BLACK BOX WHITE PAPER: SIX THINGS TO KNOW ABOUT COOLING IT EQUIPMENT CABINETS

LEAVE THE TECH TO US

INTRODUCTION

Selecting a cooling system for an IT equipment cabinet is an important task that is not always as simple as it might seem. The consequences of choosing the wrong system can be significant, so taking the time to make an informed choice is vital.

To choose the most efficient and cost-effective cooling system, you must first consider factors such as the IP rating and heat load for the enclosure. These two pieces of information will help you determine whether to use an air conditioner, heat exchanger, or a filtered fan system to cool the enclosure.

However, the choices do not stop there. Once you decide which type of cooling system makes the most sense, you must determine the cooling capacity and the appropriate size to ensure optimal efficiency.

Even with access to resources such as cooling capacity calculators, selecting the right cooling system can be challenging, especially if you have never gone through the process before. The financial consequences of choosing an improperly sized system are not insignificant, so it is important to make your purchase with confidence. The goal of this white paper is to help simplify the process of selecting a cooling system for an IT enclosure. Although the details provided are comprehensive enough to help narrow your choices, it is always best to consult an expert before making an investment in new cooling equipment for IT enclosures.

COMMON ENVIRONMENTS FOR IT EQUIPMENT CABINETS

IT enclosures can be found in environments as diverse as factories, windmill farms, and coal mines. The European Committee for Electrotechnical Standardization (CENELEC) creates industry standards for the performance of electrical enclosures based on the surrounding environment. The IP enclosure type will help determine which kind of cooling system is appropriate for an application.

IP54 enclosures, designed for both indoor and outdoor use, provide protection against falling dirt, windblown dust, rain, sleet, and snow, as well as ice formation.

The IP14 rating is identical to IP54 except that it doesn't specify protection against windblown dust.

IP66 enclosures, also designed for indoor and outdoor use, protect against windblown dust and rain, splashing and hose-directed water, and ice formation. IP66 specifies that the enclosure will also protect against corrosion caused by the elements.

IP52 enclosures are constructed for indoor use only and are designed to provide protection against falling dirt, circulating dust, lint, fibers, and dripping or splashing noncorrosive liquids. Protection against oil and coolant is also a prerequisite for IP52 designation.

Enclosures of IP types 10 and 11 can often be cooled with a simple filtered fan system that does not provide protection against water spray, dust, or other airborne contaminants. The other types of enclosures require a closed loop system that can be achieved with either an air conditioner or a heat exchanger depending on the ambient temperature, the heat load of the enclosure, and the sensitivity of the equipment.

DETERMINING AND MANAGING ENCLOSURE HEAT LOAD

The heat load of an IT enclosure is primarily the amount of heat generated by the equipment inside the unit. Too much heat in an enclosure can cause damage to equipment and shorten its life, which is why it is so important to select a cooling system that has the capacity to adequately lower the temperature.

Understanding the sources that contribute to the heat load and how that heat is transferred is one of the first steps in selecting an appropriate cooling system.

The two primary factors that contribute to the heat load of the enclosure are the internal and external (ambient) heat sources.

INTERNAL ENCLOSURE HEAT

Any number of heat sources might exist in an equipment cabinet, but in an IT environment, it's primarily servers and other networking equipment.

It is worth noting that many of these same heat-generating components are the same ones that require protection from damage due to excess heat. Most components come with specifications that outline the highest expected heat output. You can use this information to help calculate the heat load of the enclosure.

AMBIENT HEAT

Ambient heat refers to the temperature in the environment surrounding the enclosure.

In indoor environments, the ambient temperature can be affected by factors such as equipment density, room cooling or heating, ventilation, and proximity to windows.

When ambient heat is high enough to impact the internal temperature of the enclosure, it must be factored into the heat load calculation.

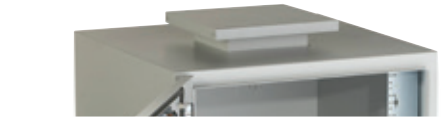
The combination of internal and external heat sources will help you determine the heat load, or just how much heat must be removed from the system, but how do you actually achieve the desired cooling?

UNDERSTANDING HEAT TRANSFER

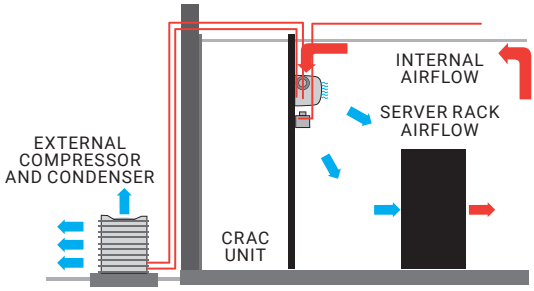
1. NATURAL CONVECTION COOLING

The flow of heat from a warmer environment to a cooler environment occurs naturally when the ambient temperature surrounding an IT cabinet is cooler than the internal temperature. The heat from the enclosure will naturally radiate through its walls, and the internal temperature will be lowered accordingly.

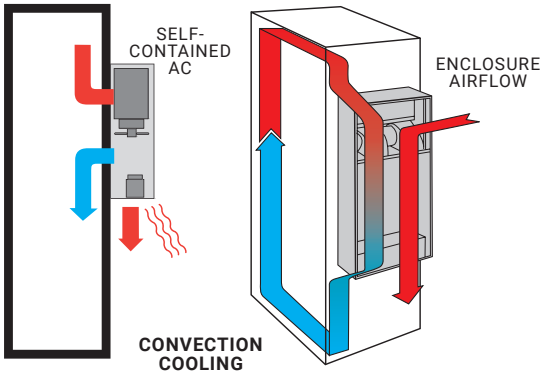
Although this method is by far the simplest, it is also the least effective because the temperature difference between most enclosures and their ambient environments is not large enough to sufficiently cool the components inside the enclosure.



