INCREASING THE LIFESPAN AND RELIABILTY OF ELECTRICAL COMPONENTS IN CLASS I, DIVISION 1 & 2 HAZARDOUS ENVIRONMENTS

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The Problem Heat is both a by-product and one of the greatest enemies of electrical and electronic components. If not dissipated, this heat has the potential to cause early failures and malfunctions. The primary purpose of these electrical enclosures is to provide protection and safety for the components they house. If an enclosure is properly cooled, the components within can have a long and useful life. Without proper cooling however, the components in these enclosures can be subject to damaging heat, shortening their longevity and reliability.

Special purpose enclosure air conditioners are recommended where high heat transfer and closed loop cooling are required. Unlike their comfort cooling counterparts, special purpose enclosure air conditioners are closed loop systems designed for use in higher ambient conditions. Typically these air conditioners have refrigerant charged compressors that are controlled by a thermostat to limit electrical enclosure temperatures while saving energy between cycles.

Air conditioners should be sized for a maximum allowable temperature from which the BTU/H is determined. The maximum enclosure air temperature should be limited to the lowest maximum operating temperature for each specific device. Typically the most susceptible devices are variable frequency drives and computers.

Accomplishing the required cooling in a hazardous environment adds to the challenge. Typically the ambient air surrounding these enclosures contains flammable concentrations of gases or vapors. Traditional enclosure air conditioners have components that can arc during start up or operation that may ignite flammable, unsafe air. It is necessary to protect the air conditioner itself, including its air movers, compressor, controls and relays from this environment to obtain safe operation.

The Solution Kooltronic has developed an answer to these challenges with the **Hazardous Location Series Air Conditioners**. All electrical components are located in a sealed, pressurized compartment, representing a major advance in safety and reliability. This design utilizes the electrical enclosure's existing purge system and allows for general purpose components to be used, reducing both initial and service costs.

Consider the Application Enclosures installed in flammable vapor hazardous locations should meet UL 484 & NFPA 496 Requirements, utilizing purging systems of either safe air or nitrogen, and fall into one the following categories: NEC Class I, Division 1, Groups A, B, C and D Type X purged enclosures; Class I, Division 2, Groups A, B, C and D Type Z purged enclosures; Class I, Zone 1 Groups A, B, C and D hazardous locations, Type X purged enclosures and Class I, Zone 2 Groups A, B, C and D Type Z purged enclosures. These units are also suitable for Class I, Zone 1, Groups IIA, IIB plus hydrogen and IIC, as well as Class I, Zone 2, Groups IIA, IIB plus hydrogen and IIC.

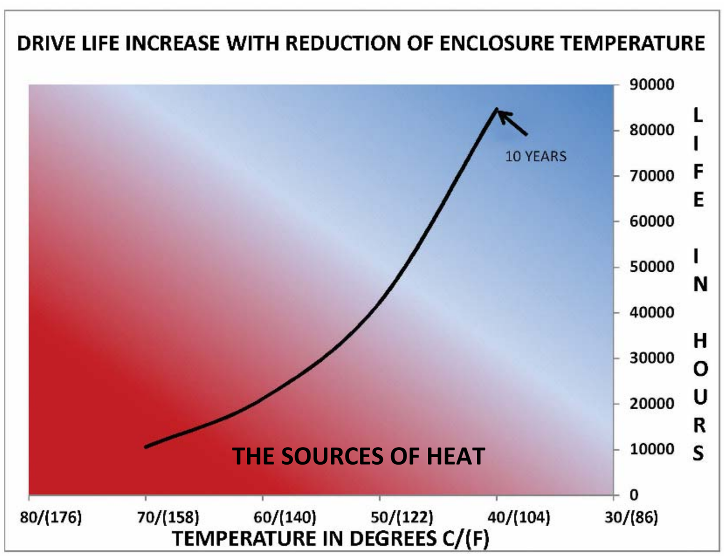
As stated, the objective is to cool sensitive components housed within enclosures. Although individual manufacturer's specifications vary, the majority of electrical distribution and control equipment is designed to operate properly and achieve normal life expectancy under ambient air conditions ranging from 40°-50°C [104°-122°F]. The table below indicates the maximum operating temperatures for specific devices. (It is generally accepted that operating temperatures above this range reduce life expectancy: Every ten degree rise in temperature shortens the average reliability of electrical/electronic components by 50%.) Below are examples of components typically found in electrical enclosures:

