Ammonia Refrigeration Series

Discover why ammonia is the refrigerant of choice for industrial refrigeration systems!

Introduction to Ammonia Refrigeration Systems

October 8–10, 2012
Madison, Wisconsin

March 6–8, 2013
Madison, Wisconsin

Understand principles of ammonia systems
Understand equipment use
Learn best practices for system safety and operation
Get answers to your questions

Understand basic theory and system operation as you focus on:

- Refrigeration cycle basics
- Refrigeration system components and layout
- Overview of safety issues, including OSHA and EPA regulations

ENROLL ONLINE TODAY!
Or visit our Web site
Introduction to Ammonia Refrigeration Systems
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Update Your Knowledge
This practical course is your opportunity to learn more about a proven, long-term refrigerant used in food production and storage facilities: anhydrous ammonia. Environmentally friendly anhydrous ammonia is a “natural refrigerant” that has zero ozone-depleting potential and near-zero global warming potential. Successfully used in the industrial sector for decades, ammonia refrigeration now offers you an attractive option to counter the phase-out of CFC- and HCFC-based refrigerants and the uncertain future of HFC refrigerant alternatives.

Attend this course and discover why interest in ammonia refrigeration systems has never been higher!

Understand Basic Theory and System Operation
This course will provide you with a foundational understanding of the principles and practices of ammonia refrigeration systems. The course content will focus on developing your background in refrigerants (ammonia), thermodynamics, refrigeration cycles, and related equipment, as applied to ammonia refrigeration systems.

Because this is an introductory level course, you can benefit without an extensive prior knowledge of fluid properties, thermodynamics, or refrigeration system theory. As a refresher, however, the course will also be helpful to those with prior knowledge in the areas covered.

Key Course Topics
- Material compatibility issues
- Safety issues
- OSHA and EPA regulations
- Refrigeration cycle basics
- Refrigeration system components
- Refrigeration system layouts

Past Participants Say...
- “EXCELLENT CONTENT AND PRESENTATION.”
- “NOW I FEEL I CAN SAFELY AND COMFORTABLY CONTROL OUR PLANT.”
- “OUTSTANDING!”
- “THE COURSE PROVIDED AN EASY, LOGICAL EXPLANATION OF REFRIGERATION BASICS.”
- “THIS WAS A GREAT CLASS. BOTH TEACHERS DID A TREMENDOUS JOB IN SHARING THEIR EXPERTISE.”
- “THIS WILL HELP ME IMMEDIATELY IN MY JOB.”
- “EXCEEDED EXPECTATIONS. DIRECT APPLICATION TO MY CURRENT RESPONSIBILITIES AND GAVE ME PLENTY TO LOOK AT AND HOPEFULLY IMPROVE WHEN I RETURN. I’M LOOKING FORWARD TO FUTURE COURSES.”
- “ABSOLUTELY WORTH THE TIME.”

Who Should Attend
This course has been specifically designed for:
- Refrigeration system operators and technicians
- Plant engineers and managers
- Maintenance supervisors
- Facilities engineers; application engineers
- Contractors
- Utility and industrial representatives
- PSM coordinators
- Others wanting to gain more knowledge of ammonia refrigeration systems

Stressing the basics required to understand ammonia refrigeration systems, the course will be ideal for those who wish to build their knowledge of ammonia refrigeration. Please note: Be sure to bring your calculator for problem workshop sessions.

Benefits for You
- Learn best practices for ammonia system safety and operation
- Understand equipment used in ammonia systems
- Get answers to your specific questions
- Avoid operational risks by having a solid understanding of ammonia refrigeration
- Receive a valuable set of notes on ammonia refrigeration

Course Staff
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, Illinois, concentrating on thermal storage and refrigeration systems. Denkmann is also an instructor in the University of Wisconsin–Madison's Design of Ammonia Refrigeration Systems course.

Douglas T. Reindl, PhD, PE holds degrees from the Milwaukee School of Engineering and the University of Wisconsin–Madison. He has authored or co-authored four books related and numerous technical papers on all aspects related to industrial refrigeration 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.

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 www.irc.wisc.edu, e-mail IRC director Douglas Reindl, dreindl@wisc.edu, or phone toll free 866-635-4721.

ENROLL ONLINE TODAY! Or visit our Web site
**Course Schedule**

The course will follow approximately the agenda below. Duration of individual sections of the agenda may vary based on participant interests.

**Day One**

8:00 Registration/Continental Breakfast  
The Pyle Center  
702 Langdon Street, Madison, WI

8:30 Course Introduction  
Douglas T. Reindl  
Professor, Engineering Professional Development  
Director, Industrial Refrigeration Consortium (IRC)  
University of Wisconsin–Madison

8:45 Refrigeration Systems Overview  
• History of refrigeration  
• Introduction to system types  
  – direct expansion  
  – flooded  
  – liquid overflow  
• Refrigerant selection criteria  
• Environmental issues with refrigerants  
• Material compatibility issues  
• Moisture and contaminant control requirements

10:30 Overview of Properties  
• Fundamental properties: pressure, volume, and temperature  
• Derived properties: enthalpy, internal energy, and transport  
• Refrigerant phases and behavior during phase change  
• Latent and sensible energy changes  
• Diagrams: pressure vs. enthalpy  
• Refrigerant comparison: CFCs, ammonia, water, and CO2  
• Flash gas concepts

12:00 Lunch

1:00 Property Overview (continued)

