

The First Certified Heat Exchangers for Hazardous Locations

Introduction

eat exchangers (HXs) have long been recognized as efficient and cost-effective alternatives for cooling sensitive electronic panels and enclosures. Generally, they are preferable to air conditioners (A/C), which require substantial amounts of energy. A/C units must operate around the clock to maintain the required cooling conditions, which results in a significant increase in energy usage and costs. Despite these drawbacks, air conditioners were the cooler of choice for electronic cooling in hazardous locations such as the mining, petrochemical, and oil and gas industries because heat exchangers were not yet certified for pipeline, refinery and certain hazardous locations. That changed in 2015 when Noren Products became the first manufacturer in the market to receive certification for HX applications with a heat pipe core in hazardous locations.

UL/cUL certifications from UL, the former Underwriters Laboratories, have been approved for Noren's air-to-air and air-to-water heat exchangers for Class I/Division 2 A, B, C and D group types in the United States and Canada. UL, one of the leading safety science organizations in North America, certifies equipment for hazardous locations and conducts manufacturer audits. In Europe, where the same category is listed as Class I/Zone 2, international IECEx certification has been awarded by the International Electrotechnical Commission (IEC). IECEx along with ATEX, which also certified the Noren heat exchangers, has adopted IEC standards into a series of mandatory directives for operations in the European Union.

The North American and international certifications of Noren's HXs mean that operators in hazardous locations now have a cost-effective and more efficient alternative to air conditioners or compressed coolers for electronic cooling in Class I/Division 2 environments.

Noren Products is the first manufacturer in the market to receive certification for HX applications with a heat pipe core in hazardous locations.



Background

Lass 1/Division 2 (Zone 2 in Europe) is classified as a gas or vapor environment in which explosive mixtures are not likely to occur under normal operating conditions. In the event of an abnormal condition such as a system failure, the explosive mixture will last only briefly before safety mechanisms purge the area to get rid of explosive atmosphere. Regulations define hazardous locations as areas where the presence of flammable liquids, gases, vapors and dust constitute a risk for fires and/ or explosions. In addition to refineries and pipelines, other industries that operate under the classification of hazardous locations include power generation, waste water treatment, food processing, flour silos and mills.

The existing conditions in all of the above locations led to specific requirements for design and installation of equipment that would not increase the risk of explosions while cooling electronics. Industries and operators are well aware of the need to avoid the three elements of the so-called fire triangle, which can lead to ignition if all are present at the same time. The three components of the fire triangle are: (1) flammable substances (hydrogen, acetylene and propane gases) and agricultural dust, (2) an ignition source such as sparks or high heat from electrical equipment and (3) an oxidizing agent such as air in general and oxygen in particular.

For cooling, operators had only three choices prior to HX certification: air conditioners, vortex (compressed) air coolers or fans suitable for use in combustible environments. Without certification, heat exchangers, despite their documented efficiency over the others, were not an option for several reasons. Most heat exchangers at the time were made with what can be described as a convoluted core design in which heat is transferred by aluminum sheets stacked or folded together enabling airflow. Unfortunately, this type of design can cause a static or electric charge to be built up between the sheets, which can lead to a spark and ignition of explosive mixture where the heat exchanger is located—a potentially hazardous condition eliminated by heat pipe technology but not by the other core designs. This is the primary reason why no heat exchangers were certified for Class 1/ Division 2, or Class I/Zone 2 until now.

Considerable time was required to secure the North American and international certifications for the heat pipe heat exchangers since the certifying agencies had no similar source or prior certification experience for comparison other than air conditioners or swamp coolers—two technologies significantly different from heat exchangers. It had taken several years before the agencies were able to complete their research and affirm certification for Noren's technology.

In essence, heat pipe core, which is the basis of this HX technology and critical to certification, transfers heat from inside the cabinet to the outside without building up a static charge, thereby eliminating the probability of spark generation. The ignition element of the fire triangle will not come into play with heat pipe core technology. The units are capable of functioning safely in a non-purged enclosure due to non-sparking and protected sparking electrical components used in the design.





About Heat Pipe Technology

oren's certified HX technology moves waste energy and heat through the use of heat pipes with fins. Air circulates throughout the cabinet to prevent hot spots and to draw the hot air over the core. These hazardous location-capable HXs are rated to operate in the temperature range of -10°C to 70°C. A neoprene gasket and flange eliminate the possibility of air exchange and/or contamination inside or outside the cabinet or panel. The HXs are capable of providing a NEMA 4X and IP66 level of ingress protection, thereby, giving the confidence to the customers that their expensive electronics within the cabinets are protected against harmful elements. Materials in these heat exchangers have to withstand high operating temperatures encountered in Class 1/Div 2 (Zone 2 in EU) environments and provide ingress protection against dust and water under normal working conditions. They must also withstand corrosive effects of harmful gases and liquids in the surrounding environment. Noren's engineering team was able to leverage their expertise to select the right materials to meet the stringent requirements of UL as

Air-to-water heat exchangers maintain a core of copper tubing and can easily be connected to a facility water supply. A stainless steel core is preferred over copper tubing if the water source is found to be contaminated with corrosive elements. Unlike air conditioners, no compressor or refrigerants are necessary for either heat exchanger even though air-to-water HXs can still be used to provide below ambient temperatures if necessary.

