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Product Guide

- Air Conditioners
- Heat Exchangers
- Thermo-electric Cooling Units
- Enclosure Heaters
- LED Enclosure Lighting
- Accessories

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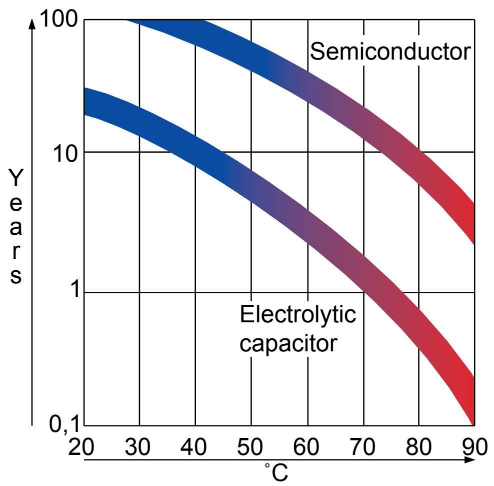
The right product for your applications

With the following information we would like to support our customers in choosing the right product. We provide an overview of the various cooling methods and explain when and where which device is best used.

Why do we need enclosure cooling?

Through the increasing automation of production processes more and more electro- technical components are being used. These components generate a lot of power loss which converts into heat. The increasing temperatures inside the enclosures have a negative influence on the life cycle of the components inside.

The diagram below shows the effects of the increased heat load on random components' service life.



Supporting process reliability and keeping service intervals within economic reasons are the main challenges thermal management of control enclosures are facing today.

Therefore, the choice of the right cooling method is very important.

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The most common cooling methods used:

1. Natural Convection

If your application only has a minimal heat loss, openings in your enclosure with louvers or grills with filters can be effective enough. Usually however this method does not provide enough cooling for today‘s electronic components.

General Rules:

- Depending on the load inside the enclosure and the temperature outside, the enclosure temperature is likely to be higher than the ambient temperature.
- No moving parts - by eliminating external fans, you create a zero maintenance application.
- No dirt - utilising exhaust filters prevents dirt from entering into the enclosure. Dirt can damage electronics as much as heat does!

If the ambient temperature is lower than the temperature inside the enclosure, the dissipated heat escapes into the environment through the enclosure surface.

The following simple formula calculates the level of heat dissipated from the enclosure:

$$P_s(W) = k \times A \times \Delta T$$

P_s [W] = Dissipated power (thermal power dissipated from the surface area of the enclosure).

k [W/m²K] = Coefficient of heat transmission (dissipated power per 1 m² surface area and 1 K difference in temperature). This constant is determined by the material [1].

A [m²] = Surface area of the enclosure.

ΔT [K] = Temperature difference between ambient air and internal enclosure air.

[1] Sheet steel - 5.5 W/m²K
Aluminium - 12.0 W/m²K
Stainless steel - 5.5 W/m²K
Plastic - 3.5 W/m²K

2. Forced Convection

If your installation is in a clean, non-hazardous environment with an ambient temperature less than the desired enclosure temperature, a simple forced ventilation system utilizing the ambient air is usually sufficient.
Combined with air filters, such devices generally meet the heat dissipation needs of electronic equipment.

General Rules:

- Considered rise should be at least + 10 Kelvin above ambient temperature (can vary depending on the load inside the enclosure and the ambient temperature).
- Multiple configurations possible – filter fans can be located in a number of locations within complex enclosure configurations.
- Calculate the size of a fan to include static pressure – understanding how static pressure affects the performance of a fan is very important when choosing filter fans.

The following simple formula calculates the required airflow:

$$V = \frac{3.1 \times P_v}{\Delta T} \text{ [m}^3\text{/h]}$$

V [m³/h] = Air flow volume of a filter fan

P_v [W] = Power loss (thermal power generated inside an enclosure by the dissipation loss of components)

ΔT [K] = Temperature difference between ambient air and internal enclosure air

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3. Closed loop cooling units

If your application is installed in an environment with high ambient temperatures, oil and dust exposure and you have high splash proof requirements (NEMA / IP), then it becomes absolutely necessary to prevent the ambient air from entering into the enclosure.

