



## UL Standards – Update on Natural Refrigerants

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# A Little History

Pre-1990, most refrigerants were non-flammable

In the 1990s, environmental concerns caused the refrigeration industry to look at different refrigerants.

It was originally not easy for UL to accept refrigerants that are flammable

We were active participants in developing the requirements SC61C, UL 250, SC61D,

And we continue to be active In addition to household refrigerators, UL has developed requirements for the use of flammable refrigerants in commercial refrigerators, vending machines, and room air conditioners.



# Developmental History

- UL 250 – Household Refrigerators, published, Similar to requirements in IEC 60335-2-24 57 gram limit
- UL 471 – Commercial Refrigerators, published, Similar to requirements in IEC 60335-2-89, 150 gram limit
- UL 60335-2-24 - Household and Similar Electrical Appliances, Part 2: Particular Requirements for Refrigerating Appliances, Ice-Cream Appliances and Ice-Makers; published 50 gram limit
- UL 399 - Drinking Water Coolers; published 50 gram limit
- UL 541 - Refrigerated Vending Machines; published 150 gram limit for A3 refrigerants
- UL 484 – Room Air Conditioners, Published requirements 1 Kg limit  
Similar to requirements in IEC 60335-2-40



# Requirement Highlights - Tests

- Appliances to be constructed so that leaked refrigerant will not accumulate near ignition sources
- Ignition Sources: Electrical switching components (they potentially arc during normal operation). Also, hot parts that exceed the ignition temperature of the flammable refrigerant.
- Leakage Tests (refrigerators):
  - SB5.1.2 Protected Cooling System
  - SB5.1.3 Unprotected Cooling System
  - SB5.1.4 Leakage outside the food storage area
  - The measured concentration of refrigerant close to ignition sources shall not exceed 75% of LFL, or 50% of LFL for over 5 minutes.



# Requirement Highlights

- What happens if the LFL is exceeded?
  - Move the component
  - Determine if component is really an ignition source
- Ignition test: May be conducted on switching components that can be exposed to flammable refrigerant
- Temperature test: Surface temperatures shall not exceed the ignition temperature of the flammable refrigerant reduced by 100 C
  - Propane: 470 C
  - Isobutane: 460 C
- Markings/Installation Instructions



# What is UL Doing?

1. February 2011, UL facilitated the initial Flammable Refrigerants JTG meeting in Las Vegas, NV.
2. The JTG established three (3) working groups (WG's).
  - a. WG1 developing requirements for flammable refrigerants applicable to air conditioning equipment.
  - b. WG2 developing similar requirements for refrigeration equipment.
  - c. WG3 to address requirements for the testing and evaluation of flammable refrigerants (including the new 2L types) and take into consideration the recommended requirements of the equipment WG's.



# Carbon Dioxide

## As a Secondary Coolant

- CO2 pressure typically 34.5 bar (500 psig) or less
- Pressure relief device required, set at design pressure
- Pressure Regulating Relief device required, set at 90% design pressure
- Ultimate Strength = 3X Design Pressure
- Cascade systems similar, but pressures may be higher.
- Note Machinery Room requirements in ASHRAE 15
- Loss of power is a particular concern – that's why regulating relief devices are used (lose less CO2)



# Carbon Dioxide

## Transcritical Systems

- **Transcritical system:** a refrigeration system where evaporation occurs in the subcritical region and heat rejection may occur above the critical point of the refrigerant (e.g. R-744).
- **Intermediate Pressure Stage:** An intermediate pressure stage on CO<sub>2</sub> transcritical systems that lays between the highside and lowside pressure stages. This intermediate pressure range is regulated by a flash gas bypass valve and this stage may include a flash gas tank and gas cooler.
- **Flash gas tank:** Supercritical gas after cooling in gas cooler is throttled to subcritical region and enters this device whose function is to separate the vapor and supply liquid to evaporators for further expansion.
- **Flash Gas bypass valve:** regulates the removal of gas from the flash gas tank for compression.
- **Gas cooler:** a heat exchanger designed to remove heat from a transcritical system.





**Thank You**



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**Questions?**



 **ATMO**  
**sphere**  
the Business Case  
**natural refrigerants**

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Thank you!

