

# SAFETY ISSUES ASSOCIATED WITH LOW GWP ALTERNATIVE REFRIGERANTS AND OVERVIEW OF INTERNATIONAL AND REGIONAL STANDARDS IN THE RAC SECTOR

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# The IIR

**58** member countries worldwide

**500** experts

**600** corporate and private members



## Services:

**FRIDOC**, a refrigeration portal with over **100,000** references  
Journals: the **International Journal of Refrigeration** (IJR – the **best scientific journal** in its field!),  
**IIR Newsletter**, books, **Informatory Notes**, and **Statements**.



## Activities:

Conferences

Working Parties

Research Projects

Preparation of Standards



INCREASING NEEDS OF  
REFRIGERATION

INCREASING ENERGY AND  
ENVIRONMENTAL CHALLENGES

PARTICULARLY: HIGH GWP HFCs

# Low GWP alternative refrigerants

Ammonia, CO<sub>2</sub>, hydrocarbons, HFOs-unsaturated HFCs, R32 and HFC-HFO blends  
→ safety issues

## Ammonia

- toxic: Permissible Exposure Limit value (PEL): 50 ppm = 35 mg/m<sup>3</sup>
- Odour → warning effect
- Ammonia-air mixtures can be ignited: limits 15-30% vol. in air

Class B2L (ISO)

# Low GWP alternative refrigerants

CO<sub>2</sub>

- odourless, non flammable
- Toxic in high concentrations  
avoiding > 0,5% vol. in air, danger to health > 4% vol.
- Operation at high pressure: up to 130 bar on the high pressure side  
Class A1 (ISO)

Hydrocarbons (isobutane, propane, propene)

- Non toxic, nearly odourless
- Flammable

Ignition limits in dry air in vol. about 1-11

Ignition temperature: 460-540°C

Class A3 (ISO)

# Low GWP alternative refrigerants

## HFOs

- Mildly flammable  
Slow burning velocity
- Some decomposition products, during a fire, can be toxic  
Class A2L (ISO)

## HFC32

- Slightly flammable  
Class A2L (ISO)

# Refrigeration and Safety

- Current regulations often not adapted
  - ✓ technical evolutions
  - ✓ the need to replace current HCFCs and HFCs
- Barriers for the current solutions
- Countries started to revise them (USA/ hydrocarbons, France / ammonia ...)
- International standards

**ISO 5149 and ISO 817 recently updated**

**Creation of the class A2L**

# Standards and Regulations

- A standard is a voluntary commitment from private companies. However, they often are similar to a regulation.
  - Many regulations are based on adopted standards
  - Standard organizations are thus public bodies or associations at national, regional (ex.: the EU) and international levels.
  - Participants to the definition of standards are experts, particularly from important companies.
  - Building a standard is a long and huge work; they also must be similar all over the world.
- ➔ **The challenges for a country:**
- Participating to the definition of the standards in order to represent its interest
  - Adopting the standards already built and building regulations (building codes...)

# Standards and Regulations

- National systems: (More or less linked with governments)
  - Japanese Standards Associations (JSA)
  - Association Française de Normalisation (AFNOR)
  - Egyptian Organization for Standardization and Quality Control (EOS)
  - Standardization Administration of China (SAC),
  - American National Standards Institute (ANSI).
- “more than national” systems:
  - American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE).
- Regional systems:
  - Comité Européen de Normalisation (CEN), (+ CENELEC).

# Standards and Regulations

- International systems:
  - International Standardization Organization (ISO)
  - (+ International Electro technical Commission = IEC)

ISO: about 20 000 standards and 300 committees.

For refrigeration and air conditioning: TC 86 (however, others are interesting: TC 59 on Performance of household and similar electrical appliances, TC 61 of the IEC; The IEC has less members than ISO....)

Within TC86, there are sub committees, particularly:

- SC1 (Safety and Environmental Requirements for Refrigerating Systems and Heat Pumps).
- SC8: Refrigerants and Refrigeration Lubricants.  
(similar processes at other levels).

# ISO 5149 and ISO 817

- There are several ISO standards related to refrigeration and air conditioning.
- The main important ones regarding safety issues are:
  - ISO 5149: on Mechanical refrigerating systems used for cooling and heating-safety requirements.
  - ISO 817: on Refrigerants – Designation and safety classification.
- ISO 5149: has recently been revised = issues of charge limits for flammable refrigerants....
- ISO 817: has recently been revised

The class A2L

# Conclusion

The challenges are:

- Adopting international standards
- Taking into account the class A2L/flammability
- Taking into account the current technologies:
  - indirect systems (ammonia, hydrocarbons, HFCs...)
  - charge reduction
  - Hermetically sealed equipment
  - Gas sensors, air removal devices
- Taking into account the energy efficiency of the system (of course)

# Conclusion

Generally speaking:

- No problem for small equipment: efficient technologies already exist using low GWP refrigerants
- For larger systems: needs of good design, additional safety equipment and trained technicians
- New regulations and codes are needed at national levels, but also information to both companies and administrations

# Conclusion

- ➔ IIR Informatory Note “Current long-term alternative refrigerants and their possible application”
- ➔ New IIR Informatory Note on flammable refrigerants (in preparation)
- ➔ Special issue with UNEP, Italy, Centro Studi Galileo

# Thank you!

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**#refrigeration**