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AHRI’s TechUpdate e-newsletter is published twice a year and includes the latest information on AHRI’s research initiatives, including recently concluded research reports and ongoing projects. Learn more and subscribe here.

AHRI Flammable Refrigerants Research Initiative

The HVAC&R industry is transitioning to low global warming potential (GWP) refrigerants due to environmental and regulatory concerns. As many of these low GWP refrigerants are mildly flammable, AHRI is leading a collaborative flammable refrigerants research program. The program is supported by AHRI, ASHRAE, California Air Resource Board (CARB) and U.S. Department of Energy (DOE). This $5.6 million research program will fill in the knowledge gaps toward the safe use of flammable refrigerants, and is part of an ongoing global effort to phase down the use of high-GWP refrigerants and identify appropriate climate-friendly alternatives. Of the total, DOE is contributing $3 million, ASHRAE $1.3 million, AHRI $1 million, and CARB $0.3 million. The goal of the research initiative is to deliver scientific findings and produce publicly available technical references to support code and standard activities related to the use of flammable refrigerants.

The program includes the following key research projects. Leading organization, project number, and status are listed in parenthesis; Air-Conditioning, Heating and Refrigeration Technology Institute (AHRTI) is AHRI’s research arm.

- Benchmarking Risk by Whole Room Scale Leaks and Ignitions Testing (AHRTI-9007, completed)

The objective of this project was to conduct A2L refrigerants leak and ignition testing under whole room scale to understand the risk associated with the use of A2L refrigerants as opposed to the A1 refrigerants currently in use while considering ambient conditions (temperature and humidity) and refrigerant lubricants. Room scale tests were performed for commercial and residential scenarios, including a packaged terminal air conditioner in a motel room, a rooftop unit in a commercial kitchen, a walk-in cooler, a reach-in refrigerator in a convenience store, a split HVAC unit in a utility closet and with servicing error, and a split HVAC unit with hermetic electrical pass-through terminal failure. The project was completed in June 2017 and can be downloaded here.
• Investigation of Hot Surface Ignition Temperature for A2L Refrigerants (AHRTI-9008, ongoing)

The objective of the project is to establish a standard Hot Surface Ignition Temperature (HSIT) test method, and conduct the HSIT testing for various A2L refrigerants at various ambient conditions (temperature and humidity) with oil and air velocity effects included. According to the test results, the appropriate HSIT limits for A2L will be proposed to the relevant equipment safety standard for future changes. The project is ongoing at Exponent Inc, and expected to be completed this fall.

• Leak Detection of A2L Refrigerants in HVACR Equipment (AHRTI-9009, completed)

The objective of the project is to conduct a thorough review of what sensor technologies are available that can be used to detect A2L refrigerants and easily integrated into our equipment. The final report will be available this month.

• Flammable Refrigerants Post-ignition Risk Assessment (ASHRAE-1806, ongoing)
• Guidelines for Flammable Refrigerant Handling, and Equipment Servicing and Installation (ASHRAE-1807, ongoing)
• Servicing and Installing Equipment using Flammable Refrigerants: Assessment of Field-made Mechanical Joints (ASHRAE-1808, ongoing)
• Investigate the Proper Basis for Setting Charge Limits of A2L, A2, And A3 for Various Types of Products (Oak Ridge National Laboratory, ongoing)
• Modeling Tools for Low-GWP Refrigerant Blends Flammability (National Institute of Standards and Technology, ongoing)

Other AHRI Research Activities

AHRI conducts research in other areas, in addition to low-GWP refrigerant testing. Below is a list of recently completed projects as well as project that will be finalized in the near future:

• AHRI-8011: Field Evaluation for Combustion Appliance Auditing: This project identified and compared currently recognized or commonly utilized procedures for evaluating the safety and performance of installed combustion equipment, and provided information either to identify the correct procedure or to develop such a procedure if existing procedures are insufficient. The project can be downloaded from the AHRI website.

