td>Enclosure fan</td>
<td>Air flaps</td>
<td>230VAC</td>
<td>95</td>
<td>413</td>
<td>428</td>
<td>243</td>
<td>107</td>
<td>63</td>
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<tr>
<td>018840-40</td>
<td>$198.00</td>
<td>Enclosure fan</td>
<td>G3 filter</td>
<td>230VAC</td>
<td>95</td>
<td>413</td>
<td>265</td>
<td>187</td>
<td>99</td>
<td>63</td>
</tr>
<tr>
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<td>$227.00</td>
<td>Enclosure fan</td>
<td>Air flaps</td>
<td>115VAC</td>
<td>90</td>
<td>783</td>
<td>414</td>
<td>230</td>
<td>80</td>
<td>63</td>
</tr>
<tr>
<td>018849-40</td>
<td>$215.00</td>
<td>Enclosure fan</td>
<td>G3 filter</td>
<td>115VAC</td>
<td>90</td>
<td>783</td>
<td>256</td>
<td>177</td>
<td>73</td>
<td>62</td>
</tr>
<tr>
<td>118840-30</td>
<td>$49.00</td>
<td>Intake grille</td>
<td>G3 filter</td>
<td></td>
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<td></td>
<td></td>
<td>FPO intake grille designed to be used with the FPO fans listed above only.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note: Performance data (current draw, power consumption, free airflow with a grille and filters, sound level) for all AC fans is based on 60Hz.
Filter Fan

Applications
Filter fans provide an optimum climate in enclosures. The interior temperature of enclosures is reduced by channeling cooler filtered outside air into the enclosure, thus expelling heated internal air. The resulting air flow prevents formation of localized heat pockets and protects electronic components from overheating.

Outdoor filter fans are used in outdoor enclosures where warm air must be dissipated. To clean and exchange the filter mat, you open the lockable door of the outdoor hood, eliminating the need to allow interior access to the enclosure. IP55 protection type is achieved due to the special design of the hood and the use of fine filter mats.

Features
- Easy filter change
- Outer door lock for outdoor models
- Impact resistant
- Weather/UV resistant UL-f1
- Flammability Rating: UL 94V-0
- No-screw installation - except outdoor models
- Low noise
- 120VAC and 24VDC models available
- Service life - 50,000 hrs @ 77°F (25°C) + 65%RH
- Connection type - 2 wires w/case clamps, AWG 14, length 4” to 373 CFM - 3 pole terminal, AWG 14, clamping torque 0.8 Nm
- Airflow direction easily switched by reversing the axial fan (except on models 018040-01 and 018050-01)
- Includes self-adhesive gasket pre-installed on frame
- Optional mounting screws for additional support
- G3 (coarse), G4 (medium) and M5 (fine) replacement filter mats available

Standards
- All models: IP54, VDE, EAC, UL type 12 when using supplied filter (outdoor models IP55).
- UL recognized - file: E234324

Note: Using fine filter mat M5 reduces the airflow. (No test data available for G3 filter mats. See Stego Air Volume and Pressure Data, later in this section.)

