Ammonia Refrigeration Series

Intermediate Ammonia Refrigeration Systems

December 4–6, 2013
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 4–6, 2013 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

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.

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.”

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. Denkmann is also an instructor in other ammonia refrigeration courses at the University of Wisconsin–Madison.

Todd B. Jekel, PhD, PE, is a research scientist and assistant director with the Industrial Refrigeration Consortium (IRC) at the University of Wisconsin–Madison. Jekel has been actively conducting research on refrigeration systems including vessel design practices, oil separators, and analysis of dehumidification alternatives for cold storage warehouses.

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).

Daniel Dettmers is an associate researcher with the Industrial Refrigeration Consortium at the University of Wisconsin–Madison. Dettmers’ expertise includes mechanical integrity, long-range refrigeration system planning, refrigeration system design, and related areas. An experienced instructor, he provides seminar training and technical presentations to a variety of audiences. Dettmers is a principal author of the IRC’s mechanical integrity guidebooks.

ENROLL ONLINE TODAY! Or visit our Web site
Course Outline

**Wednesday, December 4**
8:00  Registration/Coffee
The Pyle Center
702 Langdon Street
Madison, WI
8:30  Workshop Introduction
Douglas T. Reindl, PhD, PE
Professor, Engineering Professional Development
Director, Industrial Refrigeration Consortium
University of Wisconsin–Madison
8:45  Refrigeration Systems Review
• Introduction to types of systems: direct expansion, flooded, liquid overfeed
• System components
• Basic arrangements
• Refrigerant selection criteria
Douglas T. Reindl
10:00  Break
10:15  Properties of Ammonia Refrigerants
• Fundamental properties: pressure, volume, temperature
• Derived properties: enthalpy, internal energy, transport
• Phase change
• Diagrams: pressure vs. enthalpy, pressure vs. temperature
• Refrigerant comparison: CFCs, ammonia, water, CO₂
• Flash gas
• Subcooling and superheat
• Influence of water in ammonia refrigerant properties
Douglas T. Reindl
11:30  Psychrometric Properties and Processes
• Definitions: dry bulb, wet bulb temperatures, humidity ratio, psychrometric chart
• Psychrometric processes: latent and sensible energy changes
• Effects of refrigerant evaporating temperature on space humidity levels
Todd B. Jekel, PhD, PE
Assistant Director, IRC
12:00  Lunch
1:00  Property Workshop
1:45  Break
2:00  Psychrometric Properties and Processes (continued)
3:00  Break
3:15  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
Todd B. Jekel
5:00  Adjourn

**Thursday December 5**
8:00  Coffee/Conversation
8:15  Refrigeration Cycles and Cycle Performance
• Conservation principles
• Performance measures
Ideal Cycles and Actual Cycles
• Capacity and required refrigerant mass flow rates
• Overview of multi-stage systems
Douglas T. Reindl
10:00  Break
10:15  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
12:00  Lunch
1:00  Compressor Workshop
1:45  Break
2:00  Vessels and Refrigerant Pumps
• Types: high-pressure receiver, low-pressure accumulator, flash intercooler
• Configurations: horizontal or vertical
• Ratings
• Proper practices for system integration
• Knock-out velocity
• Down-comer sizing
• Pump types and performance curves
• Net positive suction head required
• Net positive suction head available
• Refrigerant pump cavitation (causes and cures)
• Variable speed pumping
Todd B. Jekel
5:00  Adjourn

**Friday December 6**
8:00  Coffee and Conversation
8:00  Evaporators
• Types
• Performance characteristics
• Selection and operation
• Configuration: top feed or bottom feed
• Defrosting techniques
• Rating methods
• Evaporator pressure regulators
• Determining optimum refrigerant feed rates (overfeed systems)
James L. Denkmann
President, Denkmann Thermal Storage, Ltd.
9:45  Break
10:00  Condensers and Heat Recovery
• Types
• Performance characteristics
• Selection
• Heat recovery potential
Daniel J. Dettmers
Research Engineer, IRC
12:00  Lunch
1:00  System Troubleshooting
• Condensers: liquid refrigerant hold-up, proper practices for parallel condenser operation
• Evaporator defrost best-practices
• Open question and answer
James L. Denkmann
2:30  Final Adjournment
Four Easy Ways to Enroll

Internet: http://epd.engr.wisc.edu/webN221

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

Mail to: The Pyle Center
Attn: Engineering Registration
702 Langdon Street
Madison, Wisconsin 53706

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

Course Information

Please enroll me in Intermediate Ammonia Refrigeration Systems
☐ Course #N221 December 4–6, 2013 in Madison, Wisconsin Fee: $1195
☐ Course #N221 December 4–6, 2013 in Madison, Wisconsin Industrial Refrigeration Consortium (IRC) Member Fee: $995

Personal Information (Please print clearly.)

Name ____________________________________________
Title ____________________________________________
Company __________________________________________
Address __________________________________________
City/State/Zip ______________________________________
Phone (_________) Fax (_________) ______________________
E-mail ____________________________________________

Billing Information

☐ Bill my company
☐ P.O. or check enclosed (Payable in U.S. funds to UW - Madison)
☐ Enter credit card information

Card No. _______________________
Cardholder’s Name ___________________________
Name __________________________________________
E-mail __________________________________________
Title __________________________________________

UW# ____________________________________________
Billing Information

From mailer panel.

Please check the box if you are a person with a disability and desire special accommodations. A customer service representative will contact you. Requests will be kept confidential.

Related Courses from UW–Madison

Process Safety Management Audits for Compliance and Continuous Safety Improvement
January 15–17, 2014, Course #P021
Introduction to Ammonia Refrigeration Systems
March 5–7, 2014, Course #P022
October 8–10, 2014, Course #P032
Fundamentals of HVAC
March 12–14, 2014, Course #P023
September 17–19, 2014, Course #P030
Ammonia Refrigeration System Safety
April 14–16, 2014, Course #P024
Achieving Energy Cost Savings for Ammonia Refrigeration Systems
May 19–21, 2014, Course #P025
Design of Ammonia Refrigeration Systems for Peak Performance and Efficiency
September 8–12, 2014, Course #P028

Process Hazard Analysis
September 24–26, 2014, Course #P031
Principles and Practices of Mechanical Integrity for Industrial Refrigeration Systems
November 5–7, 2014, Course #P033

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.

On-Site Courses

We can offer many of our courses face-to-face or online:
• At a location of your choice
• At your convenience
• At reduced per-person cost
• Tailored to your needs
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.

General Information

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

Cancellation If you cannot attend please notify us at least seven days prior to the course start, and we will refund your fee. Cancellations received after that date and no-shows are subject to a $150 administrative fee per course. 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 online at epd.engr.wisc.edu/lodgingN221 or call 866-301-1753 or 608-256-2621. Room requests after November 5 will be subject to availability. Other fees and restrictions may apply.

We have reserved a second block of guest rooms (rates starting at $89, including parking and Madison Taxi's silver cab from airport) at Campus Inn, 601 Langdon Street, Madison, WI. Reserve a room online at epd.engr.wisc.edu/lodgingB022 or call 800-589-6285 or 608-256-4391 and indicate that you will be attending this course under group code 128061. Room requests after November 11 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