

THE HVACR INDUSTRY IS TAKING A RESPONSIBLE APPROACH TO ENSURE THE SAFE USE OF FLAMMABLE REFRIGERANTS

The HVACR industry is transitioning to low global warming potential (GWP) refrigerants due to environmental concerns and regulatory requirements. The California Air Resource Board (CARB) is considering a January 1, 2023 transition to low-GWP refrigerants. Many of these low-GWP refrigerants are classified as lower flammability, which has required the update of relevant safety standards and codes to enable the use of these environmentally friendly refrigerants in a timely and cost-effective manner.

Over the past decade, industry and industry associations have collaborated with federal and state governments to conduct research about refrigerant flammability and the safe use of these refrigerants. The Air-Conditioning, Heating and Refrigeration Technology Institute (AHRTI) has been leading a research program, “The Flammable Refrigerants Research Initiative,” aimed at generating publicly available and sound technical data to support Underwriters Laboratory (UL) and American Society of Heating and Refrigeration Engineers (ASHRAE) safety standard modifications related to the use of flammable refrigerants. This \$6 million plus initiative is jointly funded by Air-Conditioning, Heating, Refrigeration Institute (AHRI), ASHRAE, CARB and the U.S. Department of Energy (DOE) to develop scientific findings and produce publicly available technical references to support code and standard activities related to the use of flammable refrigerants.

Flammable Refrigerants Research Initiative

AHRTI surveyed 46 relevant safety standards committees and working groups related to flammable refrigerants for technical data gaps to identify and understand refrigerant flammability risk, including the impact of refrigerant charge size, refrigerant detector technologies, mitigation effectiveness and equipment installation. The reports from these high priority projects have been shared with the standards communities and the public, and used to substantiate changes to safety standards. The list of these projects is attached in Exhibit-1.

AHRTI performed an industry analysis of potential risk with several whole room-scale air-conditioning and refrigeration leak and ignition tests using rapid liquid refrigerant releases and multiple strong ignition sources placed in locations where combustible mixtures were most likely to occur. For example, these unrealistic release and ignition scenarios showed that refrigerant detection systems would need a faster response time than the 30 second response originally envisioned by the safety standards. This detection response time change has been adopted by the relevant safety standards such as ASHRAE Standard 15 and UL 60335-2-40.

Another AHRI project evaluated potential ignition sources in homes. The project demonstrated that many household sources (e.g. burning cigarette, sparks from common household appliances and tools etc.) could not ignite lower flammability refrigerants.

After critical testing was completed, safety standards were upgraded. However, much like other industries, AHRTI is continuing to explore ways to optimize systems using lower flammability refrigerants (e.g., AHRTI-9014: Assess Refrigerant Detector Characteristics for Use in HVACR Equipment) and summarize previous learnings by other industries already using lower flammability refrigerants (e.g., ASHRAE-1855: Determination of the Impact of Combustion byproducts on the Safe Use of Flammable Fluorinated Refrigerants).

For additional information or to participate in the AHRI Safe Refrigerant Transition Task Force¹, go to <https://ahrinet.org/SafeRefrigerant>.

¹ ***AHRI Safe Refrigerant Transition Task Force***

The AHRI Safe Refrigerant Transition Task Force (SRTTF) is comprised of 50 organizations including AHRI members, training groups, contracting groups, fire service organizations, state and federal government agencies, unions, and others. The goal of the SFTTF is to lead the charge in enabling the safe and reliable use of mildly flammable refrigerants.

Exhibit-1: The following AHRTI projects were developed as the result of the survey of safety standards community. They were prioritized among other identified research needs and considered as high priority projects by a group of experts including industry experts, major safety standard committee chairmen and members, and representatives from DOE, Environmental Protection Agency (EPA), and National Institute of Standards and Technology (NIST).