A cooling system with closed loop cooling normally consists of 2 loops; one loop closes the ambient air off and cools and circulates clean air into the enclosure. The second loop uses the ambient air or water to dissipate the heat.

For these applications cooling units and air/water heat exchangers are mainly used.

General Rules:

- The only method to reduce enclosure temperature below ambient temperature
- Suitable for NEMA /IP requirements.
- During planning you need to take the ambient temperature and the generated power loss into consideration. For outdoor applications, please also consider the solar loading (check the performance charts of the product you want to use to ensure that your system temperature is properly maintained).

The right selection of a cooling unit us determined by the following criteria:

1. Required cooling capacity in Watt
2. Max. ambient air temperature and desired enclosure air temperature
3. Mounting requirements (wall, recessed or top mount)
4. Dimensions of cooling unit and enclosure
5. Mounting location (indoor, outdoor, shading, etc.)

The following simple formula calculates the necessary cooling power:

$$P_K = P_V - P_R$$

P_K [W] = Cooling capacity of the unit

P_V [W] = Power loss (thermal power generated inside a enclosure by the dissipation loss of components)

P_R [W] = Radiant heat gain/loss (heat transfer through the outer casing of the enclosure)

The following simple formula calculates the heat gain/loss:

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

k [W/m²K] = Coefficient of heat transmission.

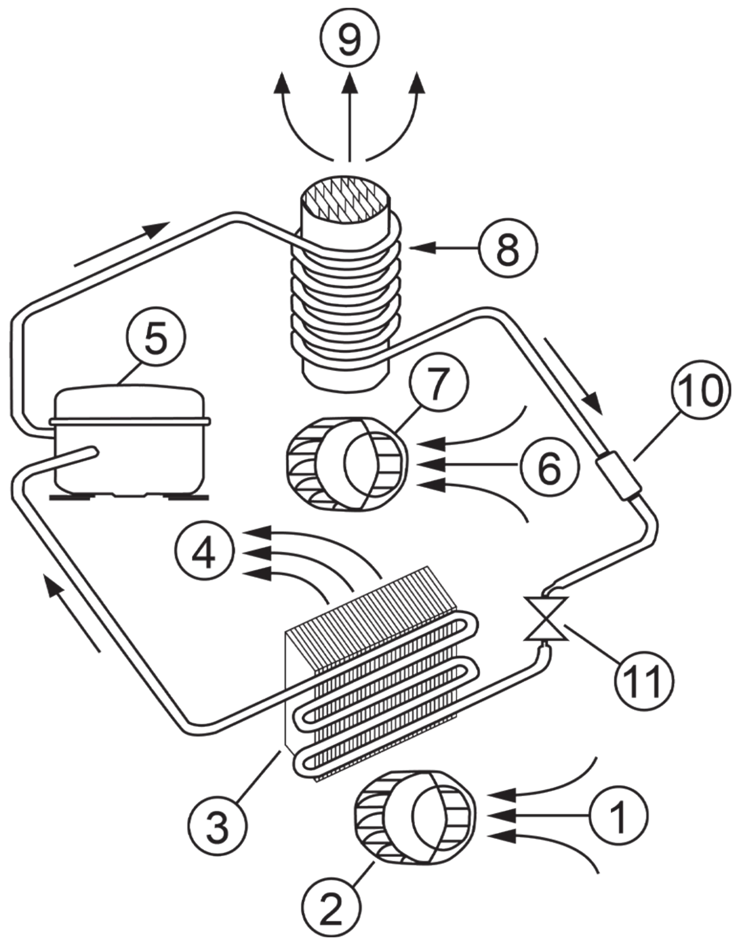
A [m²] = Enclosure surface area.