<table>
<thead>
<tr>
<th>Part Number</th>
<th>Price</th>
<th>Cutout Dimensions</th>
<th>Operating Voltage</th>
<th>Power Consumption</th>
<th>Current Draw</th>
<th>Free Airflow 1.2</th>
<th>Airflow with Grille and Filters 1.2</th>
<th>Max. Static Pressure 1.2</th>
<th>Sound Level 1</th>
<th>Min/Max Operating Temp.</th>
<th>Included Filter Rating</th>
<th>Average Arrestance</th>
</tr>
</thead>
<tbody>
<tr>
<td>018000-02</td>
<td>$93.00</td>
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<td>24VDC</td>
<td>2.2</td>
<td>90</td>
<td>12</td>
<td>9</td>
<td>19</td>
<td>31</td>
<td>-14/158°F [-10/70°C]</td>
<td>G4 (medium)</td>
<td>94%</td>
</tr>
<tr>
<td>018000-01</td>
<td>$69.00</td>
<td>120VAC</td>
<td>13</td>
<td>160</td>
<td>14</td>
<td>11</td>
<td>18</td>
<td>31</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>018010-02</td>
<td>$103.00</td>
<td>4.92 x 4.92</td>
<td>24VDC</td>
<td>5</td>
<td>210</td>
<td>32</td>
<td>25</td>
<td>32</td>
<td>40</td>
<td>-13/140°F [-25/60°C]</td>
<td>G5 (fine)</td>
<td>98%</td>
</tr>
<tr>
<td>018010-01</td>
<td>$76.00</td>
<td>120VAC</td>
<td>15</td>
<td>180</td>
<td>37</td>
<td>28</td>
<td>30</td>
<td>40</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>018020-02</td>
<td>$106.00</td>
<td>24VDC</td>
<td>5</td>
<td>210</td>
<td>60</td>
<td>40</td>
<td>23</td>
<td>39</td>
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<tr>
<td>018020-01</td>
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<td>120VAC</td>
<td>15</td>
<td>180</td>
<td>69</td>
<td>46</td>
<td>27</td>
<td>39</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>018040-01</td>
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<td>120VAC</td>
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<td>470</td>
<td>136</td>
<td>84</td>
<td>60</td>
<td>52</td>
<td>-13/140°F [-25/60°C]</td>
<td>G4 (medium)</td>
<td>94%</td>
</tr>
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<td>840</td>
<td>176</td>
<td>135</td>
<td>23</td>
<td>53</td>
<td></td>
<td>-14/158°F [-10/70°C]</td>
<td></td>
<td></td>
</tr>
<tr>
<td>018030-01</td>
<td>$269.00</td>
<td>120VAC</td>
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<td>700</td>
<td>202</td>
<td>156</td>
<td>27</td>
<td>53</td>
<td></td>
<td>-14/158°F [-10/70°C]</td>
<td></td>
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</tr>
<tr>
<td>018050-01</td>
<td>$221.00</td>
<td>120VAC</td>
<td>60</td>
<td>700</td>
<td>202</td>
<td>156</td>
<td>27</td>
<td>53</td>
<td></td>
<td>-13/140°F [-60/-25°C]</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Outdoor Filter Fans (Rain Hoods)

<table>
<thead>
<tr>
<th>Part Number</th>
<th>Price</th>
<th>Cutout Dimensions</th>
<th>Operating Voltage</th>
<th>Power Consumption</th>
<th>Current Draw</th>
<th>Free Airflow 1.2</th>
<th>Airflow with Grille and Filters 1.2</th>
<th>Max. Static Pressure 1.2</th>
<th>Sound Level 1</th>
<th>Min/Max Operating Temp.</th>
<th>Included Filter Rating</th>
<th>Average Arrestance</th>
</tr>
</thead>
<tbody>
<tr>
<td>018210-04</td>
<td>$147.00</td>
<td>4.92 x 4.92</td>
<td>24VDC</td>
<td>5</td>
<td>210</td>
<td>12</td>
<td>11.8</td>
<td>48</td>
<td>30</td>
<td>-14/158°F [-10/70°C]</td>
<td>G5 (fine)</td>
<td>98%</td>
</tr>
<tr>
<td>018210-02</td>
<td>$125.00</td>
<td>120VAC</td>
<td>15</td>
<td>180</td>
<td>14</td>
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<td>54</td>
<td>30</td>
<td></td>
<td>-13/140°F [-60/-25°C]</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Notes:
1. Performance data (current draw, power consumption, free airflow, airflow with grille and filters, sound level) for all 120VAC fans is based on 60Hz.
2. Free airflow and maximum static pressure are measured with fan and louvered housing only.
3. Airflow with grille and filters include entire system: complete fan assembly with filter and exhaust grille with filter.

Dimensions in inches [millimeters]
Applications

Designed to maintain the temperature inside an electrical enclosure at or below a safe level for the enclosed equipment, while maintaining a closed loop environment inside the enclosure to keep out contaminates that can be in the ambient air. Can be used in environments such as steel, food processing, petro-chemical, cement, paper/pulp and plastics industries, provided there are no corrosive gases or liquids that could damage internal components.

Construction

- Free-standing rigid chassis for easy installation and maintenance
- All mounting hardware, full-size template and instruction manual included
- Power input terminal block on all models
- All Type 4 and 4X models come with condenser coils coated with an electrically applied corrosion-resistant coating

Features

- Programmable temperature controller with visible alarm features in a 0.57 x 0.29 in [14.5 x 7.3 mm] panel
- 70 °F to 95 °F (20 °C to 35 °C) temperature control range
- 50 °F to 125 °F (10 °C to 52 °C) ambient temperature range
- Pre-wired for external alarm monitoring connections (22 AWG three-conductor cable, 7R (2.3 m) long)
- Active condensate evaporation system with safety overflow
- Protective coated condenser coils on NEMA Type 4 and 4X for corrosion resistance.
- Thermal expansion valve for maximum efficiency over wide range of temperatures and loads
- Anti short-cycle compressor protection
- High and low refrigerant cut-outs with fault indication
- Highly energy-efficient compressors
- UL/cUL listed