2:30 Safety in Ammonia Refrigeration  
• Safety/health issues  
• OSHA and EPA guidelines  
• IIAR 2 and ASHRAE 15 standards  
• Flammability of ammonia and ammonia-oil mixtures  
• Process Safety Management (PSM)  
• Special requirements for ammonia mechanical/engine rooms  
• Protecting equipment from damage (e.g. fork lifts)

4:00 Discussion of Refrigerant Property Problems

5:00 Adjourn

**Day Two**

8:00 Continental Breakfast/Conversation

8:30 Review of Refrigerant Property Problems

9:00 Introduction to Refrigeration Cycles  
• Basic components  
• P-h diagram  
• Capacity and required refrigerant mass flow rates  
• Coefficient of performance

10:30 Refrigeration System Components: Compressors  
• Reciprocating  
• Screw (single/twin)  
• Configuration: open drive vs. semi-hermetic or hermetic  
• Capacity control/unloading  
• Compressor ratings

12:00 Lunch

1:00 Refrigeration System Components: Heat Transfer Equipment  
• Evaporators: direct-expansion (DX), pumped overfeed, flooded, blast freezers, shell-and-tube, scraped surface, plate-and-frame, welded plate, coaxial, defrost requirements, factors influencing performance, and liquid slugging (causes and consequences)  
• Condensers: air cooled, evaporatively cooled, water cooled, and ground coupled  
• Subcoolers, desuperheaters

3:00 Refrigeration System Components: Valves/Metering Devices  
• Valves: stop, globe, angle, ball, check, pressure relief, solenoid, differential pressure, butterfly  
• Expansion valves: thermostatic, electronic, and hand  
• Floats: high-side and low-side float arrangements  
• Vessels/receivers

5:00 Adjourn

**Optional Evening Session**

5:15 System Troubleshooting  
• Condensers  
  – liquid refrigerant hold-up  
  – proper practice for parallel condenser operation  
• Evaporator defrost practices

Open Question/Answer/Discussion

6:30 Adjourn Optional Session

**Day Three**

8:00 Continental Breakfast/Conversation

8:30 Refrigeration Cycle Review

9:00 Refrigeration System Design Options  
• System types  
  – direct expansion  
  – flooded (gravity recirculation)  
  – liquid overflow  
• Advantages and disadvantages  
• When to use  
• Multi-stage (multi-temperature) options

12:00 Lunch

1:00 Refrigeration System Design Options (continued)  
• Cascade systems  
• Economizers (flash, heat exchanger)  
• Defrost options  
• Liquid transfer options  
• Oil management  
• Oil recovery  
• Stills  
• Advantages of ammonia vs. other refrigerants

2:30 Open Discussion  
3:00 Final Adjournment

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**Continuing Education Credit**

By participating in this course, you will earn 20 Professional Development Hours (PDH) or 2.0 Continuing Education Units (CEU).
Courses on our website: epd.engr.wisc.edu/wisc.edu. You can also check out these courses, please call 800-462-0876 or send an e-mail message to custserv@epd.engr.wisc.edu. You can also check out these courses on our website: epd.engr.wisc.edu/ammoniarefrigeration.

Four Easy Ways to Enroll

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

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

Course Information

Please enroll me in Introduction to Ammonia Refrigeration Systems

- Course #N213: March 6-8, 2013 in Madison, WI Fee: $1195
- Course #M623: October 8–10, 2012 in Madison, WI Fee: $1195

Personal Information

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Related Courses from UW-Madison

Design of Ammonia Refrigeration Systems for Peak Performance and Efficiency
September 17–21, 2012

Course #M623

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

Course #M624

Intermediate Ammonia Refrigeration Systems
December 5–7, 2012

Course #M624

Fundamentals of HVAC
March 13–15, 2013

Course #N214

Ammonia Refrigeration System Safety
April 17–19, 2013

Course #N215

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

Course #N216

To receive a brochure for any of these courses, please call 800-462-0876 or send an e-mail message to custserv@epd.engr.wisc.edu. You can also check out these courses on our website: epd.engr.wisc.edu/ammoniarefrigeration.

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Need to Know More?

Call toll free 800-462-0876 and ask for

Program Director: Douglas Reindl
reindl@wisc.edu

Program Associate: Mary Danielson
Or e-mail custserv@epd.engr.wisc.edu

General Information

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

Cancellation If you cannot attend, please notify us at least seven days in advance of the course start date, and we will refund your fee. Cancellations received after that 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 For the October course, we have reserved a block of guest rooms (rates starting at $89, including continental breakfast and free wifi) at Lowell Center, 610 Langdon Street, Madison, WI. Reserve a room online at epd.engr.wisc.edu/lodgingM623 or call 800-301-1753 or 608-256-2621. Room requests after September 9 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 breakfast, private airport taxi (a $30 value), and parking) at Campus Inn, 601 Langdon Street, Madison, WI. Reserve a room online at epd.engr.wisc.edu/lodgingBM623 or call 800-589-6285 or 608-257-4391 and indicate that you will be attending this course under group code 115256. Room requests after September 16 will be subject to availability. Other fees and restrictions may apply.

For the March course we have reserved a block of guest rooms (rates starting at $89, including continental breakfast and free wifi) at Lowell Center, 610 Langdon Street, Madison, WI. Reserve a room online at epd.engr.wisc.edu/lodgingN213 or call 866-301-1753 or 608-256-2621. Room requests after February 5 will be subject to availability. Other fees and restrictions may apply.

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