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Refrigerating systems and heat pumps - Safety and environmental requirements - Part 1: Basic requirements, definitions, classification and selection criteria

Kälteanlagen und Wärmepumpen - Sicherheitstechnische und umweltrelevante Anforderungen - Teil 1: Grundlegende Anforderungen, Begriffe, Klassifikationen und Auswahlkriterien

Systèmes de réfrigération et pompes à chaleur - Exigences de sécurité et d'environnement - Partie 1 : Exigences de base, définitions, classification et critères de choix

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This European Standard was approved by CEN on 13 October 2007.

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Foreword

This document (EN 378-1:2008) has been prepared by the CEN Technical Committee CEN/TC 182 "Refrigerating systems, safety and environmental requirements", the secretariat of which is held by DIN.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by August 2008, and conflicting national standards shall be withdrawn at the latest by August 2008.

This document supersedes EN 378-1:2000.

EN 378 consists of the following parts under the general title *Refrigerating systems and heat pumps — Safety and environmental requirements:*

— *Part 1: Basic requirements, definitions, classification and selection criteria*

— *Part 2: Design, construction, testing, marking and documentation*

— *Part 3: Installation site and personal protection*

— *Part 4: Operation, maintenance, repair and recovery*

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Bulgaria, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland and United Kingdom.

Introduction

This European Standard relates to safety and environmental requirements in the design, manufacture, construction, installation, operation, maintenance, repair and disposal of refrigerating systems and appliances in respect to the local and global environments, but not to the final destruction of the refrigerants.

The term "refrigerating system" used in this European Standard includes heat pumps.

The extent to which hazards are covered is indicated below. In addition, machinery should comply as appropriate with EN ISO 12100-1 and EN ISO 12100-2 for hazards which are not covered by this European Standard.

It is intended to minimize possible hazards to persons, property and the environment from refrigerating systems and refrigerants. These hazards are associated essentially with the physical and chemical characteristics of refrigerants as well as the pressures and temperatures occurring in refrigeration cycles.

Inadequate precautions may result in:

— component rupture or explosion, with risk of projectiles;

— escape of refrigerant with the risk of environmental damage or toxicity due to a fracture, a leakage caused by bad design, incorrect operation, and inadequate maintenance, repair, charging or disposal;

— burning or combustion of escaping refrigerant with consequent risk of fire including the risk of toxic products of combustion from non-flammable refrigerants.

Refrigerants, their mixtures and combinations with oils, water or other materials, which are present in the refrigerating system, intended or unintended, affect the internal surrounding materials chemically and physically for example due to pressure and temperature. They can, if they have detrimental properties, endanger persons, property and the environment directly or indirectly due to global long term effects (ODP,GWP) when escaping from the refrigerating system. Refrigerants shall be selected with due regard to their potential influence on the global environment as well as their possible effects on the local environment. Evaluation of the environmental performance however requires a life cycle approach. With regard to global climate change the **T**otal **E**quivalent **W**arming **I**mpact approach is generally used as the basis (see Annex B). Reference should be made to the EN ISO 14040 series to address other environmental aspects. Many factors influence environmental impacts such as:

— location of the system;

— energy efficiency of the system;

— type of refrigerant;

— service frequency;

— refrigerant leaks;

— sensitivity of charge on efficiency;

— minimisation of heat load;

— control methods.

The cost of the system will have an indirect influence on the environmental performance. Additional investments may be directed towards reducing leaks, increasing energy efficiency or modifying the design in order to use a different refrigerant. Only a life cycle approach is capable of identifying where additional investments will have the most beneficial effects.

Hazards due to the states of pressure and temperature in refrigerating systems are essentially due to the simultaneous presence of the liquid and vapour phases. Furthermore, the state of the refrigerant and the stresses that it exerts on the various components do not depend solely on the processes and functions inside the plant, but also on external factors.