Stratus Air Conditioners General Specifications

<table>
<thead>
<tr>
<th>Part Number</th>
<th>Nominal Cooling Capacity (BTU/H)</th>
<th>Operating Voltage</th>
<th>Inrush Current (A)</th>
<th>Running Current (A)</th>
<th>Recommended Fuse Size/Time Delay (A)</th>
<th>SCCR (A)</th>
<th>Connection</th>
<th>Refrigerant</th>
<th>Refrigerant Amount (oz)</th>
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<tr>
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<td>1000</td>
<td>120VAC/60Hz</td>
<td>14.50</td>
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<td>14.00</td>
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<td>5</td>
<td>160kA</td>
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</tbody>
</table>

Notes: *SCCR rating is based on the SCCR rating for the circuit protection device installed in the panel/enclosure per UL484 & UL4848a to protect the AC unit. Typically, 100kA - 200kA for Time-Delay Fuses. Atmosphere: No corrosive gases or liquids.
TA10 Series Enclosure Air Conditioners, Frame Size TA10-1

Air Conditioner Performance Curves

Air Conditioner Dimensions

Dimensions in inches [millimeters]

Please see our website www.AutomationDirect.com for complete engineering drawings.
TA10 Series Enclosure Air Conditioners, Frame Size TA10-2

Air Conditioner Performance Curves

Air Conditioner Dimensions

Dimensions in inches [millimeters]

Please see our website www.AutomationDirect.com for complete engineering drawings.
TA10 Series Enclosure Air Conditioners, Frame Size TA10-3

Air Conditioner Performance Curves

Air Conditioner Dimensions
Dimensions in inches [millimeters]

Please see our website www.AutomationDirect.com for complete engineering drawings.
TA20 Series Compact Air Conditioners, Frame Size TA20-0

Air Conditioner Performance Curves

Air Conditioner Dimensions

Dimensions in inches [millimeters]

Please see our website www.AutomationDirect.com for complete engineering drawings.
TA20 Series Compact Air Conditioners, Frame Size TA20-1

Air Conditioner Performance Curves

Air Conditioner Dimensions

Dimensions in inches [millimeters]

Please see our website www.AutomationDirect.com for complete engineering drawings.
Enclosure Cooling –
Selecting a Heat Exchanger

Heat exchanger selection
To select the proper size heat exchanger, the worst-case conditions should be considered. For a heat exchanger to work, the ambient air temperature must be lower than the desired internal enclosure air temperature.

There are three main factors in choosing a heat exchanger for an uninsulated metal NEMA rated enclosure located indoors:
- Internal heat load
- Delta T
- Heat load transfer

Internal Heat Load
Internal heat load is the heat generated by the components inside the enclosure. This can be determined by a few different methods. The preferred method is to add the maximum heat output specifications that the manufacturers list for all the equipment installed in the cabinet. This is typically given in Watts.

Delta T (ΔT)
Delta T = maximum allowable internal enclosure temperature °F – maximum outside ambient temperature °F.

Heat Load Transfer
Heat load transfer is the heat lost (negative heat load transfer) or gained (positive heat load transfer) through the enclosure walls with the surrounding ambient air. This can be calculated by the following formulas:

Surface Area (sq. ft.) = 2 [(H x W) + (H x D) + (W x D)] / (144 sq. inches/sq. ft.)

Note: Only include exposed surfaces of enclosure in calculations. Exclude surfaces such as a surface mounted to a wall.

Heat Load Transfer (W/°F) = 0.22 W/°F sq. ft. x surface area

Note: Use 0.22 Watts/°F sq. ft. for painted steel and non-metallic enclosures. Use .10 Watts/°F sq. ft. for stainless steel and bare aluminum enclosures.

Cooling Capacity
Once you have determined your Internal Heat Load, the Heat Load Transfer and the Delta T, you can choose the proper size unit by calculating the needed cooling capacity.

Cooling Capacity (W/°F) = Internal Heat Load / ΔT - Heat Load Transfer

Heat Exchanger Selection Example
A NEMA 12 Hubbell Wiegmann N12302412 enclosure (30” high x 24” wide x 12” deep) contains a GS3-4010 AC drive 10 HP 460 volt that has a maximum allowable operating temperature of 104°F and is located in a warehouse that has a maximum outside ambient air temperature of 90°F.

Power to be dissipated is stated in the specifications of the GS3-4010 and is found to be 345 watts.

Internal heat load:
Internal Heat Load = 345 Watts

Delta T:
ΔT (°F) 104°F – 90°F = 14°F

Heat load transfer:
Surface Area (ft.²) = 2 [(30 x 24) + (30 x 12) + (24 x 12)] / 144 sq. inches = 19 ft.²

Heat Load Transfer = 0.22 x 19 ft² = 4.2 Watts/°F

Cooling capacity:
Cooling Capacity = 345 Watts/14°F - 4.2 Watts/°F = 20.4 Watts/°F

In this example, you are able to determine that a Stratus heat exchanger, with a capacity of at least 20.4 Watts/°F is needed, such as a TE30-030-17-04.

