

An Update on the Transition to Flammable Refrigerants

**A short course on the transition to flammable refrigerants
and its impact on building design and equipment safety requirements**

Sunday, July 10, 2022, 12:00 p.m. to 5:00 p.m.

Rawls Hall

Purdue University
West Lafayette, Indiana

Organized by

U. S. National Committee of the IIR
Ray W. Herrick Laboratories

The demand for refrigerants with lower global warming potential has led the HVAC&R industry to consider using refrigerants that are flammable. While these refrigerants have been demonstrated to perform quite well thermodynamically, the use of flammable fluids will require changes in various safety codes and guidelines related to building design, HVAC&R installation and service requirements, as well as system design and manufacture. Building and equipment safety codes must not only protect the building occupants, but also first responder personnel who may be called to a fire or other emergency situation with no knowledge of the installed equipment. Flammable fluids may also require changes in system pipe joining methods, performance testing procedures and apparatus, and additional training of service employees to comply with likely more stringent insurance requirements.

Recognized experts who work daily in the development of safety codes and flammable refrigerant applications will cover building, equipment, and servicing changes that will be required for future generations of refrigerants. Topics include:

- Status and timelines of UL 60335-2-40 (Heat Pumps, Air-Conditioners, Dehumidifiers)
- Status and timelines of UL 60335-2-89 (Commercial Refrigerating Appliances)
- Changes in state building codes as well as ASHRAE Standard 15 (Mechanical Rooms)
- New developments in gas detectors and other leak detection equipment
- Oak Ridge National Lab leak test results for entire HVAC&R systems
- Fire service testing with flammable refrigerants for future applications
- Transitioning to flammable refrigerants from a manufacturer's perspective

**Electronic presentation files will be provided to all participants. Those attending the short course should bring a laptop computer to follow along and take notes.*

FLAMMABLE REFRIGERANTS SHORT COURSE SCHEDULE - Sunday, July 10, 2022

- 12:00 pm Course registration (lunch provided)
- 12:50 pm **Course Logistics and Introduction**
William Murphy
- 1:00 pm **UL 60335-2-40 – Safety Requirements for Electrical Heat Pumps, Air-Conditioners, and Dehumidifiers**
Brian Rodgers, Underwriter's Laboratory
This standard will replace UL standard 1995 for residential equipment in 2024. Many new test protocols will be required to certify systems with flammable refrigerants. This is an update of recent and pending future changes in these standards related to the safe use of flammable refrigerants.
- 1:30 pm **UL 60335-2-89 – Safety Requirements for Commercial Refrigerating Appliances**
Brian Rodgers, Underwriter's Laboratory
Residential refrigerators in Europe already can use flammable refrigerants, subject to charge limits. This discussion will provide an update on changes to this standard and the status of proposals to move standards for all refrigeration equipment categories in North America in the direction of the European model.
- 2:00 pm **Changes in Building Safety Codes for Use of Flammable Refrigerants**
Brian Rodgers, Underwriter's Laboratory
State building codes dictate the types of HVAC&R equipment that can be used and how they must be installed in certain applications. This presentation will address proposed changes to various state codes to reflect the use of flammable refrigerants and include discussions of ASHRAE Standard 15 and Standard 15.2P for residential applications.
- 2:30 pm Break (refreshments provided)
- 2:40 pm **Safety Testing with Flammable Refrigerants**
Xudong Wang, Air-Conditioning, Heating, and Refrigeration Institute
This presentation will give a summary of recent and ongoing research being sponsored by DOE, ASHRAE, AHRI, UL, and other organizations on combustion potential when using flammable refrigerants.
- 3:10 pm **HVAC&R System Refrigerant Leak Characterization – Laboratory Investigations**
Ahmed Elatar, Oak Ridge National Laboratory
Controlled lab tests of refrigerant releases on several different HVAC&R systems were performed. Impact of leak location, leak orifice sizes, and equipment operating state (on or off) on leak rate and other characteristics will be discussed. Measured refrigerant dispersion through the test room will be reviewed as well.
- 3:40 pm **Refrigerant Gas Leak Detectors**
Stefan Elbel, University of Illinois, Creative Thermal Solutions
Flammable refrigerants will require detectors so that HVAC&R equipment can be deenergized prior to reaching explosive concentrations in the event of a leak. This presentation will provide results of leak detector studies conducted for AHRTI, including gas leak measurement methods that were used.

- 4:10 pm Break
- 4:20 pm **Transitioning the HVAC&R Industry to Flammable Refrigerants**
Xudong Wang, Air-Conditioning, Heating, and Refrigeration Institute
AHRI has established a Safe Refrigerant Transition Task Force to identify major changes that will be required in manufacturing, installation, and servicing of HVAC&R equipment that uses flammable refrigerants. Working groups explore the impacts of changes to codes, safety training, O&M practices, and refrigerant storage, transport, handling, and disposition.
- 4:50 pm **Final Questions for All Speakers**
- 5:00 pm Course Evaluations, Adjourn

Refrigeration Short Course Speaker Biographies

Brian Rodgers has been Principal Engineer for Heating, Ventilating & Large-Scale Cooling Equipment with Underwriters Laboratories for over 15 years. He previously was Product Safety Engineer with Tecumseh Products for 17 years. Most of his career has been devoted to the development of US, regional, and international safety standards, for which he received the IEC's 1906 Award in 2015 for his work on IEC SC61C MT1 for motor compressors. UL has named him to its William Henry Merrill Society in recognition of his leadership in his field. Brian received his engineering degree from Eastern Michigan University.

Dr. Stefan Elbel received his MS and PhD degrees in Mechanical Engineering from the University of Illinois at Urbana-Champaign (UIUC), where he currently holds an appointment as Research Assistant Professor. He is the Associate Director of the Air-Conditioning and Refrigeration Center (ACRC). Since 2007 he has also been the Chief Engineer at Creative Thermal Solutions, Inc. (CTS). Dr. Elbel has over 20 years of R&D experience in advanced air-conditioning and refrigeration systems for mobile and stationary applications using low-GWP refrigerants. He was the PI on a recent research project for AHRTI that addressed leak detection of flammable refrigerants.

Dr. Ahmed Elatar is a member of the Building Equipment Research Group at Oak Ridge National Laboratory. His area of expertise is in experimental and numerical thermal and fluid sciences. His current research involves the evaluation of catastrophic leak scenarios for R-32 and R452B from roof top air-conditioning units. He was involved with the extensive assessments of flammable refrigerant leaks from building HVAC equipment conducted at Oak Ridge. Dr. Elatar received his BS and MS degrees from Alexandria University (Egypt) and his Ph.D. from Western University (Canada) in Mechanical Engineering.

Dr. Xudong Wang is Vice President of Research for the Air-Conditioning, Heating, and Refrigeration Institute where he oversees all their research programs related to alternative refrigerants and their adoption by industry. He has initiated and managed multiple research programs and projects related to assessing low GWP refrigerant performance, compatibility, and safety. Dr. Wang coordinates with HVAC manufacturers, trade groups, professional societies, national labs, and standards writing bodies to develop new technologies, practices, and policies for successful implementation by industry. Dr. Wang received his Ph.D. in Mechanical Engineering from the University of Maryland.

William E. Murphy, PhD, PE, FASHRAE
Professor Emeritus of Mechanical Engineering, University of Kentucky
Research Interests: A/C system dynamics; ground source heat pump systems
BS University of Kentucky, MS and PhD Purdue University. Mechanical Engineering