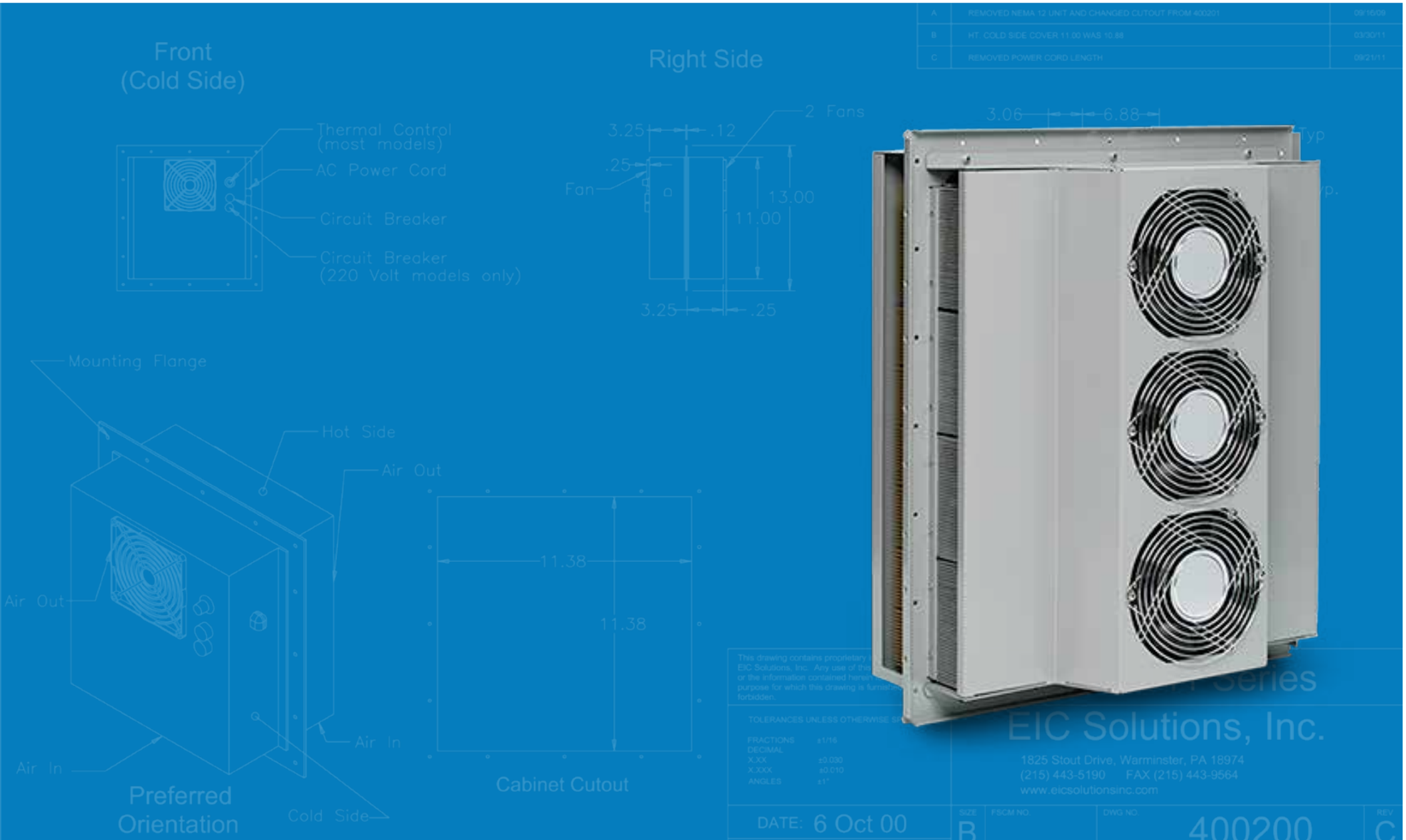
EIC SOLUTIONS

UNDERSTANDING HEAT LOAD

What you need to know about heat load before choosing a cooling system



WHAT IS "HEAT LOAD"? WHAT FACTORS CONTRIBUTE TO IT?

Knowing the total heat load of your application is the critical first step when choosing a cooling system that will achieve your goals.

Heat load refers to the amount of heat energy to be removed from a space to achieve a desired temperature within the space. There are three types of heat load you must consider when calculating the total heat load in an application:

1. External heat load
2. Solar load/gain
3. Internal heat load

These types of heat load are important to look at when considering a cooling solution. This eBook will explain each type in more detail.

