Why reliable cooling units are so important for your electrical enclosure

A Pfannenberg cooling unit for your electrical enclosure is much more than just an accessory. In fact, it is basically the backbone of your entire production process because trouble-free production is only guaranteed if the sensitive climate inside your electrical enclosures is maintained.

Even the slightest overheating of the electronic controller units can result in serious consequences such as long standstills, delivery problems or total breakdown. Therefore, we not only take into account the demands placed on your equipment, but on the cooling unit as well.

As an example, how large are the fluctuations in the ambient temperature? Is the control cabinet placement in an environment where the air is full of dust or oil? Is the equipment to be cooled exposed to the weather, i.e. moisture and sunshine? How large are the designated dimensions of the required cooling units?

Once these questions have been clarified completely, Pfannenberg supplies you with highly efficient air conditioning solutions that guarantee the highest degree of safety and energy efficiency.

Air/water heat exchanger
from the Pfannenberg PWS series

Cooling units
from the Pfannenberg DTT/DTI series

Why you should choose air conditioning products from Pfannenberg

Whereas as most of our competitors offer only ‘off the shelf’ products, we additionally offer customised solutions.

This means that our units or unit combinations are precisely tailored to your needs, i.e. neither over nor under-dimensioned and, therefore, always particularly energy-efficient. This is an aspect that is playing an ever larger part in climate control considerations.

In choosing Pfannenberg products, you additionally benefit from high quality, robustness and precision, as well as simple mounting and service friendliness. Many of our products, such as our patented filterfan, can even be mounted and serviced without tools.

As you can see, many reasons speak in favour of Pfannenberg. Let us know your requirements; we will then supply you with an individual solution at a fair price without delay.

Side mounted cooling units
from the Pfannenberg DTS series

Determine the correct air conditioning products

When can Filterfans be used?

If the ambient temperature is always lower than the temperature required in the electrical enclosure, then filterfans represent an economical solution for thermal management of electrical enclosures.

Important for the use of Filterfans:

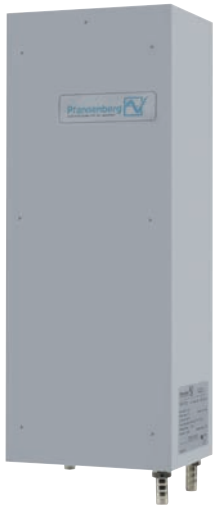
Use filterfans to force the surrounding air into the electrical enclosure, so that a slight overpressure builds up inside the enclosure. The surrounding air enters the electrical cabinet exclusively via the filterfan, which ensures that it is filtered.
Install the filterfan in the lower third of the electrical enclosure and the exhaust filter as close to the top as possible. This assists the natural convection of the air and avoids hot spots within the enclosure.

When are cooling units necessary?

- if cooling cannot be accomplished by the outside air
- if the temperature required inside the electrical cabinet should be equal to or lower than the ambient temperature
- if the ambient air is strongly contaminated with oil or conductive dusts

Important for the use of cooling units:

- ensure a good supply of air intake and outtake from the external circuit of the cooling unit, so that thermal energy can be transferred to the surroundings
- the lowest temperature inside the enclosure may not necessarily be the best. The 35 °C preset by Pfannenberg represents a good compromise between service life and the accumulation of condensation.



When must air/water heat exchangers be used?

- if the thermal energy may not be dispersed to the surroundings
- if aggressive ambient air restricts the use of conventional cooling units
- if a very high IP class is required (up to IP 65)
- if a maintenance-free cooling unit is required

PSS Climatisation – Pfannenberg Sizing Software for the thermal management of electronic enclosures

PSS Climatisation, a new JAVA based software package will help you size filterfans, cooling units, air/water heat exchangers and heaters for your electronic enclosures. The software accounts for both indoor and outdoor applications and can assist you in calculating the heat dissipation within your enclosure, component by component.

Please go to http://pss.pfannenberg.com to download the software.

Combined use as a system solution

Air/water heat exchangers and Chillers

The combination of air/water heat exchangers and chillers offers an ideal system solution for the cooling of your processes, machines and controllers. All cooling tasks in a system or machine and also on a control cabinet can be taken care of simply and economically via a closed pipeline system.