NATURAL CONVECTION COOLING



FORCED CONVECTION COOLING



2. FORCED CONVECTION COOLING

The amount of heat that transfers from a warmer area to a cooler area can be increased with the addition of a fan or blower to decrease the thermal resistance of the barrier between the two areas.

In the case of an IT enclosure, fans can provide affordable forced convection cooling to reduce the internal temperature. But what happens when the outside air has contaminants like dust and dirt or oil? The fan may provide the cooling you need, but it will deposit these contaminants on electrical components at the same time. When air contamination might be a problem, the best solution is a closed loop air-to-air heat exchanger.

However, just as with natural convection cooling, the amount of heat that can be transferred away from the components inside the enclosure is limited by the ambient air temperature.

3. ACTIVE CONVECTION COOLING

When natural convection or forced convection does not provide enough heat transfer to adequately cool the components inside the enclosure, an air conditioner may be required. An air conditioner also provides the closed loop system that is needed when the components inside the enclosure must be protected from environmental factors such as dirt, dust, or liquids.

SELECTING THE RIGHT COOLING SYSTEM

After you have identified the IP rating of the enclosure and calculated its heat load, you have enough information to decide whether you need a filtered fan, a heat exchanger, or an air conditioner.

AIR CONDITIONER SIZING AND SELECTION

An air conditioner is necessary when the internal temperature of the enclosure must be lowered below the ambient temperature outside the enclosure. Air conditioners are suitable for enclosures of IP types 66 and 12.

Selecting a properly sized air conditioner is critical for achieving optimal performance and efficiency. An air conditioner that has insufficient cooling capacity will not be able to adequately cool the components inside the enclosure. On the other hand, an oversized air conditioner will cycle on and off too frequently, making it less efficient, increasing operating costs, and potentially shortening the life of the equipment.

Full size IP cabinets with a choice of air conditioner sizes are like self-contained data centres, enabling the user to install servers and other IT equipment without investing in costly infrastructure. They are ideal for indoor use when servers need to be kept outside a climate-controlled data centre. Be sure that these cabinets include fully gasketed openings and a gland plate in the base to allow cable access while protecting the devices from contaminants.

With these environmentally controlled cabinets, there is no need for piping or a drain. Simply put the cabinet where you want it and plug it in.

24U CLIMATECAB

42U CLIMATECAB

CALCULATING COOLING CAPACITY

Calculating the required cooling capacity is an essential step in selecting a properly sized air conditioner. The required cooling capacity of an air conditioner, which is expressed in BTU/hour, is based on the internal heat load and the heat load transfer.

- Internal heat load – Each component in the enclosure has a maximum heat output specification, typically provided in Watts, which can be converted to BTU/hour. Adding the maximum heat output specifications for every component in the enclosure will give you the total internal heat load for the system.

- Heat load transfer – The heat that transfers between the inside of the enclosure and the ambient air outside is referred to as the heat load transfer. When the temperature inside the enclosure is higher than the ambient temperature, the heat load transfer will be negative. When it is warmer outside the enclosure than it is inside, the heat load transfer will be positive. The calculation takes into account factors such as:
  - The surface area of the enclosure
  - The enclosure material
  - The maximum ambient air temperature
  - The maximum temperature allowed in the enclosure
  - Whether the enclosure is insulated
  - The location of the enclosure
  - Industry standard constants

The internal heat load and the heat load transfer are added together to determine the required cooling capacity for the air conditioner. Cooling capacities for enclosure air conditioners range from 1.000 BTU/hour to 20.000 BTU/hour (300 to 6.000W), so you can see that an accurate calculation is a critical step in selecting the right unit for your application.

AIR CONDITIONER AND ENCLOSURE DIMENSIONS

In addition to calculating the cooling capacity, you must also consider the physical size of both the air conditioner and the IT enclosure to ensure that they are compatible. Enclosure air conditioners come in a variety of shapes and sizes, including narrow units that are designed to fit on enclosures as small as only 18 cm deep.

Full size climate-controlled cabinets can be found in sizes such as 14U, 24U and 42U, with various depths and rail types. Air conditioners sizes range from 2.950 to 8.530 BTUs (800 to 2.500W).

CONCLUSION

Selecting the right cooling system for an IT equipment cabinet is important for keeping operating costs low, protecting valuable equipment, and getting the most from your investments. Choosing the wrong system could result in equipment damage, higher operating costs, or even equipment failure.

The steps for selecting the right cooling system include:

1. Determining the IP rating of the enclosure
2. Calculating the heat load of the enclosure
3. Deciding which type of cooling system is appropriate
4. Calculating the required cooling capacity
5. Selecting a system that meets all of the above requirements and physically fits on the enclosure

Although each step in the process is clearly defined, the actual process of selecting a cooling system can be quite intimidating, especially if you have never done it before. When you consider the potential consequences of installing a cooling system that does not function as expected, it is clear that making the right choice from the beginning is extremely important.

If you need help selecting the right cooling system for your application, talk to the professionals at Black Box. Our experts will work with you from beginning to end to ensure that you have the most cost-effective solution for your application. We also work with engineers who design IT enclosures to help determine the right temperature control solution early in the design process.

The ClimateCab™ IP52 Cabinet is your answer when you need to house servers or IT equipment but don't have a cooling infrastructure in place. In smaller installations, you can save thousands by using a ClimateCab cabinet instead of installing a complete data centre with a custom cooling system and raised floors. For more information, visit **BLACK-BOX.EU/CLIMATECAB.**