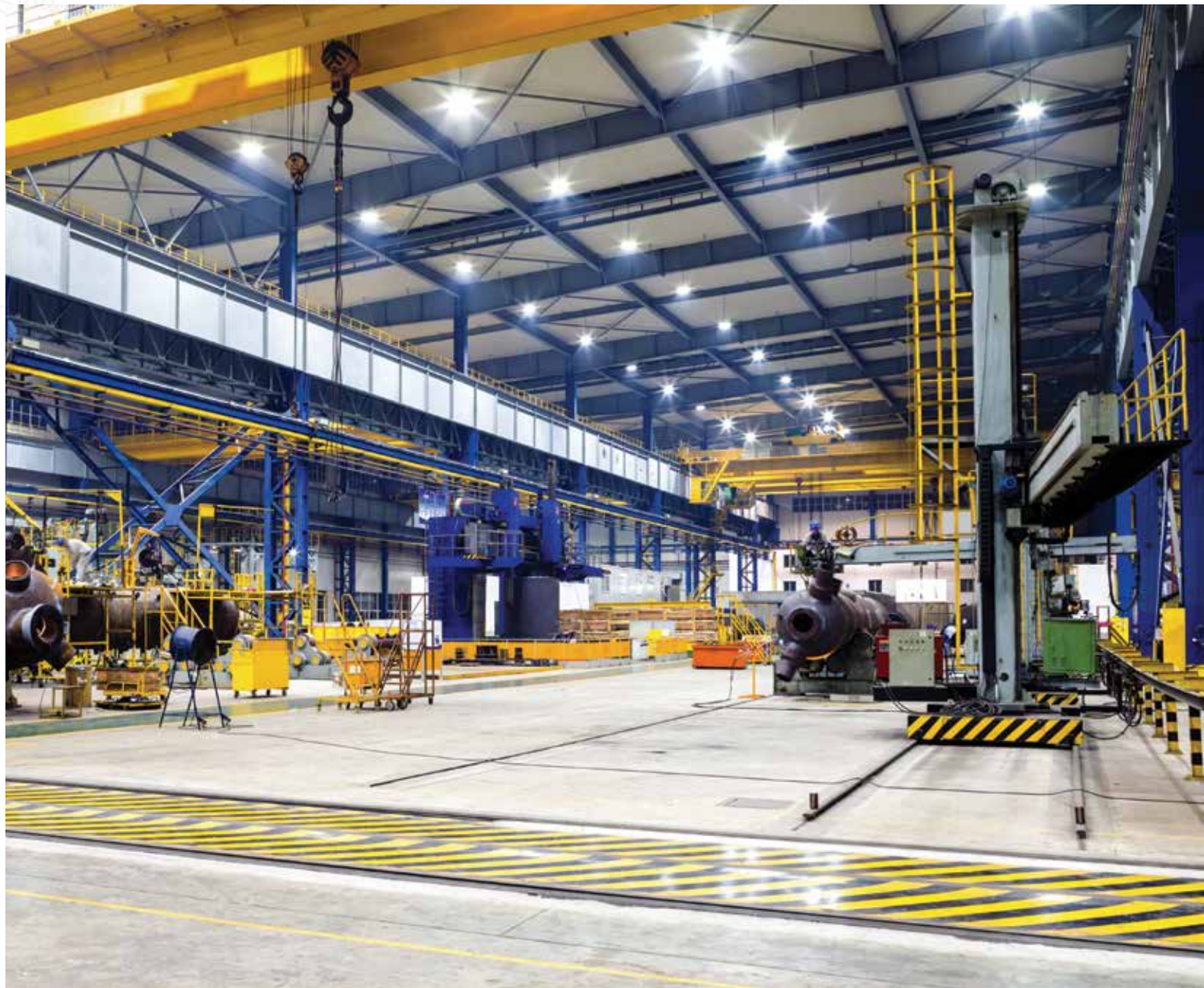
EXTERNAL HEAT LOAD

External heat load refers to the heat transferred from the ambient environment where an enclosure is located.

In order to determine the external heat load, the key component is the difference between maximum ambient temperature where the enclosure is located and the desired internal temperature. The greater the difference, the more heat will transfer from the outside of an enclosure to the inside and therefore to the enclosed equipment. Additional external heat can also come from machinery or processes that are in close proximity to the enclosure.

Examples of external heat sources include:

- Furnaces
- Compressor and Engine Rooms
- Industrial Ovens
- Metal Foundries
- Welding Processes



HOW TO CALCULATE EXTERNAL HEAT LOAD

How to calculate

1. Measure the surface area of your enclosure in ft².
2. Calculate the difference between the ambient temperature and desired internal temperature or Delta T (ΔT) in °F.
3. Determine the R Value of your enclosure insulation. (The higher the R Value the better the insulation material's ability to resist the flow of heat through it. If you do not have insulation the R Value is 0).
4. Plug the variables into the formula at right to calculate the external heat load in watts.

