Ammonia Refrigeration Series

Intermediate Ammonia Refrigeration Systems

December 5–7, 2012
Madison, Wisconsin

A practical course for:

☑ Experienced refrigeration system operators and mechanics
☑ Plant, facilities, application, and design engineers
☑ Ammonia refrigeration contractors

Increase your knowledge of ammonia refrigeration
Learn more about ammonia refrigeration equipment
Consider system optimization strategies
Review application tips and traps

Please route this brochure to colleagues who would also benefit by attending.
Intermediate Ammonia Refrigeration Systems
December 5–7, 2012 in Madison, Wisconsin

Bridge the Gap Between Principles and Practice
This course is a great opportunity to expand your knowledge of ammonia refrigeration. Building on fundamental concepts and practices, the course will enhance your understanding of the principles and operation of ammonia refrigeration systems. The intermediate-level content will further develop your background in refrigerants (ammonia), psychrometrics, thermodynamics, refrigeration cycles, and related equipment, as applied to ammonia refrigeration systems.

Key Course Topics
• Refrigeration load calculations
• Psychrometrics
• Ammonia refrigeration system principles and practices
• Best practices in ammonia refrigeration
• Troubleshooting techniques
• Optimization

Who Should Attend
The course has been specifically designed for:
• Refrigeration system operators
• Plant and facilities engineers
• Design and application engineers
• Ammonia refrigeration contractors
• Utility industrial representatives
• Refrigeration service technicians
• Others wanting to expand their knowledge of ammonia refrigeration system principles and practices

Because this is an intermediate course, we expect attendees to have completed our Introduction to Ammonia Refrigeration Systems course or have significant working experience with refrigeration systems. To benefit fully, you should have basic knowledge that includes fluid properties, psychrometrics, and refrigeration system principles.

Benefits for You
• Expand your knowledge of ammonia refrigeration
• Learn techniques to optimize your system
• Increase your understanding of equipment used in ammonia refrigeration systems
• Learn application-specific tips and traps
• Receive a valuable set of ammonia refrigeration notes

Expert Instructors
James L. Denkmann received a BSME degree from Washington University. He spent 10 years in mechanical contracting and then served as a project manager with several large consulting firms. In 1986 he started his own consulting firm in Chicago, concentrating on thermal storage and refrigeration systems. He currently is a principal in his own consulting company. Mr. Denkmann is also an instructor in other ammonia refrigeration courses at the University of Wisconsin–Madison.

Douglas T. Reindl, PhD, PE holds degrees from the Milwaukee School of Engineering and the University of Wisconsin–Madison. He has been involved in field evaluation, simulation, and modeling of refrigeration systems, advanced refrigeration cycles, thermal energy storage, and HVAC systems. Reindl is a professor in the Department of Engineering Professional Development at the University of Wisconsin–Madison and director of the Industrial Refrigeration Consortium (IRC).

Past Participants Say…

"AN INCREDIBLE WEALTH OF KNOWLEDGE AND EXPERIENCE WITH REAL-WORLD APPLICATION!"

"I LIKED HOW DOS AND DON'TS WERE GIVEN, AS WELL AS RECOMMENDATIONS."

"VERY INFORMATIVE MATERIALS AND EXCELLENT PRESENTATIONS."

"THE COURSE TIED UP A LOT OF LOOSE ENDS FOR ME. VERY WORTHWHILE."

"I LIKED THE INSTRUCTORS' ABILITY TO ANSWER QUESTIONS AND GIVE REAL-WORLD EXAMPLES. BOTH INSTRUCTORS WERE EXTREMELY KNOWLEDGEABLE."

Industrial Refrigeration Consortium (IRC)
The IRC, a collaborative effort between the University of Wisconsin–Madison and industry, offers its members practical refrigeration information and application-oriented research, a telephone hotline, Internet-based information resources, on-site technical assistance, and specialized publications. To learn more, check the IRC website at irc.wisc.edu, e-mail IRC director Douglas Reindl, dreindl@wisc.edu, or phone toll free 866-635-4721.