Launched High Priority Projects	Funding Organization	Project Description	Status
AHRTI-9007-01: Benchmarking Risk by Whole Room Scale Leaks and Ignitions Testing of A2L Refrigerants	AHRI	A2L refrigerants leak and ignition testing under whole room scale conditions was conducted to develop data and insight into the risks associated with the use of A2L refrigerants versus A1 refrigerants while considering ambient conditions (temperature and humidity) and refrigerant lubricants.	Completed
AHRTI-9007-02: Benchmarking Risk by Whole Room Scale Leaks and Ignitions Testing of A3 Refrigerant	CARB	A3 refrigerant leak and ignition testing under whole room scale conditions to understand the severity and risk associated with the use of A3 refrigerants and to provide test data to support future revisions of relevant safety standards associated with using A3 refrigerants.	Report under review
AHRTI-9008: Investigation of Hot Surface Ignition Temperature for A2L Refrigerants	AHRI	A test methodology was developed to assist in the evaluation of the propensity of A2L refrigerants (R32, R1234ze, and R452B) to ignite on hot surfaces, and to carry out testing per the new test methodology.	Completed
AHRTI-9009: Leak Detection of A2L Refrigerants in HVACR Equipment	AHRI	A thorough review of sensor technologies was conducted to evaluate available technologies that can be used to meet safety standards requirements of detecting A2L refrigerants and easily integrated into air-conditioning and refrigeration equipment. Infrared (IR) and Metal Oxide Semiconductor (MOS) sensors were found to be the most promising sensor technologies.	Completed
AHRTI-9014: Assess Refrigerant Detector Characteristics for Use in HVACR Equipment	AHRI	Further assess refrigerant sensor and refrigerant detector performance to optimize those systems for class 2L, 2, 3 flammable refrigerants for use with indoor HVACR equipment in occupied spaces or a machinery rooms.	Ongoing
AHRTI-9015: Assessment of Refrigerant Leakage Mitigation Effectiveness for Air-Conditioning and Refrigeration Equipment	AHRI	Demonstrate the efficacy of refrigerant leakage mitigation strategies contained within residential split-systems, packaged air-conditioning equipment and commercial refrigeration products.	Ongoing
ASHRAE-1806: Flammable Refrigerants Post-Ignition Risk Assessment	ASHRAE	Further document the severity of events where various HVAC&R products containing various flammable refrigerants are ignited under different scenarios duplicating previous testing by others to make the data publicly available.	Ongoing
ASHRAE-1807: Guidelines for flammable refrigerant handling, transporting, storing and equipment servicing and installation	ASHRAE	This project accessed flammable refrigerant safety guidelines and/or requirements that exist domestically and internationally. The assessment will be used to propose requirements/guidelines for the safe handling, storing and transporting of flammable refrigerants.	Completed
ASHRAE-1808: Servicing and Installing Equipment Using Flammable Refrigerants: Assessment of Field-made Mechanical Joints	ASHRAE	Test of leak-tightness of various types of field-made joints used to connect refrigerant piping and system components in HVAC&R equipment. The results of this project provided necessary data to suggest whether or not common types of joints, other than brazed or soldered joints, should be permissible for use in equipment containing flammable refrigerants.	Completed

ASHRAE-1855: Determination of the Impact of Combustion byproducts on the Safe Use of Flammable Fluorinated Refrigerants	ASHRAE	Summarize available literature regarding decomposition products of halogenated refrigerants (e.g. HF and COF ₂) and clean up methodologies following ignition events. Identify information gaps if any are found.	Ongoing
ORNL: Determination of setting charge limits for various types of equipment employing flammable refrigerants	DOE	Examine the currently imposed limits for flammable refrigerant alternatives (A2L, A2, and A3) and identify reasonable adjustments to these limits as appropriate.	Completed
ORNL: Experimental Evaluation of Refrigerant Leak Characteristics for Different HVAC&R Equipment Types	DOE	Quantify leak rates and duration for various pieces of equipment by conducting refrigerant leak tests under operating conditions representative of actual applications.	Completed
NIST: Modeling Tools for Flammability Ranking of Low-GWP Refrigerant Blends	DOE	Develop modeling tools that can predict the burning velocity of arbitrary mixtures of R32, R125, R134a, R152a, 1234yf, and 1234ze(E), so that flammability of a blend can be minimized, while simultaneously maximizing performance related to other parameters for new refrigerant blends.	Ongoing