

# Proceedings of the Fourth International Cryocooler Conference

Easton, MD  
Sept. 25-26, 1986

Edited by

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<p>This document contains the proceedings of the Fourth Cryocooler Conference for electronic systems and sensors. Cryocoolers-4 was held September 25 and 26, 1986, in Easton, Maryland. About 170 people attended, representing 11 countries, 14 universities, 21 government laboratories, and 60 industrial companies. Thirty-one papers were presented, describing advancements and applications of cryocoolers in the temperature range below 80 K. Keywords: Compressors, Superconducting Coils, Reciprocating Magnetic Refrigerators, Magnetic Refrigerators, Helium Refrigerators, Liquid Helium Recondensing Refrigerators, Heat Exchangers, Stirling Cycle Refrigerators, Gas Compressors, Piston Compressors, Symposium</p>						
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## PREFACE

This document contains the proceedings of the Fourth Cryocooler Conference for electronic systems and sensors. Cryocoolers-4 was held September 25 and 26, 1986, in Easton, Maryland. About 170 people attended, representing 11 countries, 14 universities, 21 government laboratories, and 60 industrial companies. Thirty-one papers were presented, describing advancements and applications of cryocoolers in the temperature range below 80 K.

Key words: cryocoolers, cryogenics, cryopumps, helium, infrared detectors, refrigeration, superconductors

This document contains the proceedings of the Fourth International Cryocooler Conference, which was hosted by the David Taylor Naval Ship Research and Development Center and held in Easton, Maryland, on September 25-26, 1986.

The first of the cryocooler conferences was held in 1980 at the National Bureau of Standards in Boulder, Colorado. Initially, this conference was designed to get the scientific and engineering community together to discuss the latest development and advances in refrigeration for cryogenic sensors and electronic systems at temperatures below 20 K. The temperature range was increased to 80 K for the Second and Third Cryocooler Conferences, held at NASA Goddard Space Flight Center, Greenbelt, Maryland (1982) and National Bureau of Standards, Boulder, Colorado (1984).

The scope of the Fourth International Cryocooler Conference covered the scientific and technological development of small closed-cycle refrigerators and components applicable in the temperatures below 80 K. Some 170 participants from 11 countries, 14 universities, 21 foreign and domestic government laboratories, and 60 private industrial companies attended.

Thirty-one technical papers were presented, describing advancements in many areas of cryocooler technology. These presentations of cryogenic systems included discussions of magnetic refrigerators, absorption coolers, space coolers, squid coolers, pulse tube refrigerators, and hybrid systems. Two special attractions on applications of these cryogenic systems were presented. The first was a videotaped performance of an infrared detection system installed on an A-6 fighter plane. This system had taken pictures of the Annapolis, Maryland area. The second was a film describing the development of the Japanese magnetically levitated high speed train.

The development and application of a small, compact, reliable and efficient cryocooler is essential if cryogenics is to become state-of-the-art technology. To this end, we feel that the papers presented at Cryocoolers-4 and included in this proceedings show significant progress in cryocooler technology.

The Editors

NOTE ON THE CRYOCOOLER USER EXPERIENCE  
DATA COLLECTION CENTER

UNIVERSITY OF CALGARY  
ALBERTA, CANADA

A Center for compilation and collation of cryocooler user experience has been established in the Department of Mechanical Engineering, University of Calgary, Alberta, Canada by Professor Graham Walker.

Cryocooler users are invited to contribute their experience to the Center - both good news and bad news is welcome. To facilitate compilation it would be helpful if the contributions could be prepared in the following format:

Cryocooler Type: \_\_\_\_\_ Model No.: \_\_\_\_\_

Manufacturer: Name and address/contact person or service representative.

Application: What is the cryocooler used for (no more than 1/2 page typed).

Experience: Annual operating hours.  
Duty cycle (period of continuous running).  
Maintenance requirements: 1) scheduled  
2) unscheduled  
Failure modes - type and reasons for system being non-operational.  
Operating Time/Elapsed Time between failure (defined as system not operational).  
Any other relevant information.

Any contributions submitted will be strictly confidential and need not be identified when submitted. It would, however, be useful to have the contributor's name and telephone number for further information if required.

The data collected will be summarized and published annually in the technical press or by direct mail from the Center. Contributors will automatically be sent a copy of the annual report following their submission. Copies of the annual report will be available to anyone else for a small postage/handling fee.

Contributions should be submitted to:

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