

**Proceedings  
of the  
1986 INTERNATIONAL  
COMPRESSOR ENGINEERING  
CONFERENCE — AT PURDUE  
VOLUME I**

**August 4-7, 1986  
West Lafayette, Indiana**

**Sponsored by . . . . .**

**Ray W. Herrick Laboratories, School of Mechanical Engineering,  
Purdue University, West Lafayette, Indiana 47907 U.S.A.**

**In cooperation with . . . . .**

**Air Conditioning and Refrigeration Institute (ARI)**

**American Society of Heating, Refrigerating, and Air-Conditioning  
Engineers (ASHRAE)**

**The American Society of Mechanical Engineers (ASME)  
Design Engineering Division, and  
Fluids Engineering Division**

**The Compressed Air and Gas Institute (CAGI)**

**Deutscher Kalte- und Klimatechnischer Verein (DKV)**

**The Institute of Engineers (India), Mechanical Engineers Division**

**Japanese Association of Refrigeration (JAR)**

**The Japan Society of Mechanical Engineers (JSME)**

**Royal Institute of Engineers in the Netherlands (KIVI)**

**Refrigeration and Fluid Machinery Associations of China**

**Edited by  
James F. Hamilton  
Raymond Cohen**

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Raymond Cohen

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Purdue University sponsors this conference to provide a forum for the free exchange of ideas on the engineering state-of-the-art in the compressor field. The ideas expressed are those of the author(s), and do not necessarily represent the opinions or policies of the University or the cooperating organizations. The papers are not subject to the formal review procedures of the separate cooperating organizations as they would be if they were to be published by the cooperating societies. Instead they are subject to the review procedures of the Organizing Committee.

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## FOREWORD

This is a collection of papers to be presented at the (eighth) biennial International Compressor Engineering Conference at Purdue University in West Lafayette Indiana August 4-7, 1986. The 1986 International Institute of Refrigeration (IIR) Commissions B1, B2, E1, and E2 Meeting on "Progress in the Design and Construction of Refrigeration Systems" is to be held on August 5-8, 1986 also at Purdue University. The two conferences are presented to attendees as a package such that registration at one gives all privileges to both. Papers which were primarily directed at compressors were arbitrarily assigned to the compressor conference.

The number of papers in the 1986 compressor conference require three simultaneous sessions. The 1986 IIR conference requires only one session at a time. Together there are about 120 papers from 20 different countries.

Additional copies of the three volume set of this 1986 compressor conference are available from the Office of Publications, South Campus Courts - D, Purdue University, West Lafayette, IN 47907, USA. Copies of the Proceedings of the IIR conference will be available from the IIR Paris office -- Institut International du Froid, 177, Bd Malesherbes, F 75017 Paris.

Since the first Purdue compressor conference in 1972 was organized, attendees have had an opportunity to meet practitioners and researchers to exchange current information and to discuss future trends primarily in positive displacement compressors. The Proceedings from these conferences have been used by compressor designers and others as one of the best collections of technical compressor papers available. The organizers of this 1986 conference hope that this collection will have as great an impact as those from the prior conferences.

The page size of the proceedings has been reduced, partly to be compatible with the standard size of the IIR booklets, but primarily because we believe it will be handier for readers to use. Reduction in size has required that we use three volumes. Your comments regarding them will be appreciated. Appendix A contains papers from the seventh conference which were presented in 1984 but which had not arrived in time to be printed in the 1984 Proceedings. Appendix B contains papers which are to be presented at the 1986

conference, but for which the manuscripts arrived too late to be included in their proper place. Abstracts appear for some papers which were presented orally but for which manuscripts did not come in time for inclusion.

Again we are fortunate to have so many cooperating organizations join us in presenting the 1986 compressor conference. Our cooperating organizations provide a real service to the conference and especially to their membership by their help with publicity, and by encouraging their members to participate at all levels - on conference committees, as authors, participants and often as session chairpersons. My thanks to them, and to the following for their considerable help and encouragement:

- + The IIR for making it possible to hold these two conferences jointly.
- + The compressor conference advisory committee.
- + Representatives of cooperating organizations.
- + Session chairmen and authors.
- + The Purdue Division of Conferences and Continuing Education, and especially Barbara Meyer, the conference coordinator.
- + Professor Rahmat Shoureshi for the Short Course preceding the conference titled "Software/Hardware and Applications of Microprocessors".
- + The papers committee, consisting of Carl Speich and Professors James Hamilton, Raymond Cohen and Werner Soedel.
- + Connie Marsh, the Herrick Laboratories conference secretary, who attended to the myriad of details so necessary for a successful conference.
- + Herrick Laboratories staff and students.

The ninth compressor conference at Purdue is planned for the week of 17-22 July 1988. Please check the dates with the Herrick Laboratories as the time for it becomes closer.

James Hamilton and Raymond Cohen, Conference Co-Chairmen  
5 July 1986

## PUBLICATION IN ARCHIVAL JOURNALS OF COMPRESSOR CONFERENCE PAPERS

Many excellent papers are presented at the International Compressor Engineering Conferences at Purdue University. However, not all such papers are archival in nature and could not be accepted for publication in archival journals. An archival paper should contain original, quantitative, detailed scientific and technical material which is placed in proper perspective relative to prior work and is supported by references to the appropriate literature.

