The International Symposium on New Refrigerants and Environmental Technology 2025

An Update on the U.S. Industry Low-GWP Refrigerants Research to Support Refrigerant Transition

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U.S. Industry Research on Refrigerants

- Remove barriers of using A2L refrigerants for certain applications
- Generate essential A2L refrigerants data
- Identify potential alternative refrigerants
- Assess risks of A3 refrigerants

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Risk Assessment of Open Flame Proximity to Commercial Refrigeration Appliances

- The project is to confirm or revise the ASHRAE standard 15 that prohibits the equipment with flammable refrigerants within 20 ft of an open flame
- Evaluate the equipment configurations and refrigerant leak scenarios of commercial refrigeration products
  - ice maker (floor-mount)
  - Ice maker (countertop mount)
  - 3-door reach-in cooler
  - three room sizes and various charge levels for R-454C and R-290

- Conduct a risk assessment for flammable refrigerant applications close to open flame ignition sources

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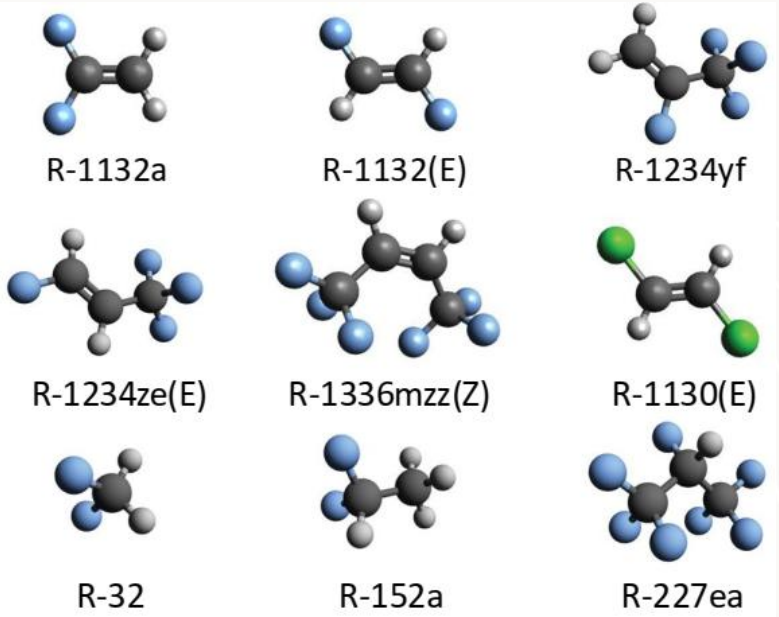
Low-GWP Refrigerants Data Generated

- Pure refrigerants or binary blends' thermodynamic properties

	Measurements			Modeling	
Refrigerants	p-ρ-T-x	Speed of sound (liquid)	VLE (Psat for pures)	Mixture model	Pure-fluid EOS
R-32/1234yf	✓	✓	✓	✓	
R-32/1234ze(E)	✓	✓	✓	✓	
R-152a/1234yf	✓	✓	✓	✓	
R-125/1234yf		✓	✓	✓	
R-1234ze(E)/227ea	✓	✓	✓	✓	
R-1132a (pure)		✓			
R-1132a/1234yf			✓	✓	
R-1132(E)/1234yf	✓	✓		✓	
R-1132(E)/32	✓	✓		✓	
R-1132(E)					✓
R-1130(E)	✓	✓	✓		✓
R-1336mzz(Z)/1130(E)		✓	✓	✓	
R-1336mzz(Z)			✓		



[Source: NIST Interagency Report (NISTIR) 8570. https://doi.org/10.6028/NIST.IR.8570]

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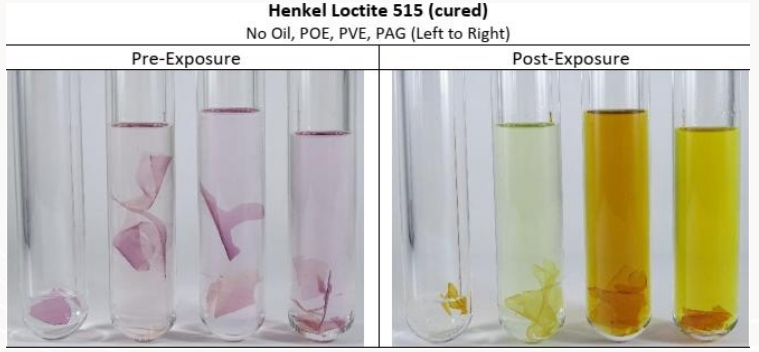
Low-GWP Refrigerants Chemical Stability and Material Compatibility