• AHRI-8014: The Effect of Lower Return Air Temperatures on Furnace Heat Exchangers: The objective of the project was to investigate the effect of low return air temperatures on the integrity of furnace heat exchangers. Five production furnaces were tested to 100 days of cycling time or 12000 cycles in accordance with the section 2.15 Corrosion Resistance of ANSI Z21.47-2012, CSA2.3, Standard for Gas-fired Central Furnaces. The only difference was that the return air temperature and combustion air temperature were maintained at 45°F ± 5°F, with most of the time spent at 45°F ±2°F and a period average of 46.1°F. The test results indicate that low return air temperatures should be avoided if using a non-condensing furnace as that operation will cause more rapid deterioration of the furnace than will operation at normal comfort levels of ambient air (65°F to 75°F). The project can be downloaded from the AHRI website.
• AHRI-8017: *Investigation of Energy Produced by Potential Ignition Sources in Residential Application*: The project's goal is to evaluate energy produced by potential ignition sources in residential applications relative to minimum ignition energy from a list of A2L refrigerants, and to investigate the likelihood of the presence of ignition sources and refrigerant ignition. The results could be used to expand the existing risk assessment studies of A2L refrigerants by providing further detail. The project is near completion, and the final report is expected to be available to AHRI members this fall.

**AHRI/ASHRAE Co-funded Projects**

AHRI works closely with ASHRAE to leverage the AHRI research program by co-funding with ASHRAE on projects that are useful to AHRI members, some of which are listed below. All AHRI co-funded ASHRAE project final reports are available to AHRI members upon request.

• **AHRTI-ASHRAE-1507: Binary Refrigerant Flame Boundary**: The project developed, through a literature search, a database of past pertinent binary flame boundary concentrations, and determined, through laboratory measurements, values for 10 additional refrigerant component pairs of commonly used and newly introduced flammable/nonflammable refrigerants pairs. The project is completed, and the final deliverable is being prepared.

• **AHRTI-ASHRAE 1634, Guide for Sustainable Refrigerated Facilities and Refrigeration Systems**: The objective of the project is to develop a guide for sustainable refrigerated facilities and refrigeration systems. Information in the Guide will be used for the design of new facilities, expansions, and remodels, as well as provide guidance on improvements and operating methods that may also be applied to existing facilities. This project is ongoing at Massey University.

• **AHRTI-ASHRAE1645, Development of New Accelerated Corrosion Tests for All-Aluminum Microchannel and Tube and Fin Heat Exchangers**: The objective of this research is to develop a new corrosion test, or justify the use of an existing standardized accelerated test, for both all-aluminum tube and fin and brazed microchannel heat exchangers. This project is ongoing at University of Northern Texas.

• **AHRTI-ASHRAE -1717, Improve Accuracy and Reproducibility of ASTM-E681 Test Method for Flammability Limit Measurement of 2L Flammable Refrigerants**: The project will identify modifications needed for testing new alternative refrigerants for flammability following ASTM E681 to allow ASHRAE SSPC 34 to properly identify their safety classification for use by the industry. The project is ongoing at University of Maryland.

• **ASHRAE-1721-WS, Oil Return and Retention in Unitary Split System Gas Lines with HFC and HFO Refrigerants**: The objective of this research is to collect sufficient data to develop normalized rules that will allow design engineers to confidently specify line sets for all current refrigeration-oil combinations as well as future combinations in cooling and heating applications. This project is ongoing at Purdue University.

• **ASHRAE-1728-RTAR, Development of Models for Prediction of Oil Refrigerant Mixture Properties of Low-GWP Refrigerant and Synthetic Compressor Oils**: The objective of this project is to evaluate simulation tools that model refrigerant and oil mixture properties; in
particular, mixture properties of new refrigerants and refrigerant blends with commercially available oil formulations.

- **ASHRAE-1731-RTAR, Heat Transfer Performance of Medium Pressure Alternative Lower GWP Refrigerants in a Flooded Evaporator Comprising an Enhanced Tube Bundle:** The objective of this research is to experimentally measure the refrigerant-side heat transfer performance of R134a (baseline) and lower GWP refrigerants boiling in tube bundles, quantifying trends by refrigerant against the baseline.

