



Climate change: melting glaciers, diminishing water resources, trapped sunrays increase global warming



THE USE OF FLAMMABLE REFRIGERANTS

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RESEARCH ON THE USE OF FLAMMABLE REFRIGERANTS

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Abstract

ASHRAE is collaborating with AHRI (Air-Conditioning, Heating, Refrigeration Institute) and the U.S. - DOE (United States - Department of Energy) to fund vital research that will establish a more robust database of facts concerning the properties and the use of flammable refrigerants. This effort is part of an ongoing global effort to phase down the use of high-global warming potential (GWP) refrigerants and identify appropriate climate-friendly alternatives.

In anticipation of a global plan to phase down high-GWP refrigerants, the industry has spent the past five years researching potential alternatives. Through that effort, several promising refrigerants were identified, many of which are low toxicity but are classified as mildly flammable or flammable. This new research program will provide the technical knowledge needed to facilitate and accelerate the safe use of these refrigerants. The results of this research will immediately be transmitted to the committees responsible for ANSI/ASHRAE Standard 15-2013, *Safety Standard for Refrigeration Systems*, and ANSI/ASHRAE Standard 34-2013, *Designation and Safety Classification of Refrigerants*, with a goal of using the results to update the standards as soon as possible, subject to full compliance with the ANSI consensus process.

The presentation will give insight on these research projects, which are expected to be completed during 2017 with final results made available by the end of 2017. These projects when completed will address safety issues pertaining to flammable refrigerants such as: Refrigerant Handling, Transporting, Storing, Equipment Servicing and Installation, and system risk assessment.

Introduction

Harnessing and adapting new technologies and research enables the HVAC&R industry to create a future where the built environment is healthier, more comfortable and more energy efficient, thus producing a more sustainable world. Nowhere are such rapid changes occurring as in the flammable refrigerants field.

Regulations – along with an ever-growing concern for the environment – have made flammable refrigerants one of the more prevalent topics for the HVAC&R industry within the past five years. Without a doubt, balancing the safety of flammable refrigerants with their impact on the environment requires an immense amount of data and information. As such, research to identify effective refrigerant alternatives with low global warming potential (GWP) has intensified as part of a global effort to phase down the use of high GWP refrigerants.

Through that effort, several promising refrigerants have been identified, many of which are low toxicity but are classified as either mildly flammable or flammable. These include hydrocarbons,

such as propane (R290) and isobutane (R600a), as well as ammonia (R717), R32 and other low GWP HFO's. However, there is a clear and present need to continue exploring their environmental impact as well as their effective influence on system performance.

Alternative lower GWP refrigerants would ideally provide the same – if not better – energy performance as current refrigerants, but would do so with a reduced environmental impact for both now and the future.

With this goal in mind, the HVAC&R industry and various research organizations have been investigating the performance of these refrigerants in HVAC&R systems and components. However, while the demand for flammable refrigerants is increasing, the current codes and standards adoption processes are relatively slow.

That's why ASHRAE, the Air-Conditioning, Heating, and Refrigeration Institute (AHRI) and the U.S. Department of Energy (DOE) have collaborated to fund vital research that will expedite findings and establish a more robust fact base about the properties and the use of flammable refrigerants.

This \$5.2 million investment will provide the technical knowledge needed to facilitate and accelerate the safe use of these refrigerants as well as identify any additional climate-friendly alternatives. Of the total, DOE is contributing \$3 million, ASHRAE \$1.2 million and AHRI \$1 million.

Overall, seven research efforts are currently under way or planned as part of this collaboration including three high-priority projects led by ASHRAE, which are:

Flammable Refrigerants Post-Ignition Simulations And Risk Assessment Update (ASHRAE-RP 1806)

A 12-month project, the findings of ASHRAE-RP 1806 will help the industry better understand the severity of events where flammable refrigerants are being ignited. Furthermore, the results will help refine the accuracy of safety standards currently being developed for flammable refrigerants and the associated building codes.

Guidelines For Flammable Refrigerant Handling, Transporting, Storing And Equipment Servicing, Installation And Dismantling (ASHRAE-RP 1807)

The objectives of ASHRAE-RP 1807 are three-fold and include reviewing existing requirements/practice for safe handling of flammable refrigerants; reviewing technician licensing or certification requirements; and proposing requirements for servicing and installing HVAC&R products using flammable refrigerants. Once complete, ASHRAE-RP 1807's findings will support revisions of relevant sections in ASHRAE and UL safety standards.

Servicing And Installing Equipment Using Flammable Refrigerants: Assessment Of Field-Made Mechanical Joints (ASHRAE-RP 1808)

The last of the three high-priority projects led by ASHRAE, researchers on ASHRAE-RP 1808 will spend six months assessing the effectiveness of joints made in the field, considering human and mechanical factors. The goal of which is to help determine whether common types of joints

other than brazed or soldered joints should or should not be allowed in ASHRAE Standard 15.2, and other relevant codes and standards.

Four additional research efforts outside of those led by ASHRAE also have been identified as part of this collaborative investment. Those include:

- Benchmarking Risk by Real Life Leaks and Ignitions Testing (AHRTI 9007)
- Investigation of Hot Surface Ignition Temperature (HSIT) for A2L Refrigerants (AHRTI 9008)
- Leak Detection of A2L Refrigerants in HVAC&R Equipment (AHRTI 9009)
- Determination of Setting Charge Limits for Various Types of Equipment Employing Flammable Refrigerants (DOE/ORNL)

Each of these high-priority efforts have been given accelerated timelines and large funding investments ranging from \$50,000 to \$1 million in hopes that all will be completed this year, with results being made available by the end of 2017.