For Related Course Descriptions
epd.engr.wisc.edu/ammoniarefrigeration

ENROLL ONLINE TODAY! Or visit our Web site
Intermediate Ammonia Refrigeration Systems
December 5–7, 2012 in Madison, Wisconsin

Course Outline

Wednesday, December 5
8:00 Registration/Continental Breakfast
The Pyle Center
702 Langdon Street
Madison, WI
8:30 Course Introduction
Douglas T. Reindl, PhD, PE
Professor, Engineering Professional Development
Director, Industrial Refrigeration Consortium
University of Wisconsin–Madison
8:45 Overview of Refrigeration Systems
• Introduction to types of systems: direct expansion, flooded, liquid overfeed
• Refrigerant selection criteria
• Environmental issues with refrigerants
Douglas T. Reindl
9:15 Refrigeration Load Calculations
• Temperature requirements
• Envelope loads
• Product loads
• Internal loads
• Evaporator fan heat gains
• Make-up air loads
• Door loads: theory vs. real-world
James L. Denkmann
10:00 Psychrometric Properties and Processes
• Definitions: dry bulb, and wet bulb temperatures, humidity ratio, and psychrometric chart
• Psychrometric processes: latent and sensible energy changes
Douglas T. Reindl
11:00 Lunch
1:00 Properties of Ammonia Refrigerants
• Fundamental properties: pressure, volume, temperature
• Derived properties: enthalpy, internal energy, and transport
• Phase change
• Diagrams: pressure vs. enthalpy, pressure vs. temperature
• Refrigerant comparison: CFCs, ammonia, water, and CO2
• Flash gas
• Subcooling and superheat
• Influence of water in ammonia refrigerant properties
Douglas T. Reindl
3:00 Refrigeration Cycles and Cycle Performance
• Basic components
• P-h diagram
• Capacity and required refrigerant mass flow rates
• Coefficient of performance
• Overview of multi-stage systems
Douglas T. Reindl
5:00 Assign Psychrometric Properties and Processes Homework
Douglas T. Reindl

Thursday, December 6
8:00 Continental Breakfast/Conversation
8:30 Homework Review
Douglas T. Reindl
9:30 Introduction to Advanced Systems
• Multi-staged systems
• Economized systems
• Cascade systems
James L. Denkmann
12:00 Lunch
1:00 Compressors and Compressor Performance
• Interpreting compressor maps
• Correcting for actual compressor application/operation
• Compression ratio limits
• Off-design operation
• Unloaders and part-load performance
• Oil cooler heat rejection methods (screw compressors)
• Economized ratings–when to/not to use (screw compressors)
Douglas T. Reindl
2:30 Vessels and Refrigerant Pumps
• Types: high-pressure receiver, low-pressure accumulator, and flash intercooler
• Configurations: horizontal or vertical
• Ratings
• Proper practices for system integration
• Pump types and performance curves
• Net positive suction head required
• Net positive suction head available
• Refrigerant pump cavitation (causes and cures)
James L. Denkmann
5:00 Adjourn

Friday, December 7
8:00 Continental Breakfast/Conversation
8:30 Homework Review
Staff
9:30 Evaporators
• Types
• Performance characteristics
• Configuration: top feed or bottom feed
• Defrosting techniques
• Rating methods
• Evaporator pressure regulators
• Determining optimum refrigerant feed rates (overfeed systems)
James L. Denkmann
10:30 Condensers
• Types
• Performance characteristics
• Selection
James L. Denkmann
12:00 Lunch
1:00 System Troubleshooting
• Open question/answer session
James L. Denkmann
2:30 Final Adjournment

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To inquire about courses that we can bring to your site, including optimal group size and costs, call 800-462-0876 and ask for Corporate Education Director Carl Vieth (608-263-7424 direct or vieth@wisc.edu). Or see epd.engr.wisc.edu/onsite.