EXTERNAL LOAD FORMULA: $W = \frac{\Delta T * SA}{4(r+1)}$

VARIABLE	DESCRIPTION
SA	Surface Area in ft² of the Enclosure
r	Insulation R-Value
ΔT	Delta T
W	Heat load in Watts

SOLAR HEAT LOAD

Another source of heat gain is solar load.

This is defined as the increase in temperature of a space or object as a result of solar radiation. Any time an enclosure will be subjected to direct sunlight, solar loading needs to be factored into the required-cooling calculation. The color of an enclosure will have a direct effect on the amount of heat generated from the solar load. Darker colors absorb more sunlight while lighter colors reflect more of the sun's radiant energy. Choosing a light color enclosure will reduce the solar heat load. If a dark enclosure must be used, a sun shield to partially or fully shade the enclosure can reduce the amount of heat caused by the sun.

HOW TO CALCULATE SOLAR HEAT LOAD

How to calculate

1. Measure the surface area of your enclosure in ft²
2. Select color factor in °F from the chart below
3. Use the same R Value of your enclosure insulation determined in the previous section
4. Plug the variables into the formula below to calculate the solar heat load in watts

COLOR	COLOR FACTOR (°F)
Indoors or Full Shade	0
White	11
Metallic	15
Light Gray	28
Gray	40
Black	50

*Note: Estimate of solar gain for steel enclosure based on color.

SOLAR LOAD FORMULA: $W = \frac{CF * SA}{4(r+1)}$

VARIABLE	DESCRIPTION
CF	Color factor in °F for Outdoor Enclosures
SA	Surface Area in ft² of the Enclosure
r	Insulation R-Value
W	Heat load in Watts

INTERNAL HEAT LOAD

The final source of heat gain is internal heat load.

This is the heat being dissipated by the equipment housed inside the enclosure, usually measured in watts. It can also be referred to as the core load, or internal gain. Almost all equipment will generate heat. This heat load, whether large or small, will have an impact on the equipment's functionality and will directly influence the selection of a cooling system.

Examples of internal heat load sources include:

- AC Drives/Inverters
- VFD's
- PLC's
- DVR's
- Communications Gear
- Powers Supplies
- Servers
- Transformers
- Routers & Switches

HOW TO CALCULATE INTERNAL HEAT LOAD

Manufacturer's Spec

Start with the manufacturer's specification.
The manufacturer of your equipment should be able to provide the heat dissipation of the equipment when running at 100%. This may oversize the cooling recommendation, but will eliminate any guesswork associated with determining efficiencies during operation. Although the equipment may only run at 100% capacity 1-2 times a day for a very short period of time, you want ensure you have enough cooling when this occurs.

Existing Enclosure Temperature Reading

If the equipment is currently operating in an enclosure, you can calculate the internal heat load by taking two temperature readings.

1. The first reading required is the inside of a completely sealed enclosure when the equipment is running as it will normally operate. We recommend leaving the thermometer/thermocouple inside the enclosure for approximately 4 hours while running the equipment.

2. The second temperature reading needed is the ambient temperature outside of the enclosure. Be sure this temperature reading is taken immediately after the internal temp is recorded. If your enclosure is subject to any solar loading during this reading, be sure to factor this in for an accurate result. The critical factor is to take the internal temperature reading under the same environmental conditions as the external temperature reading. Based on the rise in internal temperature from ambient, an estimate can be made as to the internal heat load.

Existing Ventilation Fan Airflow Calculation

A temperature reading can be used to estimate the heat load in an existing enclosure that is ventilated. This measurement can only be done with an active ventilation system that uses a fan. A temperature reading needs to be taken at both the air intake of the ventilation system as well as the air output during normal operation of the internal equipment. The CFM of the fan will also need to be known. In the following equation, the heat load is the product of airflow, temperature differential, and heat transfer to air:

- heat load (W) = airflow (m3/hr) * temperature differential (°C) / 3 in SI
- heat load (BTU/hr) = airflow (cfm) * temperature differential (°F) * 1.08 in Imperial

Disclaimer: The equations provided herein are simplified versions of EIC Solutions, Inc. full sizing equation. Other heat load factors that are not included above may influence the results. These are provided as a guideline to help estimate the heat load of an application. EIC Solutions, Inc. assumes no responsibility for customer run sizings based on this guide. For a complete detailed sizing please contact EIC Solutions directly.

MORE INFO:

Get answers to common questions regarding our enclosures and cooling products.

www.eicsolutions.com/resources/

ENCLOSURES AND COOLING SYSTEMS ENGINEERED FOR RELIABILITY

Determining the heat load in your application will allow for proper selection of a cooling system that will keep your equipment operational and prevent down time due to failure of critical electronics housed in your enclosure. If you are unable to determine the internal heat load with the three options provided, or if you have questions about your cooling needs, please contact EIC's knowledgeable sales engineers to recommend the right solution for your specific application.

CONTACT EIC SOLUTIONS