Upon the projects' completions, the findings will be used to update relevant codes and standards where applicable as soon as possible to fill any knowledge gaps. This includes ASHRAE Standard 15-2016, *Safety Standard for Refrigeration Systems*, and ASHRAE Standard 34-2016, *Designation and Safety Classification of Refrigerants*.



Most recently updated in 2016, these key ASHRAE standards guide refrigerant identification and usage while providing essential guidance to manufacturers, design engineers and operators who need to stay current with new air conditioning and refrigeration requirements. Therefore, utilizing the results from this critical research investment to update the standards tied to flammable refrigerants will be immensely helpful in furthering the HVAC&R

industry. A brief overview of both ASHRAE Standard 15 and 34 and their importance are below:

ASHRAE Standard 15-2016, Safety Standard For Refrigeration Systems

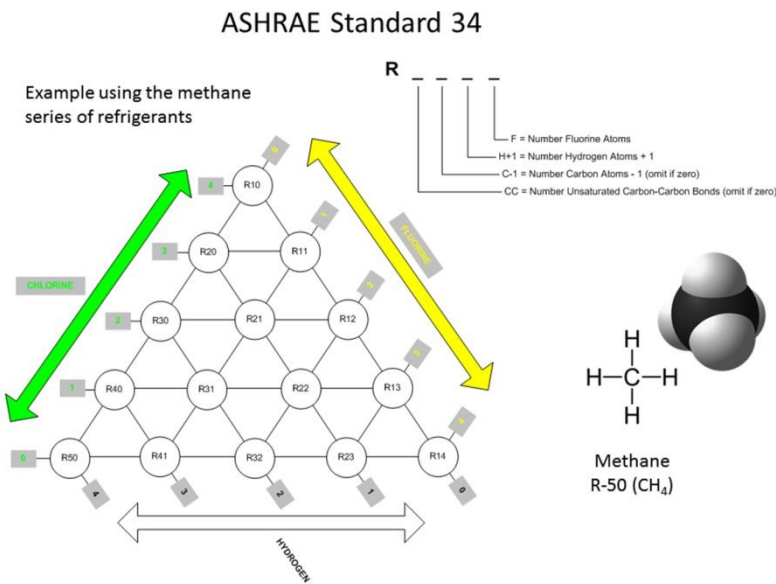
ASHRAE Standard 15 is directed toward the safety of persons and property on or near the premises where refrigeration facilities are located. This standard features up-to-date research designed to improve the safe design, construction, installation and operation of refrigeration systems. Additionally, ASHRAE Standard 15 gives a method for determining the amount of refrigerant in a given space that, when exceeded, requires a machinery room.

I N C R E A S I N G	F L A M M A B I L I T Y	SAFETY GROUP		
		Higher Flammability	A3	B3
		Lower Flammability	A2 A2L*	B2 B2L*
No Flame Propagation	A1	B1		
		Lower Toxicity	Higher Toxicity	

INCREASING TOXICITY →

ASHRAE Standard 34-2016, Designation And Safety Classification Of Refrigerants

Initially published in 1957 as an ASRE standard, ASHRAE Standard 34 describes a shorthand way of naming refrigerants and refrigerant blends. It also assigns safety classifications based on toxicity and flammability data. The primary components of Standard 34 include the numbering and designation of refrigerants, safety group classifications, as well refrigerant concentration limits. ASHRAE Standard 34 addresses the designations and safety classification of refrigerants as Figure explained in Figure 1.



The International Code Council (ICC) has stated any revisions made to these standards based upon the findings of the collaborative research investment will be eligible to be fast-tracked into international codes, in accordance with ICC procedures.

In addition to these research efforts, ASHRAE is leading the way of addressing flammability in refrigerants in education and training.

One example ASHRAE is doing this is by the development of a course for specialists in the field that explains the classification system by which ASHRAE assigns refrigerants to meet these needs. The course explains the process described in ASHRAE Standard 34 that results in a standardized system of assigned refrigerant numbers and well defined safety classifications, including toxicity and flammability ratings.

The ever-growing list of refrigerants currently includes 161 chemicals and chemical blends proposed for use as refrigerants. While there has long been use of flammable and toxic materials used as refrigerants, such as propane and ammonia, but their use has been restricted to appropriately design industrial systems, as proscribed in ASHRAE Standard 15 and other safe use guidelines. With global climate change top-of-mind, the cooling industry is being driven to consider new classes of chemicals to be used as refrigerants. With the new chemicals are new safety classifications for flammability, including “Class 2L.”

With ongoing education in mind, ASHRAE and UN Environment have partnered on a web-based course entitled “Refrigerants Literacy.” It provides 4.5 hours of instruction covering the basics of refrigerants used in air conditioning and refrigeration applications.

The course provides a basic understanding of refrigerants required by all involved in refrigerant policy and management, including policy makers, facility managers and specialists.

The course consists of four lessons:

- Lesson 1 covers refrigerants types and addresses environmental considerations
- Lesson 2 deals with refrigerant classifications, including ASHRAE Standards 15 and 34
- Lesson 3 addresses refrigeration selection, including residential and small commercial applications
- Lesson 4 covers Refrigerant Management, including development of a management plan, containers, storage, and recover, recycling and reclamation

For these research efforts and ongoing educational opportunities to be successful, it is imperative that all parties within the HVAC&R industry work together.

Each element from manufacturers to contractors, from building and system engineers to building operators and all those in-between will need to look beyond their own motives and cooperate with other industry segments to achieve optimized success.

Scientific breakthroughs – and the implementation of the findings – will happen only through collaboration and industry-wide teamwork. When these discoveries occur, all will benefit as each party applies the research and updated standards to their own work. In doing so, the HVAC&R industry will be much more well-equipped to make the built environment more sustainable both now and in the future.