ΔT [K] = Temperature difference between ambient air and internal enclosure air.

Important information when utilising cooling units:

1. The enclosure should be sealed to prevent the inflow of ambient air.
2. The NEMA /IP rating of the cooling unit and of the enclosure should be the same.
3. Use a door contact switch to prevent operation with open doors and consequent excessive accumulation of condensation.
4. Ensure that the air inflow and air outflow in the external circuit are not obstructed which would prevent proper heat exchanging at the condenser.
5. It also must be ensured that components with a high level of self-ventilation do not direct the air into the cold air outlet of the cooling device.
6. Ensure the unit stands straight.
7. Setting the temperature to the lowest is not always the best solution. The pre-set value of +35°C is a good compromise ensuring long life of electrical components, efficient operation and minimum condensation. This might also vary depending on the application.

Schematic of an enclosure cooling unit

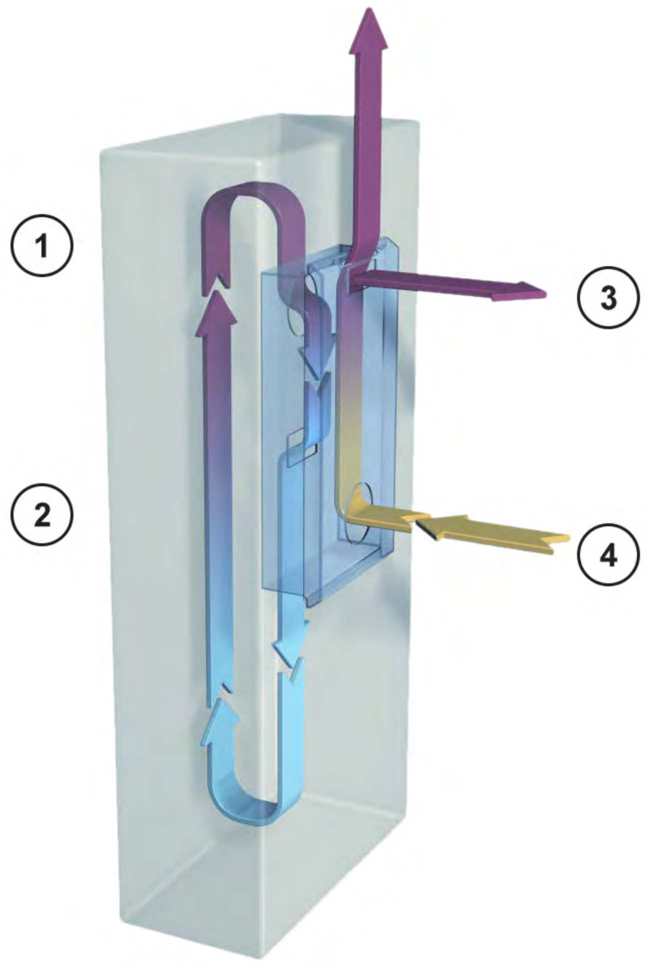


1. Air inlet enclosure side
2. Radial fan enclosure side
3. Evaporator
4. Air outlet enclosure side
5. Compressor
6. Air inlet ambient side
7. Radial fan ambient side
8. Condenser
9. Air outlet ambient side
10. Filter device
11. Expansion device

Enclosures cooling units work on the basis of a refrigeration circuit consisting of four main components; compressor, evaporator, condenser and expansion device.
The circuit is hermetically sealed and R134a refrigerant circulates inside it (R134a is chlorine free and has an Ozone Destruction Potential [ODP] of 0 and a Global Warming Potential [GWP] of 1430). The refrigerant R134a can be used without restrictions according to the current regulations.