- through the highly economical supply of water as the cooling medium for the air conditioning of control cabinets with air/water heat exchangers
- and 100% independence from the ambient temperature at the installation location

Filterfans and Thermostats

With a combination of filterfans and thermostats you can additionally achieve energy savings, material and time plus a significantly longer service life. This results in an optimised environmental balance as well as greater reliability of your production process:

- through reduced energy consumption and improvement of the filterfan efficiency
- through the reduction of the time required for cleaning the filter mats and
- through a reduction in the consumption of filter mats

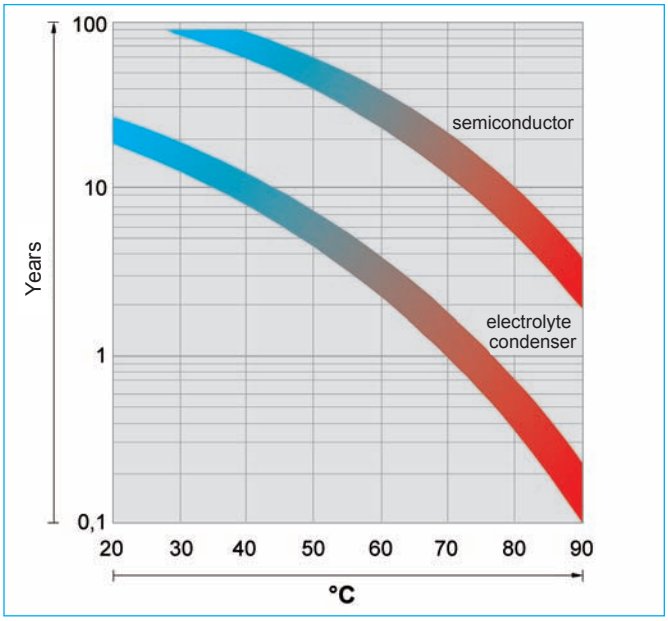
Thermostats, Hygrostats and Heaters

Electrical enclosure heaters in combination with thermostats and hygrostats ensure that the correct temperature is always available. In addition to savings on energy and, therefore, a better environmental balance, the combination of heaters with thermostats and hygrostats offers greater reliability of the production process:

- through pinpoint distribution and constant temperatures in the electrical enclosure
- through reduced energy consumption and improvement of the heater efficiency

The Technology of Cooling

Due to the increasing automation of processes, electro-technical components are used more and more. Therefore, the development of warmth inside the cabinet increases.
The diagram below shows the effects of the increased heat load on random components' service life. The process reliability and keeping service intervals within an economic framework are special challenges thermal management of control cabinets is faced with special challenges such as process reliability and keeping service intervals within an economic framework. Therefore, the choice of the cooling method can be pivotal with regards to it's advantages.



Three basic cooling methods

When selecting a cooling method there are three types to consider:

Natural Convection

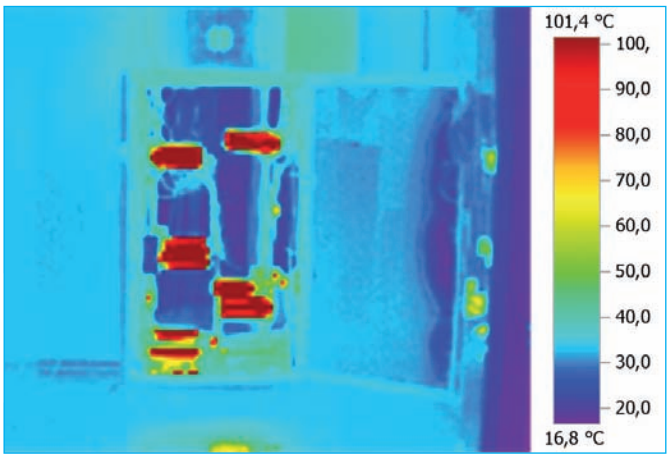
If there is only a minimal heat loss in your application, use of louvers or grills with filters can be effective. This method, however, usually provides less cooling effect than is necessary with today's components.

Forced convection

If the installation will be in a clean, non-hazardous environment with an acceptable ambient (outside the enclosure) temperature range, a simple forced-air cooling system utilizing outside air is usually adequate. Combined with an air filter, such devices generally meet the heat removal needs of typical electronic equipment and many electrical applications. An example of forced convection air cooling is filterfans.

Closed-loop cooling

In harsh environments involving high temperatures, wash-down requirements, heavy particulate matter or the presence of chemicals capable of damaging components (NEMA 4 or 12 environments), ambient air must be kept out of the enclosure. Closed-loop cooling consists of two separate circulation systems. One system seals out the ambient air, cooling and re-circulating clean, cool air throughout the enclosure. The second system uses ambient air or water to remove and discharge the heat. Example of closed-loop cooling equipment employed with electronics and process controls are cooling units and heat exchangers.