*This selection procedure applies to metal and non-metal, uninsulated, sealed enclosures in indoor locations. This selection procedure gives the minimum required size; be careful not to undersize when purchasing.
Air To Air Heat Exchangers

Consider a Better Solution: Air to Air Heat Exchanger

- Always closed loop
- Low cost
- Easier to mount on only one side of your enclosure
- Energy efficient; uses no more power than a filtered fan system
- Filter-free; no diminished cooling capacity

Applications

A closed loop cooling system which employs the heat pipe principle to exchange heat from an electrical enclosure to the outside.

Construction

- Heat pipe technology
- Closed loop design

Features

- All units are available in NEMA Type 4 and 4X
- Available in 120 VAC and 24 VDC
- Motors have a sealed overload protector
- Finned evaporator and condenser sections provide a closed loop
- Coil systems use aluminum end plates and baffles which improve conduction and reduce corrosion for longer life.
- UL/cUL listed

Applications

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Air to Air Heat Exchange

The Air to Air Heat Exchanger is a closed loop cooling system which employs the heat pipe principle to exchange heat from an electrical enclosure to the outside. Where ambient temperatures are suitable for heat pipes, they are the most efficient method of cooling as the waste heat is the engine which drives the system. The only power requirement is to operate two circulating fans or blowers.

Heat pipes have a liquid refrigerant under a partial vacuum inside sealed tubes. They operate with a phase change process which is much like that of mechanical air conditioning, but without the compressor. Each heat pipe has an evaporator section and a condenser section which are separated by a permanent baffle so as to provide a closed loop. The bottom of each heat pipe is in contact with heated air from the electrical enclosure. When the enclosure air reaches approximately 75 degrees F., the refrigerant changes to vapor phase (boils) and the vapor (steam) rises to the top of the tube which is in contact with cooler outside (ambient) air.

When the outside air temperature is lower than the enclosure temperature, the refrigerant vapor gives up heat to the outside air and returns to the liquid phase. It then falls to the bottom and repeats the cycle endlessly so long as there is a negative temperature differential between the enclosure and outside. Heat pipes will not operate in reverse cycle so heat cannot be transferred from the ambient to the interior of the enclosure. Although the operation is self limiting, thermostatic control can be used to shut off the fans when not needed.

The Stratus design has a top-to-bottom enclosure air flow pattern with maximum separation of the inlet and outlet. This design pulls the hottest air from the top of the enclosure and returns the cooled air from the bottom of the heat pipe to the enclosure. The air flow on the ambient side is bottom in, top out, so that the hotter discharge air moves up and away rather than being recirculated.

The units use aluminum end plates and baffles which improve conduction and reduce corrosion for longer life. The center aluminum baffle, which is swaged into the heat pipe coil, provides an air tight seal between the two air systems.
In this image, a standard installation shows where the dirt and particulate will enter the enclosure and be pulled in by the fans on your drives and devices. Filters or not, contamination is invited in by this open loop approach.

In this image, a standard installation demonstrates the closed loop condition maintained by the Air to Air Heat Exchanger. Cool air inlet and outlet vents are completely covered by the heat exchanger. This provides NEMA type 4 or 4X.

### Air To Air Heat Exchanger Specifications

<table>
<thead>
<tr>
<th>Part Number</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>TE20-016-17-04</td>
<td>$1,325.00</td>
</tr>
<tr>
<td>TE20-016-17-4X</td>
<td>$1,510.00</td>
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<td>TE20-016-24D-04</td>
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<td>TE20-036-17-04</td>
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<td>TE20-036-17-4X</td>
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<th>Voltage/Hz</th>
<th>Maximum Ambient Temperature</th>
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<tr>
<td>deep</td>
<td>2. Stainless Steel</td>
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<tr>
<td>tall</td>
<td>3. Stainless Steel</td>
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### Stratus Air to Air Heat Exchangers General Specifications

<table>
<thead>
<tr>
<th>Part Number</th>
<th>Price</th>
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<tr>
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</table>

1 SCCR rating is based on the SCCR rating for the circuit protection device installed in the panel / enclosure per UL50 and UL508a to protect the AC unit. Typically 10KA for Fast Acting Fuses.
2 Cold rolled steel with ANSI 61 gray polyester powder coating inside and out.
3 Fabricated from 16-gauge 304 stainless steel.