The compressor compresses the refrigerant (thus taking it to high pressure and high temperature), and pushes it through the condenser, where it is cooled by ambient air thus passing from the gas to the liquid state. At the liquid state it then passes through the expansion device being a much lower pressure the refrigerant arrives to the evaporator where it absorbs the necessary heat to change from liquid to gas state. The gas is then drawn back into the compressor completing the cycle.

The right use of enclosure cooling units



1. Air inlet enclosure cold side
2. Air outlet enclosure cold side
3. Air outlet ambient warm side
4. Air inlet ambient warm side

Cooling devices are used when:

- The necessary heat dissipation can no longer take place constantly via the ambient air.
- The required temperature inside the enclosure should be the same as or lower than the ambient temperature.
- The ambient air is heavily polluted or there is increased humidity.

Product efficiency: Enclosure cooling units work according to the heat pump principle and consequently consume electrical energy, which is a financial expense. How efficiently a cooling device converts this energy into cooling performance is described by the cooling performance figure or Coefficient of Performance (COP).

The new generation of energy efficient cooling units have a COP of up to 2.5. This means that a cooling unit a rated cooling power of 2,000 W (L35L35) will only consume 800 W power (2,000 / 2.5) power.

The correct way to use heat exchangers

Air / air heat exchangers are used when cool ambient air is available but should not enter the control enclosure because of contamination. Air/air heat exchangers are mainly used in outdoor applications.

Air / water heat exchangers are mainly used when water cooling systems are available or if high power losses in small areas need to be handled.
In both cases the enclosure temperature is higher than the ambient air or cooling water.

When to use chillers?

The recooling of liquids using chillers is one of the basic requirements for smooth and reliable operation in many industrial processes.

When choosing a chiller, the most important thing to consider is the right cooling medium. This can consist of oils, an antifrogen / water mixture or deionized water. Depending on the selection, the cooling capacity of the chiller must be adapted.

We offer chillers with cooling capacities from 500 W up to 200 kW, which we can adapt to the individual customer requirements.

Contact us, we will be pleased to advise you.

When to use Peltier units?

The thermo-electric effect (also called the Peltier effect after its inventor Jean Charles Athanase Peltier) is the direct conversion of temperature differences to electric voltage and vice-versa. Since the direction of heating and cooling is determined by the polarity of the applied voltage, thermo-electric devices can also be used as temperature controllers.

Peltier cooling units are mainly used for smaller power losses (30 - 800 W). Unlike conventional cooling units, Peltier devices can be mounted in any position (please keep your condensate management in mind). With aprotection rating of IP 66 they can be used both for Indoor and Outdoor applications.

When can filter fans be used?

Filter fans and exhaust filters are used when the desired enclosure temperature may constantly be above the ambient temperature. Combined with thermostats, additional energy can be saved; the fan only runs when actually needed. In addition this results in less consumption of filter mats and less maintenance, extending the service life of the filter fans and improving process reliability.

Filter fans are best used to force cool ambient air into the enclosure (Figs. 2 and 3) thus building up a slight overpressure, ensuring that the ambient air only gets into the enclosure through the filter fan. The air forced in displaces the warm air inside the enclosure so that it can escape through the outlet filter. If, on the other hand, the air is sucked out of the enclosure (Fig. 1), it must be ensured that no unfiltered ambient air can penetrate through unsealed gaps or cable entries.

If you install a combination of filter fan / exhaust filter, the filter fan should always be placed in the lower third of the enclosure and the exhaust filter in the upper part of the enclosure preventing heat pockets.