Cooling by natural convection

Rules of thumb:

- **limited to roughly + 25 Kelvin rise above ambient -** in general, the temperature rise inside the enclosure would be roughly + 25 Kelvin utilizing natural convection
- **no moving parts -** by eliminating external fans, you create a zero maintenance application
- **no dirt -** utilizing exhaust filters prevents dirt from entering cabinet, dirt can damage electronics as fast as heat!

If the ambient temperature is lower than the temperature inside the electronic cabinet, the dissipated heat escapes into the atmosphere throughout the surface of the electronic cabinet. The following simple equation is used to calculate the level of heat radiated from the electronic cabinet:

$$P_R(W) = C \times A \times \Delta T$$

- **P_R[Watt]: Radiation Power**: Thermal power radiated from the surface area of the electronic cabinet into the ambience into the electronic cabinet
- **C[W/m²K]: Coefficient of heat transmission**: Radiation power per 1 m² surface area and is difference in temperature. This constant is determined by the material:
  sheet steel - 5.5 W/m²K
  stainless steel - 5.5 W/m²K
  aluminium - 12.0 W/m²K
  plastic - 3.5 W/m²K
- **A[m²]: Surface area of electronic cabinet**: Effective surface area of a electronic cabinet measured according to the specifications of VDE 0660, part 500
- **ΔT[K]:** Difference between ambient air temperature and inside air temperature

Cooling with filterfans

Rules of thumb:

- **limited to roughly + 10 Kelvin rise above ambient -** in general, the temperature rise inside the enclosure would be roughly + 10 Kelvin
- **multiple configurations possible -** filterfans can be located in a number of locations within complex enclosure configurations
- **size fans to include static pressure -** understanding how static pressure effects the performance of a fan is very important when sizing filterfans, see chart below!

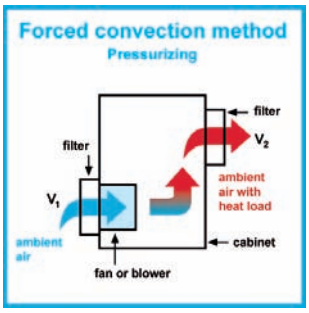
Follow this simple equation for calculating the required airflow:

$$V = \frac{3.1\ (P_D)}{\Delta T}\ [m^3/h]$$

- **V[m³/h]:** Airflow volume of filterfans
- **P_D[Watt]: Dissipation loss**: Thermal power generated inside a cabinet by the dissipation loss of components
- **ΔT:** Difference in temperature between the ambience and inside the electronic cabinet

V_1 - Fan with filter and louver rating (free flow)

V_2 - System rating with exhaust
(includes static pressure drop)



Model	V_1 [m³/h]	V_2 [m³/h]
PF 11.000	25	16
PF 22.000	61	44
PF 32.000	110	82
PF 42.500	156	116
PF 43.000	256	231
PF 65.000	480	370
PF 66.000	640	445
PF 67.000	845	560

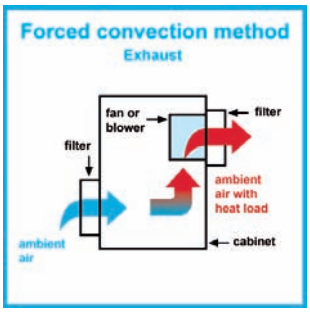
NOTE:
Always calculate cooling capacity of filterfans with the V_2 value.

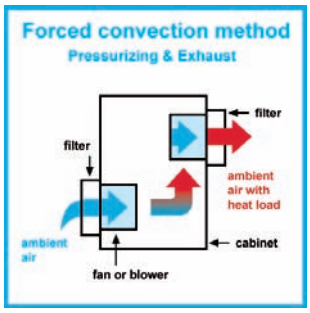
When utilizing filterfans

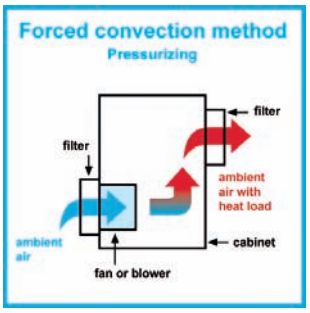
Always use the filterfan to propel the cool ambient air into enclosure. This ensures that slight positive pressure builds up inside the electronic cabinet in comparison to the ambience and that only air filtered by the filterfans flows into the enclosure. The air propelled into the cabinet displaces the warm air which exits through the exhaust filter. If, however, the air is drawn out of the electronic cabinet by suction power, unfiltered air can also enter through poor seals and cable entries.

If you install a combination of filterfan/exhaust filter, fit the filterfan in the lower third of the electronic cabinet if possible. The exhaust filter must be installed as near to the top as possible to prevent heat pockets in the upper part of the cabinet.

