DOWNLOAD PDF MINIATURE REFRIGERATORS FOR CRYOGENIC SENSORS AND COLD ELECTRONICS

Chapter 1 : Miniature refrigerators for cryogenic sensors and cold electronics in SearchWorks catalog

Miniature refrigerators for cryogenic sensors and cold electronics G. Walker, R. Fauvel and G. Reader Department of Mechanical Engineering, University of Calgary, Alberta, Canada Received 6 January A surprisingly wide diversity of sensors, instruments or devices used for military, civil, scientific and medical purposes require cooling to cryogenic temperatures.

Our technologies in miniature high-speed turbomachinery and heat exchangers as well as reverse-Brayton, magnetic, Stirling and J-T cryocoolers are applicable to temperatures down to 4 K and cooling capacities from a few milliwatts to several kilowatts. We have designed, developed and deployed cryocoolers for long-life space missions and low-cost terrestrial applications. We provide complete cryogenic services from conceptual design, analysis, and optimization to hardware development, fabrication, and qualification testing. Our cryogenic staff comprises over 40 employees with over 5 years of experience in this field. We have the staff, facilities and specialty equipment to develop and deliver high-reliability space hardware. Cryogenic systems projects at Creare include: Cryogenic cooling of space-borne infrared sensors. Space and tactical cryocooler controller electronics. Cryogenic fluid transfer and management in space. Production of slush hydrogen for hypersonic aerospace vehicles. Probes for cryosurgical treatment of cancer. Superconducting electrical buses for the space station. Shipboard liquefaction of helium to cool advanced propulsion systems. Cryogenic cooling systems and packaging for superconducting electronics. Creare has 40 employees with over five years of experience in cryogenic systems development. Reverse-Brayton Cryocoolers Creare is the world leader in reverse-Brayton cycle cryocoolers. We have developed cryocoolers for space, aircraft and terrestrial applications with cooling loads from 1 kW at K to mW at 10 K. A key feature of these cryocoolers is the high-speed, gas-bearing turbomachines. Endurance tests have demonstrated more than 14 years of nearly continuous operation without wear. Advanced developments are targeted at cooling temperatures as low as 4 K. Creare has developed cryocooler control electronics for our reverse-Brayton cycle cryocoolers. These cryocoolers use small high-speed turbomachines to produce refrigeration at low temperatures. The electronics produce electrical power to drive the turbomachines at frequencies of over 1 kHz. We have developed space versions for single- and two-stage cryocoolers. To help our customers achieve the required robustness at the lowest possible price point, Creare carries multiple CCE designs at different radiation hardness versus cost points. Contact us for specifics. Next Generation Cryocoolers Creare has extensive experience in the development of cryocoolers based on the Joule-Thomson JT cycle over a broad temperature range. We select the working fluid to have optimal characteristics at the desired temperature and design specialized compressors, heat exchangers, and expansion valves to match tip geometries. Applications of our JT systems include gas liquefaction, zero-venting cryogen storage, radiation detector cooling, and infrared detector cooling. Creare has developed an innovative dilution cycle that produces cooling by mixing a refrigerant fluid with another fluid to reduce the partial pressure of the former refrigerant flow. The second fluid can be subsequently separated from the mixture through a non-mechanical process, such as an electrochemical process. This approach enables a new type of cryocooler with no moving parts that can provide cooling down to about 20K, ideal for sensitive cryogenic detectors. We have also designed and built components for magnetic cryocoolers. We take advantage of the magneto-caloric effect to build vibration-free coolers that have high efficiency down to 2 K. To build these systems, we use bi-directional circulators and special magnetic regenerators. The resulting coolers have application in sensors for space science. Stirling and Pulse-Tube Cryocoolers Creare has designed, fabricated and fielded Stirling cycle including the Pulse-Tube variant refrigerators and components for applications such as gas liquefaction, cooling of RF devices, and the cooling of high temperature superconducting materials. Our work has generally focused on low operating temperatures in the range of 4 to 30 K. We developed and delivered to NASA in an innovative high reliability Stirling cycle cryocooler capable of providing 0. More recently, we have developed and demonstrated