Because of space limitations, compressor conference papers may not be able to satisfy all of these criteria. Also some compressor conference papers may describe present practice or be of a design nature which, though important to attendees, has relatively short temporal interest.

Because of these reasons, and especially because of the small number of copies of the Proceedings printed, the Organizing and Advisory Committees recommend to all authors who have papers which qualify to submit them to archival journals for later publication. We request that authors who choose to do so acknowledge that their paper was presented at the 1986 compressor conference, and notify the Organizing Committee of their intention to do so.



PAPERS TO BE PRESENTED AT THE  
IIR MEETING

August 5-8, 1986

PLENARY I:

F. Steimle, Universitat Essen, Essen, West Germany,  
"Trends in Air Conditioning in Europe Compared  
with United States"

SESSION: "EXPANSION DEVICES" (COMMISSION B1)

L.J.M. Kuijpers and M.J.P. Janssen, "Continuous  
Control of Refrigerating Appliances; Limits Due to  
Capillary Tube Behavior"

X. Qian, "The Superheat Degree Calculation of R-12  
Expansion Valve at Off-Standard Condition"

S. Touber and J.S. van der Meer, "Influence of the  
Expansion Valve on the Evaporator Performance"

Li Li, Changlin Zhang and Yongzhang Yu, "The  
Performance and Mathematical Model of an Expand  
Valve"

M.B. Pate and D.R. Tree, "Two-Phase Flow in a  
Non-adiabatic Capillary Tube"

PLENARY II:

J. Bougard, Faculte Polytechnique de Mons, Mons,  
Belgium, "Thermodynamical and Technical Problems  
in Solar Adsorption"

SESSION: "NON-AZEOTROPIC MIXTURES" (COMMISSION B1, B2, E2)

J.C. Blaise and T. Dutto, "Some Practical Results  
Obtained with Non-Aezotropic Mixtures of Refrigerants  
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M. Kuver and H. Kruse, "The Use of Non-Azeotropic  
Refrigerant Mixtures in Two Temperature  
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R. Gronseth and T. Kuehn, "The Use of Non-Azeotropic  
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H. Nomura, "Application of Nonazeotropic Refrigerant  
Mixtures in Multi-Zone Heat Pump Room Air Conditioner  
with Hot Water System"

K. Maczek and J. Schnotale, "Investigations into the Use of Refrigerant Mixtures in Air Conditioner Operating on a Steel Industry Crane Cabin"

U.W. Schulz, "Thermodynamic Properties of Multicomponent Refrigeration"

SESSION: "HEAT PUMP MODELING AND VERIFICATION"  
(COMMISSION B2 AND E2)

M. Sukiennik, "Experimentally Derived, Energetic Efficiency of a Small Heat Pump in an Economic and Technical Aspect"

T. Beckey, "Modeling and Verification of a Vapor Compression Heat Pump"

M. Otsubo, K. Okuma, K. Yamazaki, and H. Yuyama, "Analysis of a Heat Pump System Driven by Gas Engine for Domestic Use"

J. Reichelt, "Experimental Experiences with Evaporator Defrosting of Heat Pumps to DIN 8900"

H. Rajendran and Michael Pate, "A Computer Model of the Start-up Transients in a Vapor Compression Refrigeration System"

D.R. Tree and B.W. Weiss, "Two Time Constant Modeling Approach for Residential Heat Pumps"

PLENARY III:

SESSION: "AIR CONDITIONERS" (COMMISSIONS B1 AND E1)

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K. Torikoshi, S. Uemura, R. Yajima, and M. Fujiwara, "Prediction Using Equivalent Ratio in Estimating of the Performance of Heat Pump Air Conditioner"

M. Delandre, "Air Conditioning with Double Air Flow"

S.N.Y. Gerges and E.B. Teodoro, "Noise Reduction from Air Condition Units"

G. Scalabrin, "A Liquid Sorption/Desorption Air Conditioning System Powered by Recovered Heat"

PLENARY IV:

- S. Nowotny, "A New Designed System of Computer Programs to Generate, Evaluate, Check-up, Manufacture and Measure Automatically Pairs of Screw Rotors of Refrigerating Compressors"

SESSION: "SPECIAL HEAT PUMPS" (COMMISSION B1, B2, AND E2)

- T.H. Kuehn, "Optimization of Heat Exchanger Design and Fan Selection for Single Stage Refrigeration/Heat Pump Systems"
- J. Rasson, K.Dao and Michael Wahlig, "The Double-Effect Regenerative Absorption Heat Pump: Cycle Description and Experimental Test Results"
- K. Murozono, H. Wakabayashi and M. Hori, "New Defrosting System for Residential Heat Pumps"
- I. Cerepnalkovski, M. Sarevski and Risto Ciconkov, "Performances of a Turbocompressor Heat Pump as Common Characteristics of the Elements of the Energy System"
- M. Sarevski, "Temperature Boundary Effect of the Large Heat Pump Cycle on the Characteristics of the Turbocompressor"

PLENARY V:

- J. Wurm, "Review of Open Cycle Desiccant Air Conditioning Concepts and Systems"

SESSION: "HEAT EXCHANGERS & HIGH TEMPERATURE HEAT PUMPS" (COMMISSIONS B1 & B2)

- J.C. Blaise and T. Dutto, "R142b, A New Refrigerant for High Temperature Heat Pumps"
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