Safety Standards: Challenges and Path Forward

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AHRI:

- Is one of the larger trade associations in the U.S.
  - Representing 315 HVACR and water heating manufacturers across 40 product sections
- Establishes international standards
  - Over 100 industry standards and guidelines
- Administers rigorous certification programs
  - 44 Certification Programs
- Advocates for the industry both domestically and globally
- Conducts pre-competitive research
Our Members are Manufacturers

- Central air conditioning and heating equipment
- Water heating equipment
- Commercial and industrial air-conditioning, heating, and ventilation equipment
- Commercial and industrial refrigeration equipment
- Hydronic heating equipment
- Components for heating, air-conditioning, and refrigeration systems
Where are We?

- Kigali Amendment sets the framework
- We must identify suitable alternative refrigerants...and quickly

- Low-GWP Alternative Refrigerants Evaluation Program (AREP) laid the groundwork, identifying most promising alternatives

- Now the final work is underway
Low-GWP AREP

- Viable low GWP alternatives exist

- Many promising refrigerants are classified under ASHRAE 34 and ISO 817 as 2L (mildly flammable) or 3 (highly flammable)

- Current safety standards (ASHRAE 15, IEC 60335-2-40 etc.)
  - Do not currently differentiate between class 2 and 2L refrigerants
  - Severely restrict the use of class 3 refrigerants

- Lack of publicly available research to support changes to safety standards
What’s Next

➢ **Equipment manufacturers must:**
  
  – Assess available alternatives for products and applications
  
  – Conduct research and development, both individually and collectively
  
  – Work as an industry to adapt regulatory and safety barriers to allow the safe use of equipment using A2L and A3 refrigerants
  
  – Retool and optimize manufacturing processes
  
  – Train technicians and building managers
Industry is Moving Forward

- **OEMs starting to select alternatives**
  - Commercial refrigeration: HCs, CO₂, Cascade systems
  - Chillers: HFO 1233zd(E), HFO-1234ze(E)
  - Unitary: R32, R-452B

- **OEMs are developing components and equipment**

- **However, regulatory and safety barriers must be adapted to allow the safe use of equipment using 2L and 3 refrigerants**

- **Difference between available alternative refrigerants and equipment and commercially available equipment**
AHRI Flammable Refrigerants Research

- Objective is to produce publicly available technical results to support codes and standards activities related to the use of A2L, A2, and A3 refrigerants,
  - Ensure timely completion of relevant standards such as ASHRAE 15, IEC 60335-2-40 and IEC 60335-2-89
- Joint effort by AHRI, ASHRAE, DOE, and California ($5.6 Million)

Joint Research to support ASHRAE 15 revisions

2017: draft ASHRAE 15 completed for Public Review

End of 2017: publication of the updated ASHRAE 15 including 2L refrigerants

Jan 2018: 2021 IMC: change proposals are due
Responsibility for high priority projects

- **AHRI Conducting ($1.0 million) – (CARB $0.3 million):**
  - AHRTI-9007: Benchmarking Risk by Real Life Leaks and Ignitions Testing
  - AHRTI-9008: Investigation of Hot surface Ignition Temperature (HSIT) for A2L Refrigerants
  - AHRTI-9009: Leak Detection of A2L Refrigerants in HVACR Equipment

- **ASHRAE conducting ($1.2 million):**
  - ASHRAE-1806: Flammable Refrigerants Post-Ignition Simulation and Risk Assessment Update
  - ASHRAE-1807: Guidelines for Flammable Refrigerant Handling, Transporting, Storing and Equipment Servicing, Installation and Dismantling
  - ASHRAE-1808: Servicing and Installing Equipment using Flammable Refrigerants: Assessment of Field-made Mechanical Joints

- **DOE funding ($3.0 million):**
  - ORNL: Investigate the proper basis for setting charge limits of A2L, A2, and A3 for various types of products
  - NIST: Modeling tools for low-GWP refrigerant blends flammability
AHRTI 9007: Benchmarking Risk by Real Life Leaks and Ignitions Testing