advanced components for Stirling cryocoolers. These components included tactical electronics for single and multi-stage cryocoolers and regenerators for operating temperatures near 4 K. Creare has developed a number of advanced gas separation and storage technologies using cryogenic distillation, semipermeable membranes, and molecular sieve systems to meet the needs of aircraft, mobile hospitals, home oxygen therapy, and remote servicing applications. On aircraft, nitrogen is used for fuel tank inerting, and oxygen for emergency breathing, aeromedical use, and special operations missions requiring oxygen prebreathing. For other applications, such as home oxygen therapy and mobile medevac operations, minimizing the system power, weight, and size is critical. Correspondingly, these smaller-scale applications require significant engineering innovation to address their unique constraints and requirements. Superconducting Systems Assembling a thermal management system for a high temperature superconducting magnet. High-temperature superconducting HTS materials have the potential to revolutionize the way we generate, transmit, and consume electric power. Transformational HTS initiatives span a broad range of applications that include power conditioning and transmission systems, large-scale offshore wind turbines, high-efficiency data centers, Navy ship systems, and turboelectric aircraft. As a result, cryocoolers are a key enabling component in any superconducting system. Creare is the technology leader in the development of turbo-Brayton cryocoolers, which offer many advantages for HTS applications. We recently designed and demonstrated key components for HTS cryocoolers for Navy ships systems and future turboelectric aircraft. In addition to cryocoolers, we are also developing many of the other components needed for an HTS system, including cables, cryostats, field-serviceable connections, quick disconnect connectors, current leads, heat exchangers, and cryogenic circulators.

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Chapter 2 : Cryogenics and Cryogenic Temperature Sensors

*Miniature Refrigerators for Cryogenic Sensors and Cold Electronics (Monographs on Cryogenics) [Graham Walker] on calendrierdelascience.com *FREE* shipping on qualifying offers. An ideal reference for those involved in cryogenic engineering, as well as those who need to gain a basic understanding of the issues and opportunities in the field.*

Cryogenic Temperature Sensors Introduction: This is another one of those areas that people have heard about, but have a tough time defining. It is a very important area in basic science, engineering, food, metallurgy, manufacturing, to name but a few. Indeed, one of the features of ITS was the extension of the low end of the scale from the previous lower limit of If you wish more detail on the scales you should check the Scales page on this site or visit the web site dedicated to the scale, www. Most people associate this region with liquid nitrogen and liquid oxygen, some even with liquid hydrogen and liquid helium, for these are some of the gases used as cooling agents or propellants in many space vehicle rocket engines. Much of the work reported in the popular press does indeed revolve around work in these areas, e. There are many many faces to cryogenics from the liquid oxygen plant next to a steel mill that condenses oxygen from the air and supplies to the Basic Oxygen furnaces for making steel to the special research apparatus used in studying materials properties at temperatures below that of liquid Helium. A Wikipedia The Open Encyclopedia article entitled "Cryogenics," provides an overview of the technology. Special Sensors for Cryogenic Temperatures Many of the more commonly used temperature sensors are also used for work at cryogenic temperatures, e. However, in the very low reaches of the temperature scales, there are some unique measurements made. A big step in cryogenic thermometry improvements was produced in Palo Alto, CA developed both unique ultra-low temperature Ge thermistors with operating temperature range down to 0. This gives rise to a need not only for sensors that can measure at very, very low temperatures, but also sensors that are not affected by the presence of a magnetic field or a radio-frequency electromagnetic field superimposed on a magnetic field. Excellent reviews of the scientific literaure on thermometry and sensors in the region from K to 0. Rubin in the journal "Cryogenics" in , and The references are detailed on the References page. In addition, a special issue of the journal "Metrologia" in included significant articles on cryogenic thermometry as did the various volumes of the International Temperature Symposia, already listed. The LakeShore Cryotronics, Inc. Below the table on the Lakeshore site is a brief summary of all the types listed there along with a description of key properties. Some of the sensors covered are:

Chapter 3 : Cryogenic Bibliography

A surprisingly wide diversity of sensors, instruments or devices used for military, civil, scientific and medical purposes require cooling to cryogenic temperatures. Some work better or faster at low temperatures, are more sensitive or more effective.

Chapter 4 : Solder | Overview | Lake Shore Cryotronics, Inc.

Interest in electronic systems operating at cryogenic temperature, known as cold electronics, is growing rapidly. Cryocoolers are already used for cooling infra-red (IR) detectors in night vision and missile guidance systems.

Chapter 5 : CRYOGENIC SYSTEMS â€“ Creare

The mass-production of such cryocoolers for use in IR night vision and missile guidance system seems assured; additional fields of application may emerge in semiconductors for 'cold electronics' and in high-temperature superconducting devices.