

English Version

**State of the art on the use of flammable refrigerant  
alternatives, in particular from class A3, in refrigeration,  
air conditioning and heat pump equipment**

État de l'art sur l'utilisation de fluides frigorigènes  
inflammables de substitution, en particulier de la  
classe A3, dans les équipements de réfrigération, de  
climatisation et de pompes à chaleur

Stand der Technik über die Verwendung von  
brennbaren Kältemitteln, insbesondere der Klasse A3,  
als Alternativen in Kälte-, Klima- und  
Wärmepumpenanlagen

This Technical Report was approved by CEN on 20 March 2022. It has been drawn up by the Technical Committee CEN/TC 182.

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## European foreword

This document (CEN/TR 17608:2022) has been prepared by Technical Committee CEN/TC 182 “Refrigerating systems, safety and environmental requirements”, the secretariat of which is held by DIN.

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## Introduction

CEN and CENELEC implemented standardisation request M/555 - IMPLEMENTING DECISION of 14 November 2017 on a standardisation request to the European Committee for Standardisation and to the European Committee for Electrotechnical Standardisation as regards use of flammable refrigerants in refrigeration, air conditioning and heat pump equipment. CEN/TC 182 took the lead and established a liaison with CENELEC/TC 61.

The two European Standardization Organizations CEN and CENELEC have responded positively to standardisation request M/555 regarding use of flammable refrigerants in refrigeration, air conditioning and heat pump equipment.

CEN/TC 182 and CENELEC/TC 61 were tasked to address the standardisation request. A new working group (WG12) was set up under CEN/TC 182 with active participation of experts nominated by CENELEC/TC 61.

The technical information was gathered by six ad hoc groups two of which were led by CENELEC/TC 61 experts. The ad hoc groups analysed the current status of risk assessment in general, commercial refrigeration, transport refrigeration, industrial refrigeration, air conditioning and heat pumps, and chillers. Each of the groups finalized their summary with conclusions about existing barriers and recommendations for additional options.

The Technical Committee reviewed guidance for the risk assessment in general and for refrigeration appliances in particular. This includes reviews of guidance and standards that apply for flammable gases in general. Also, the risk assessment was reviewed of global organisations like the risk approach of the Organisation for Economic Co-operation, Development and United Nations Development Programme and United Nations Environment Programme.

The requirements of the Standardisation Request M/555 were reviewed carefully. Having reviewed the documentation, the working group agree that, responding to the standardisation request, the following deliverables were to be prepared:

- 1) A Technical Specification for the installation of refrigeration, air conditioning and heat pump equipment containing flammable refrigerants, complementing existing standards.
- 2) A Technical Specification for the operation, servicing, maintenance, repair and decommissioning of refrigeration, air conditioning and heat pump equipment containing flammable refrigerants, complementing existing standards.

The recommendations about transport refrigeration are beyond the standardisation request M/555. CEN/TC 413 will develop of a specific EN standard dedicated to transport refrigeration risk assessment.

## 1 Scope

This document provides the results of a comprehensive assessment of the state of the art on the use of flammable refrigerants, in particular from class A3.

Refrigerants from class B (toxic) are excluded from this scope.

This document includes the following elements:

- A segmentation of the refrigeration, air conditioning and heat pump market, making use of existing studies and research, including an assessment of safety-related barriers to the uptake of flammable refrigerants in particular from class A3 across all relevant applications;
- An assessment of the way risk assessments is used in existing standards for refrigeration, air conditioning and heat pump equipment and in other standards and a review of available risk assessment research to be taken into account including identification of potential needs for additional research;
- Analysis of:
  - the relationship between risk and increased charge;
  - the acceptability of increased risk compared to the risk presented by other technologies;
  - the options for additional mitigation methods if the risk increase is unacceptable;
- Review of existing standards and work programmes and identification of standards that should be further updated under existing or future standardisation requests based on relevant product safety legislation, in particular with regard to allowable charge sizes of flammable refrigerants, taking into account available technology as well as emerging research and development;
- Identification of options for performance based requirements that result from risk assessments to enable the use of all flammable substances;
- Identification of options for risk minimisation and for offering flexibility in application of mitigation measures.

## 2 Normative references

There are no normative references in this document.

## 3 Terms and definitions

No terms and definitions are listed in this document.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- IEC Electropedia: available at <http://www.electropedia.org/>
- ISO Online browsing platform: available at <http://www.iso.org/obp>

## 4 Segmentation of the Industry Sector

### 4.1 General

The refrigeration industry produces a wide range of products and applications. Commercial and professional refrigeration, industrial refrigeration, chillers and air conditioning, transport refrigeration, and heat pumps were investigated. The main results are reflected in this clause. The complete result of the review is provided in Annex B.

### 4.2 Commercial applications

#### 4.2.1 Commercial Refrigeration

Commercial refrigerated cabinets are used for storage, display, production, or sales of foodstuff. Some of these products are fixed and movable appliances.

Commercial refrigerated cabinets are cooled by a refrigerating system which enables chilled and frozen foodstuffs placed therein for display to be maintained within prescribed temperature limits. Commercial refrigerators and freezers cover a large variety of products; and they are used in diverse environments such as supermarkets, grocery stores, service stations, restaurants, hotels, pubs, and cafés. Commercial Service Cabinets are mainly horizontal refrigerated display cabinets which requires that a person serve the customer with fresh-cut or packed foodstuffs; and the appliance have one or more side facing the customer for display of fresh cut of food in a supermarket. As a sub-category some of these cabinets are also available as Self Service version.

Commercial refrigeration equipment can take many forms and combinations:

- ‘self-contained (or plug-in or integral) appliance’ means a factory made assembly of refrigerating components that are an integral part of the refrigerated equipment and consists of a storage space, one or more refrigerant compressors, refrigerant evaporators, condensers and expansion devices, eventually accompanied with additional heat exchangers, fans, motors and factory supplied accessories;
- remote display cabinets work with a remote refrigerating unit which is not an integral part of the display cabinet (e.g. condensing units, cooling packs);
- semi plug-in cabinets are cabinets with an integral condensing unit, where the heat is rejected with a secondary water or brine loop;
- refrigerating system with secondary fluid (e.g. chillers).

#### 4.2.2 Professional Refrigerated Products

Professional refrigeration equipment can take many forms and combinations, very similar to those for commercial use. Professional service cabinets are designed for dispensing or storage, but not the sale, of chilled and frozen foodstuff like professional storage cabinets, blast chillers, cold rooms, ice cream makers, etc. A professional service cabinet is a refrigerated enclosure containing goods which are accessible via one or more doors and/or drawers. The sizes of the products are typically based on the standard tray and are used in a commercial environment. They are largely used in foodservice establishments, such as restaurants, hotels, and cafeterias. A very small fraction of “professional” service cabinets contain glass in their doors, drawers, or lids (as opposed to “commercial” service cabinets that display food and hence frequently incorporate glass).

Blast cabinets use a blast of cold air to bring down the temperature of hot food rapidly so it can be stored safely avoiding bacteria growth, and can be chilled or frozen. Blast cabinets are similar in