- Refrigerants chemical stability testing
  - 13 refrigerants
  - 5 lubricants
  - 19 catalyst materials



- Refrigerants, lubricants and material compatibility testing
  - Elastomers
  - Gaskets
  - Polymers
  - Varnished and unvarnished materials

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Low-GWP Refrigerants Heat Transfer Study

- Project objective: to develop a set of heat transfer and pressure drop correlations for low-GWP refrigerants (GWP less than 150)
- The expected main outcomes:
  - Accurate heat transfer and pressure drop correlations for lower GWP refrigerants in typical air-conditioning and refrigeration systems.
  - Enhanced heat exchanger and system modeling tool.

AREP-3

- AHRI launched its 3rd round Alternative Refrigerants Evaluation Program (AREP-3)
  - Identify and evaluate promising alternative refrigerants having GWP < 300 for major AHRI product categories
    - Safe, efficient refrigerants that balance environmental impact, cost, and system complexity
  - Provide common sets of quality data for industry to use
  - Will not prioritize these alternatives

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AREP-3

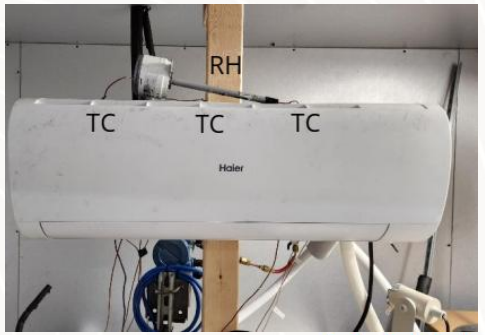
- Testing consists of:
  - Compressor calorimeter tests
  - Drop-in tests if applicable
  - Soft-optimized system tests
  - Other tests deemed necessary (such as material compatibility and lubricants research, and heat transfer tests)
- Timeline:
  - Q4, 2025: A list of refrigerant candidates will be developed.
  - Q4, 2025: The Technical Committee reviews and approves refrigerant candidates and acceptable test plans.
  - Q1, 2026: Testing begins.

A3 Refrigerants Risk Assessment

- AHRI has three industry advisory groups to collaborate with Oak Ridge National Laboratory (ORNL) to guide ORNL's risk assessments for A3 refrigerants in:
  - Commercial small-to-medium size chillers and air-to-water heat pumps
  - Residential monobloc air-to-water heat pumps
  - Direct, small charge, self contained systems (heat pump water heaters and packaged terminal air conditioners)

Odorants in R-290 to Improve Leak Detection

- Evaluate odorants impact on system performance and odorants compatibility with refrigerants, lubricants, and other materials.
  - Equipment tested
    - Reach-in cooler and mini-split heat pump
    - R-290 and 150ppm Dimethyl Sulfide
    - No significant difference between non-odorized and odorized performance
  - Material compatibility tests:
    - Refrigerant: R-290
    - Odorants: DMS (dimethyl sulfide) and MES (methyl ethyl sulfide) at 150 ppm
    - Lubricants: POE (RL32-3MAF), PAG (SHR1452), and lubricant for HC
    - Refrigerant/lubricant ratio: 20/80 by weight R-290/lubricant
    - Exposure temperature and time: 127 degrees C for 21 days



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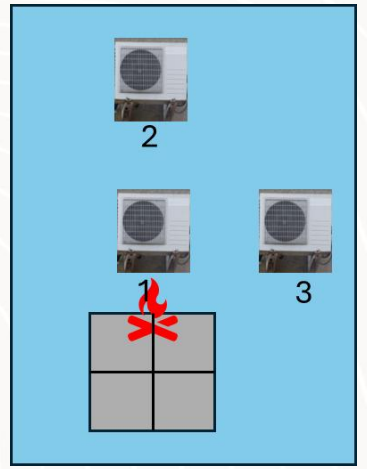
In Planning: A3 Equipment Fire Risk in Buildings

- The objective is to understand R-290 ACs/HPs fire risk in apartment/multi-family buildings.
- Two questions to be answered by demonstration testing:
  - Can outdoor units be ignited by fires from neighboring units?
  - Can outdoor units be ignited by building fires?



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Summary

- The industry is in the middle of refrigerant transition and continues to advance relevant standards to address specific applications
- Our industry has generated a large set of essential A2L refrigerants data for system and component design and optimization
- The evaluation of potential refrigerant options that balance safety, environmental impact, cost, and system complexity has started
- The potential risk of A3 refrigerants is being assessed for different applications

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Questions?

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