- **ASHRAE 1733-RTAR, Develop Design Criteria for Psychrometric Air Sampler and Mixer Apparatus for Use in ASHRAE Test Standards:** The objective of this project is to develop optimized design recommendations for indoor and outdoor air samplers, as well as mixers.

- **ASHRAE 1741-RP, Understanding Fan Coil Components and How They Relate to Energy Consumption and Energy Modeling:** The objective of this research project is to provide the industry with part-load capacity and efficiency performance maps for fan coil units at the airflows and water flows required to meet the loads of the building.

- **ASHRAE-1743-RP, Effect of Inlet Duct and Damper Design on ASHRAE 37/116 Fan Performance and Static Pressure Measurements:** The objective of this research is to develop a set of design guidelines/requirements for the construction of an inlet duct and/or damper apparatus for inclusion in a test standard. The project is ongoing at Oklahoma State University.

- **ASHRAE-1769-WS, Experimental Evaluation of the Efficiency of Belt Drives for Fans:** The objective of this research is to conduct necessary testing to determine the efficiency characteristics of belt drives for fans, and develop a belt efficiency model covering full and part-load operation. This information is not available and is needed to support fan system selection decisions and future standards, codes, and regulations.

- **ASHRAE 1773-RTAR, Ignition Potential from Electrical Devices in Commercial and Residential Applications using 2L Refrigerants:** The objective of this project is to review ignition testing using 2L refrigerants; carry out testing of minimum ignition energy (MIE), including MIE testing with HVAC components; and provide guidelines for intrinsically safe electrical components.

- **ASHRAE 1774-RP, Effect of System Chemicals Towards the Breakdown of Lubricants and Lower GWP Refrigerants:** The objective of this project is to generate and presented results from post-exposure evaluations of sealed glass tube samples prepared with lower GWP refrigerants, lubricants, and process chemicals to facilitate assessments on the relative chemical compatibility risks of lower GWP refrigerants.

- **ASHRAE 1785-RP, Refrigerant Charge Modeling in Coils for Residential Split Systems:** The objective of this project is to develop a test methodology for measuring both oil retention and refrigerant charge of round tube plate fin heat exchangers and to obtain these data using the developed test method. The data could be used by the industry to verify, select, and correlate models as required. The project is ongoing at Oklahoma State University.
• **ASHRAE 1791-WS, *Humidity Effects on Burning Velocity*: The objective of this project is to identify the need for testing refrigerant burning velocity in humid air for purposes of classification.

• **ASHRAE 1798-RTAR, *Impact of Combustion Emissions from Gas-Fired Unvented Combustion Devices on Indoor Air Quality*: The objective of this project is to investigate the impact of gas-fired unvented space heater (ANSI Z21.11.2) combustion emissions on indoor air quality in a residential building that complies with ASHRAE Standard 62.2.

• **ASHRAE 1802-RTAR, *Defining the 2 / 2L Flammability Boundary in Standard 34*: The objective of this project is to identify a technically sound approach to defining the 2L subclassification.

**Other Research Related Activities**

**AHRTI Project 9007 Results Reporting Meeting**

AHRTI hosted its AHRTI Project 9007 results reporting meeting on April 3 at UL, Northbrook, Ill. The meeting was to present the most recent A2L refrigerants leak and ignition testing results to the relevant standards working groups and committees. Technical experts attending the meeting were involved in safety standards and working groups such as ASHRAE Standards 15 and 15.2, UL 60335-2-40, UL 6-335-2-89, and IEC 60335-2-40. The researcher and AHRTI Project Monitoring Subcommittee Leads presented a summary of the project results and learning experience.

**12th IEA Heat Pump Conference**

AHRI staff attended the 12th International Energy Agency (IEA) Heat Pump Conference on May 15-18 at Rotterdam, Netherlands. They discussed the effective management on the transition to lower Global Warming Potential (GWP) refrigerants, summarized the AHRI activities on flammable refrigerants, and provided an overview of the AHRI research on low GWP refrigerants testing and risk assessment of mildly flammable refrigerants for packaged rooftop units. With participants from over 30 countries, the conference summarized the current technology, market status, progress and trends, and provided an international platform for collaborative work on heat pumps. The conference presentations are available here.