Install a FLZ 530 thermostat to control your filterfan. This will increase the life of the fan and decrease the amount of maintenance required to clean the filters.







Cooling with closed loop cooling units

Rules of thumb:

- **only method for reducing cabinet temperature below ambient -** if the ambient temperature is greater than the target internal temperature of the enclosure, active cooling is required
- **applications from NEMA type 12 to 4x -** closed loop systems can maintain the NEMA type rating of the cabinet
- **designer must size per ambient temperatures -** by utilizing performance charts, be sure to correctly size your system!

Pfannenberg cooling units operate on the principle of the Carnot cycle. This means that the cooling unit functions as a heat pump that “pumps” the thermal energy transferred from the electronic cabinet (heat dissipated from the components) up to a higher level of temperature (the ambient temperature can reach levels as high as + 55 °C). The air inside the enclosure is cooled down by the evaporator and at the same time dehumidified.

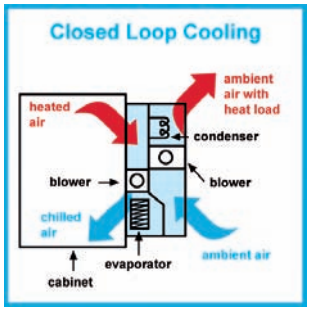
Cooling units are used if:

- the outside air cannot be used for cooling
- the required temperature inside the enclosure should be equal-to or lower-than the required ambient temperature
- the ambient air is extremely oily or dirty

Steps for sizing a cooling unit

Proper selection of a cooling unit is determined by the following criteria:

- required cooling capacity in Watt
- mounting requirements
  (side, integrated or top mount)
- dimensions of cooling unit and enclosure



Follow this simple equation for calculating the required cooling capacity:

$$P_C = P_D - P_R$$

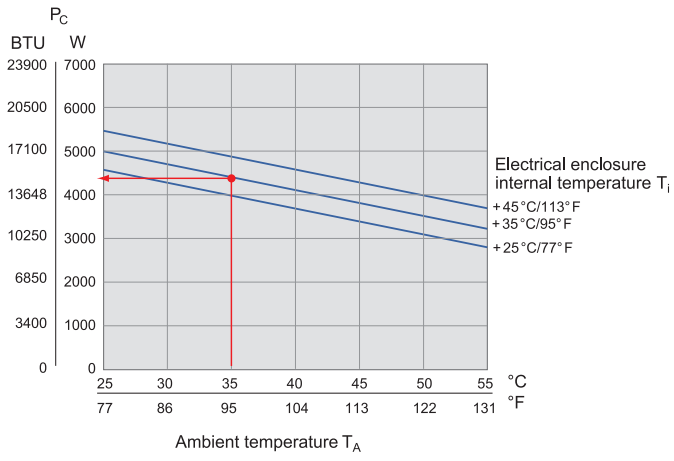
$$P_R = C \times A \times \Delta T$$

- **P_C[Watt]:** Refrigeration capacity of a cooling unit
- **P_D[Watt]: Dissipation loss**: Thermal power generated inside a cabinet by the dissipation loss of components
- **P_R[Watt]: Radiant heat gain/loss**: Heat transfer through the skin of the enclosure (insulation factor not included)

- **C[W/m²K]: Coefficient of heat transmission**
- **A[m²]: Surface area of electronic cabinet**
- **ΔT[K]:** Difference in temperature between the ambience and inside the electronic cabinet

Utilizing performance curves to properly size cooling units:

Pfannenberg utilizes the DIN standard 35/35 °C when rating our cooling units. Many other companies use 50/50 °C, which provides a higher, non-usable value. Customers should use their own application temperatures to determine the proper cooling capacity of the system.



Important information when utilizing cooling units:

- the refrigeration capacity should exceed the dissipation loss from the installed components by approximately 10%
- the enclosure should be sealed to prevent the inflow of ambient air
- use the door contact switch to impede operation with open doors and consequent excessive accumulation of condensation
- use cooling units with maximum clearance between air inflow and air outflow to prevent poor circulation
- make sure that the air inflow and air outflow in the external circuit is not hindered, preventing proper heat exchanging at the condenser
- when using top-mounted cooling units, make sure that components with their own fans do not expel the air directly into the cooling unit's cool air outflow. Make sure unit is level.
- setting the temperature to the lowest setting is not the optimal solution due to the condensation issues. The value we have preset on the cooling unit is a sound compromise between cooling the inside of the enclosure and the accumulation of condensation.

Use the Pfannenberg-Software-Service, PSS considers self-convection for calculation and demonstrates it. You can download a free version on www.pfannenberg.com