ENROLL ONLINE TODAY! Or visit our Web site
Four Easy Ways to Enroll

Phone: 800-462-0876 or 608-262-1299 (TDD 265-2370)

Mail to:
Engineering Registration
The Pyle Center, Dept. 108
702 Langdon Street
Madison, Wisconsin 53706

Fax: 800-442-4214 or 608-265-3448

Internet:
http://epd.engr.wisc.edu/webM625

ENROLL ONLINE TODAY!

Course Information

Please enroll me in Intermediate Ammonia Refrigeration Systems

☐ Course #M625 December 5–7, 2012 in Madison, WI  Fee: $1195
☐ Course #M625 December 5–7, 2012 in Madison, WI  Industrial Refrigeration Consortium (IRC) Member Fee: $995
☐ I cannot attend at this time. Please send me brochures on future courses.

Personal Information  (Please print clearly.)

Name ______________________________________________________________
Title _______________________________________________________________
Company __________________________________________________________
Address ___________________________________________________________
City/State/Zip _____________________________________________________
Phone ( ______ ) ______________________ Fax ( ______ ) ______________________
E-mail _____________________________________________________________

Additional Enrollees

Name _____________________________________________________________
Title _____________________________________________________________
E-mail _____________________________________________________________

Name _____________________________________________________________
Title _____________________________________________________________
E-mail _____________________________________________________________

Billing Information

☐ Bill my company  ☐ P.O. or check enclosed (Payable in U.S. funds to UW – Madison)

Cardholder's Name ________________________________
Card No. ________________________________ Expires ________________________________

UW# from mailer panel.

General Information

Fee Covers Notebook, course materials, break refreshments, lunches, and certificate.

Cancellation If you cannot attend, please notify us by November 28, and we will refund your fee. Cancellations received after this date and no-shows are subject to a $150 administrative fee. You may enroll a substitute at any time before the course starts.

Location The Pyle Center, 702 Langdon Street, Madison, WI. Phone messages: 608-262-1122.

Accommodations We have reserved a block of guest rooms (rates starting at $89, including continental breakfast) at Lowell Center, 610 Langdon Street, Madison, WI. Reserve a room on-line at epd.engr.wisc.edu/lodgingM625 or call 866-301-1753 or 608-256-2621 and indicate that you will be attending this course. Room requests after November 6 will be subject to availability. Other fees and restrictions may apply.

Continuing Education Credit By participating in this course, you will earn 2.0 Continuing Education Units (CEU) or 20 Professional Development Hours (PDH).

Need to Know More?

Call toll free 800-462-0876 and ask for

Program Director: Douglas T. Reindl, dreindl@wisc.edu
Program Associate: Mary Danielson
Or e-mail custserv@epd.engr.wisc.edu

Related Courses from UW–Madison

Introduction to Ammonia Refrigeration Systems
March 6–8, 2013
Course #N213

October 9–11, 2013
Course #N219

Principles and Practices of Mechanical Integrity for Industrial Refrigeration Systems
November 7–9, 2012
Course #M624

Process Safety Management Audits for Compliance and Continuous Safety Improvement
January 16–18, 2013
Course #N212

Fundamentals of HVAC
March 13–15, 2013
Course #N214

September 11–13, 2013
Course #N217

Ammonia Refrigeration System Safety
April 17–19, 2013
Course #N215

Achieving Energy Cost Savings for Ammonia Refrigeration Systems
May 22–24, 2013
Course #N216

Design of Ammonia Refrigeration Systems for Peak Performance and Efficiency
September 16–20, 2013
Course #N218

Process Hazard Analysis
September 24–26, 2013
Course #N322

To receive additional information on any of these courses, please call toll free 800-462-0876 and ask for Douglas Reindl, program director. You can also send an e-mail message to custserv@epd.engr.wisc.edu or check out these courses on our website at epd.engr.wisc.edu/ammoniarefrigeration