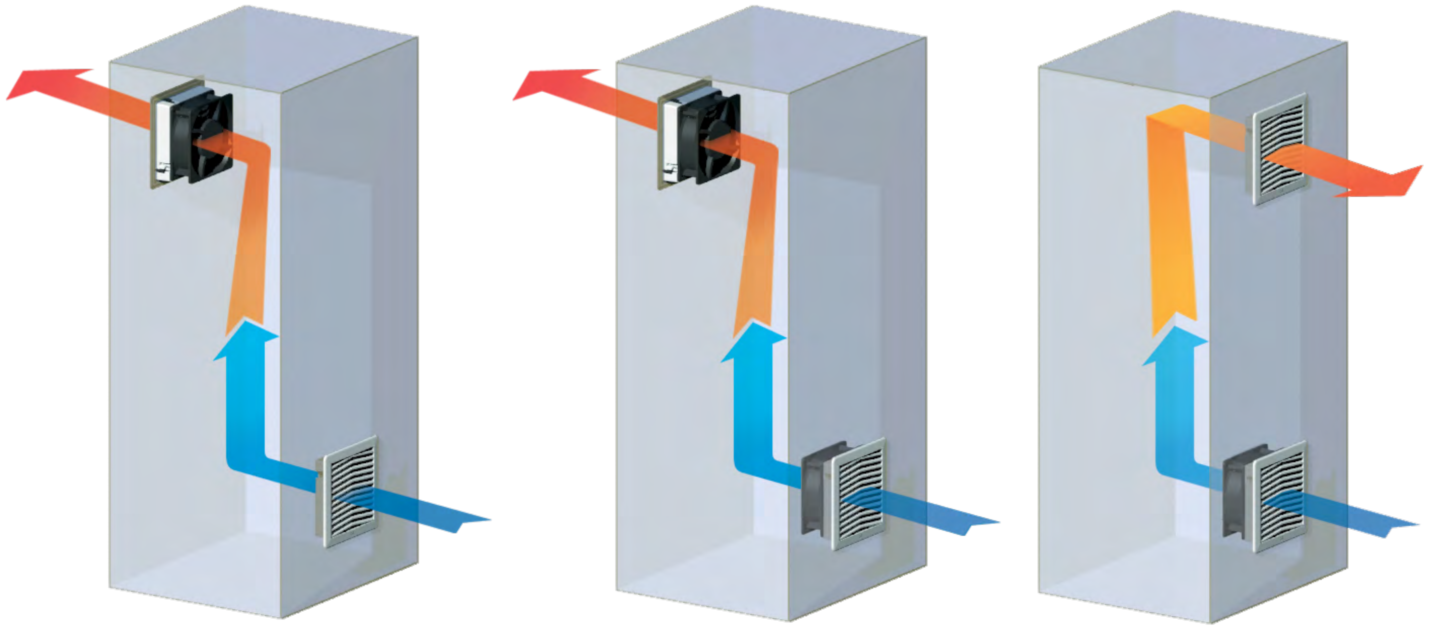


Fig. 1 Fig. 2 Fig. 3

The right use of enclosure heaters

Enclosure heaters are an important segment of the Seifert accessories program and form part of our thermal management solutions. Temperature differences in enclosures, mostly in outdoor applications, often result in humidity and condensation which may cause function failures and corrosion.

The use of the appropriate heating unit for your enclosure will eliminate these problems. Fan heaters distribute the internal warm air equally throughout the control enclosure. PTC heaters are compact in size, have a wider voltage range and the heating power adjusts in relation to the ambient temperature, resulting in better efficiency.

Enclosure accessories

Thermostats and hygrostats ensure an optimal climate inside your enclosures or cabinets. Thermostats are available either as normally closed / NC (red disk) or as normally open NO (blue disk). NC thermostat are used for regulating heaters or for alarm signals when the enclosure temperature is falling below the preset minimum value. The contact opens when the temperature is rising.
NO thermostats are used for regulating filter fans, heat exchangers, and Peltier cooling units or for switching alarm signals when the preset temperature limit has been exceeded. In addition our temperature and humidity sensors can monitor the preset parameters to ensure that failures or malfunctioning of equipment can be avoided.

Seifert LED enclosure lights have been designed to meet the criteria of illuminating industrial enclosures and cabinets. They are available either with On / Off switch or with motion sensor. They are the energy efficient and maintenance free solution for illuminating industrial enclosures.

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