Table 1

Device	Maximum Recommended Air Temperatures for Operation	Cautionary Notes
Variable Frequency Drives	40°C (104°F)	Operation above this temperature typically requires de-rating a larger drive or risking premature failure.
Variable Frequency Drives with External Heat Sinks	50°C (122°F)	Operating above this temperature typically requires de-rating a larger drive or risking premature failure.
Human Machine Interface (HMI), Touch Screens & Flat Screen Displays	50°-60°C (122°-140°F)	Manufacturers of HMI specify a maximum operating temperature for their products. A few smaller devices are available that operate as high as 70°C (158°F).
HD Televisions	40°-50°C (104°-122°F)	32°C (90°F) is recommended for normal life expectancy.
Programmable Logic Controls (PLC)	50°-80°C (122°-176°F)	Most devices are not certified to function properly beyond their maximum operating temperatures.
Computers & Server Racks	Internal air temperature 40°C (104°F) With cooling fans 55°C (130°F)	In a loaded PC with standard cooling, operating temperatures can easily exceed the limits. The result can be memory errors, hard disk read-write errors, faulty video, and other problems not typically recognized as heat related. Nearly all server racks require cooling.

The Benefit Based on the information provided in Table 1, it is clear that thermal management is advantageous. Reducing the operating temperatures within electrical enclosures is an effective way to increase life expectancy and system reliability. If an enclosure is properly cooled, the cost associated with that cooling can be recovered over the life of the equipment. The graph below "Drive Life Increase with Reduction of Enclosure Temperature," illustrates the benefits of increased longevity when a drive enclosure is cooled properly. This is based on typical drives having a 40°C (104°F) maximum recommended environmental temperature.

Identifying Heat Sources The primary source of heat production in an electrical enclosure is from the working components. Devices that transmit motive power have voltage drop or efficiency losses that are converted into heat. In the case of electronics or microprocessors, nearly all of their power is converted into heat. The means for calculating and estimating this heat generation are available from enclosure cooling manufacturers in the form of spreadsheets or calculators. Heat gain or loss is expressed in watts or BTU's (British Thermal Units). These units of heat are converted as follows: Watts = BTU /hr. ÷ 3.414 and BTU/hr. = Watts x 3.414.



Ambient Air The air outside the enclosure can also be a potential source of heat gain. The ambient air may be cool enough to allow the enclosure to dissipate heat, however, in many cases ambient air may be so hot that it adds to the heat load.

Solar Load When enclosures located outdoors are exposed to the sun, heat will be transferred to the inside of the enclosure. This is known as solar load or solar gain. (The effects of solar load can be significant; an automobile parked outdoors on a sunny day is a prime example.) Thermal insulation, white reflective paint finishes and a roof or sunshield will often help to offset solar load. Some enclosures are double walled for this purpose, however, this tends to be a very costly feature.

Investment in Enclosure Cooling Yields High Return

The installation costs of an enclosure housing a variable frequency drive and associated controls, together with the cooling system designed to cool the application, can be very costly. This application could be part of a manufacturing process or service generating considerable revenues. The cost of installing an enclosure cooling system designed for a specific application is a very low percentage when compared to the cost of the overall system; a fraction of the entire equipment cost. This low cost percentage per application is also true of large signage, kiosks and computer servers.

The economic and safety related consequences of improper heat dissipation for systems used in critical infrastructure as well as other possible service interruptions should be considered at the design stage. Lost revenue due to heat related failures can quickly justify the expense for enclosure cooling.

Whether designing a new system or retrofitting an existing system, it is important to think about cooling in the early stages of the design process. An enclosure designed from the beginning to run cool and dry will yield reliable system operation and reduced expenses.

Kooltronic provides online sizing help to select the best cooling method for any enclosure application.

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