Objectives

- Conduct A2L refrigerant leak and ignition testing under whole room conditions
- Investigate control limits and safety factors that are proposed by draft versions of IEC 60335-2-40, IEC 60335-2-89
- Determine main effects that affect the severity of A2L refrigerant thermal events
- Document the refrigerant concentration profiles vs previous CFD models
- Document any thermal events for future deflagration modeling
- Investigate other factors that may drive variability or that have been overlooked by safety standards

Final report can be downloaded at: http://ahrinet.org/arep.aspx
AHRTI 9007 – Significant Findings

- R-410A with lubricant is not flammable
- Factors having no effect on event severity
  - Refrigerant burning velocity (R-32 vs. R-452B in ACs)
  - Temperature and humidity
  - Lubricant
- Factors leading to increased event severity
  - Refrigerant concentration
  - Liquid refrigerant present in the room – many times as a fog
  - High Leak rate and low release height
  - Obstruction
- Fans must activate quickly before ignition occurs
Future Work on Flammable Refrigerants

- A3 Refrigerants - $0.3 Million funding from CARB
- Characterize refrigerant leak scenarios with actual equipment in “on” and “off” states
- Real world ignition sources
  - Ignition energy
  - Quantity
  - Spatial location throughout the room
  - Activation frequency
**AHRTI, ASHRAE and DOE Joint Research Effort on Flammable Refrigerants**

**Latest Update date**: 7/5/2017

**Coordinated activities timeline (timeline is estimated and projects should start as early as possible.)**

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**AHRTI Project No. 9007-01**
- Benchmarking Risk by Whole Room Scale Leaks and Ignitions Testing of A2L Refrigerants
  - Project completed and report published in June 2017

**AHRTI Project No. 9007-02**
- Benchmarking Risk by Whole Room Scale Leaks and Ignitions Testing of A3 Refrigerant
- Project completes within 12 months (interim results feed to relevant standard committees as needed) (The contractor is working on Task 2.)

**ASHRAE-1806- Flammable Refrigerants Post-ignition Risk Assessment**
- Project completes in 6 months (contract signed, project period 3/1/2017-6/31/2017)

**ASHRAE-1807: Guidelines for flammable refrigerant handling, transporting, storing and equipment servicing and installation**
- Project completes in 6 months (The contract was signed in June 2017.)

**ASHRAE-1808: Servicing and Installing Equipment Using Flammable Refrigerants: Assessment of Field-made Mechanical Joints**
- Planned: project completes in 6 months
- Actual: no-cost extension for two extra months. The final report is approved and will be published in July

**AHRTI Project No. 9009 Leak Detection of A2L Refrigerants in HVACR Equipment**
- Planned: project completes in 6 months

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**IMC 2021**

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**Determination of setting charge limits for various types of equipment employing flammable refrigerants**
- Phase I (review and seek stakeholders input) (10/24/2016 workshop report issued, literature review summary was provided to PMS on 2/21/2017)
- Phase II (CFD study) completes in 9 months (The work is currently ongoing. Had two PMS review calls so far.)

**AHRTI Project No. 9008 Investigation of Hot Surface ignition Temperature for A2L Refrigerants**
- Planned: project completes in 6 months.
- Actual: no-cost extension for two extra months. Testing was completed.

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**Note:** The DOE funded long term project at National Institute of Standards and Technology is not listed in this page. The project title is Modeling Tools for Flammability Ranking of Low-GWP Refrigerant Blends.
Summary

- Viable alternative refrigerants exist – Many are flammable
- Industry is moving forward – New products are being introduced
- Use of flammable refrigerants presents safety challenges
- Industry and US Government are sponsoring $5.6 Million in research related to the safe use of flammable refrigerants
- Research is needed to support amendment of safety standards
- First round of research projects will be completed in early 2018
- We are moving as fast as we can
- Industry is committed
Thank you for your attention!