Process efficiency is most pronounced by its limited use of energy. The technology is low maintenance because fans are the only moving parts in this design, which significantly reduces maintenance costs and down-time. It takes only one amp or less of electricity per fan to power Noren's HX as compared to more than 7 amps for an industrial air conditioner. Additional A/C energy requirements far exceed those of the heat exchanger; e.g. NEMA 4X (IP66) air conditioning cabinet cooling units may require as much as 5,000 BTUs depending on the severity of the conditions in which they operate.

A comparison chart* shows the substantial savings in energy costs from the use of the two types of heat exchangers. Note the difference in wattage power draws between comparable HX and A/C units:

Heat Exchanger	Operating Cost/Year	A/C	Energy Cost
Air-to-air (70 watts)	\$106.90	851 Watts	\$825.48
Air-to-water (35 watts)	\$ 59.96	851 Watts	\$825.48

*Chart based on comparison costs between Noren heat exchangers and air conditioners manufactured for cabinet cooling.

well as ATEX and IECEx hazardous location standards. Two types of heat exchangers have been certified for Class 1/Division 2 (Class I/Zone 2 for Europe): air-to-air and air-to-water. The air-to-air HX, a stand-alone device, relies on the heat pipe core for its heat transfer, which provides cooling up to ambient conditions for electronics. Light-weight and easily installed, the HXs' low power draw eliminates the need for separate circuits. Unlike air conditioners in remote areas, the certified HXs can be powered with either AC fans or DC fans powered by solar battery packs. The benefit of the latter should be obvious for maintaining panel cooling operations in remote hazardous locations; e.g. pipeline operators no longer have to rely on either air conditioners or generators to power them.

The minimal draw of energy and limited moving parts enable HXs to last years longer than other cooling methods as long as the heat pipe core is not compromised. Such heavy usage severely limits the air conditioners' lifespan (usually just two years in harsh internal and external environments) while constant energy use exerts budgetary pressures not likely to be appreciated by chief financial officers. The same considerations apply to vortex coolers that can also consume considerable amounts of energy and money.

Electronic components, for the most part, do not need to be chilled to maintain effective and efficient operations. Yet energy is wasted with constantly running air conditioners providing below ambient

August 2015

temperatures that may not be necessary. There is no reason to allocate valuable resources of money and electricity for heat transfer and cooling of components that do not require the expense of the former and the excessive use of the latter. Air-to-air HXs maintain ambient cooling, which is sufficient to ensure the operation and increase the lifespan of most electronic components. Heat exchangers can be DC or AC equipped (DC-- 12v, 24v or 48v; AC--115v or 230v).

It has not taken long for cost-conscious industries searching for efficient alternatives for hazardous location component cooling to catch on to the benefits of heat pipe technology. Alliance Pipeline of Calgary, Alberta, and Eden Prairie, Minn., has opted to use Series 5 hazardous location Class 1, Div. 2 heat exchanger units in more than 10 remote locations along the pipeline. Since Alliance's operations are in remote areas without power lines, their HXs use 24 VDC circuits that are powered by batteries. These locations have ample direct sunlight so use of a battery powered system with solar power is ideal. The heat exchangers are located in small confined pump stations with equipment that generate heat in addition to direct sunlight on the building housing all the electronics. The heat exchangers help keep the electronics cool enough so that they can operate throughout the year without any failures.

One of the unique features of this particular installation is that the HXs had to be top-mounted due to space restrictions. Alliance Pipeline chose a custom incline design (based on Noren's engineering recommendations) in order to make the units work efficiently. Following the first month of operation, Alliance reported that its HX units were performing better than expected. Alliance has ordered heat exchangers for 49 hazardous locations.

Conclusion

he term "game changer" has been invoked occasionally to an extreme, but in this case, the phrase is certainly applicable. Heat exchangers can last years because of their low power draw and efficient heat transfer, a lifespan not likely to be achieved by either air conditioners or vortex coolers operating in the often harsh environments of hazardous locations. UL/cUL, IECEx and ATEX certifications offer industries focused on dissipating electronic heat a low-maintenance and lower operating cost alternative to expensive air conditioning units for Class 1/ Division 2 or Class I/ Zone 2 hazardous locations.

About Noren Products

Noren Products, Menlo Park, Calif., has been providing thermal management solutions for more than 40 years. It is the first heat exchange manufacturer with heat pipe core technology to be awarded UL/cUL, ATEX and IECEx certifications for use in Class I, Division 2 (Europe—Class I/Zone 2) hazardous locations. In addition to Underwriters Laboratory, Noren has accreditation for ISO 9001:2008 and for GSA contracts.

Noren produces thermal management products for a wide range of industries including waste water treatment, refineries, pipelines, injection molding, oil and natural gas.

Noren Products 1010 O'Brien Drive Menlo Park, CA 94025

(866) 93-NOREN (6-6736) (650) 322-9500 (650) 324-1348 FAX sales@norenproducts.com www.norenproducts.com