The following hazards are worthy of note:

a) from the direct effect of extreme temperature, for example:

- brittleness of materials at low temperatures;
- freezing of enclosed liquid (water, brine or similar);
- thermal stresses;
- changes of volume due to temperature changes;
- injurious effects to persons caused by low temperatures;
- touchable hot surfaces.

b) from excessive pressure due to, for example:

- increase in the pressure of condensation, caused by inadequate cooling or the partial pressure of non condensable gases or an accumulation of oil or liquid refrigerant;
- increase in the pressure of saturated vapour due to excessive external heating, for example of a liquid cooler, or when defrosting an air cooler or high ambient temperature when the plant is at a standstill;
- expansion of liquid refrigerant in a closed space without the presence of vapour, caused by a rise in external temperature;
- fire.

c) from the direct effect of the liquid phase, for example:

- excessive charge or flooding of equipment;
- presence of liquid in compressors, caused by syphoning, or condensation in the compressor;
- liquid hammer in piping;
- loss of lubrication due to dilution of oil;
- condensation-induced shock.

d) from the escape of refrigerants, for example:

- fire;
- explosion;
- toxicity including products of combustion;
- caustic effects;
- freezing of skin;

- asphyxiation;
- panic;
- depletion of the ozone layer;
- global warming.

e) from the moving parts of machinery, for example:

- injuries;
- hearing loss from excessive noise;
- damage due to vibration.

Attention is drawn to hazards common to all compression systems, such as excessive temperature at discharge, liquid slugging, erroneous operation and reduction in mechanical strength caused by corrosion, erosion, thermal stress, liquid hammer or vibration.

Corrosion, however, should have special consideration as conditions peculiar to refrigerating systems arise due to alternate frosting and defrosting or the covering of equipment by insulation.

The above analysis of the hazards applying to refrigerating systems explains the plan on which this European Standard has been based.

1 Scope

This European Standard specifies the requirements relating to safety of persons and property (but not goods in storage) and the local and global environment for:

a) stationary and mobile refrigerating systems of all sizes, including heat;

b) secondary cooling or heating systems;

c) location of these refrigerating systems.

NOTE 1 For secondary heating or cooling systems charged with any refrigerants listed in Annex E the charge limitations of part 1 (Annex C) apply.

For refrigerating systems with a limited mass of refrigerant only some of the parts and clauses are applicable. The exceptions are defined in the scope and the clauses of each part of EN 378.

This European Standard is not applicable to refrigerating systems with air or water as refrigerant. Systems using refrigerants other than those listed in Annex E are not covered by this European Standard as long as a safety class is not assigned.

NOTE 2 For the safety classification of refrigerant fluids not included in Annex E, see Annex F.

This European Standard covers the hazards mentioned in the introduction.

This European Standard is applicable to new refrigerating systems and modification of existing refrigerating systems in case the type of refrigerant changed or pressure vessels are replaced. The part dealing with maintenance, repair, operation, recovery, reuse and disposal also applies to existing systems. Parties responsible for existing refrigerating systems should consider the safety and environmental aspects of this European Standard and implement the more stringent requirements so far as they are reasonably practicable.

Directive 94/9/EC concerning equipment and protective systems intended for use in potentially explosive atmospheres can be applicable to the type of machine or equipment covered by this European Standard. The present standard is not intended to provide means of complying with the essential health and safety requirements of Directive 94/9/EC.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

EN 378-2, *Refrigerating systems and heat pumps — Safety and environmental requirements — Part 2: Design, construction, testing, marking and documentation*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

NOTE See informative Annex A for equivalent terms in English, French and German.

3.1 Refrigerating systems

3.1.1
refrigerating system (heat pump)
combination of interconnected refrigerant-containing parts constituting one closed refrigerant circuit in which the refrigerant is circulated for the purpose of extracting and rejecting heat (i.e. cooling, heating)

3.1.2
self-contained system
complete factory-made refrigerating system in a suitable frame and/or enclosure, that is fabricated and transported in one or more sections and in which no refrigerant containing parts are connected on site other than by companion or block valves

3.1.3
unit system
self-contained system that has been assembled, filled ready for use and tested prior to its installation and is installed without need for connecting any refrigerant containing parts

NOTE A unit system can include factory assembled companion or block valves.

3.1.4
limit charged system
refrigerating system in which the internal volume and total refrigerant charge are such that, with the system idle, the allowable pressure will not be exceeded if complete evaporation of the refrigerant charge occurs

3.1.5
absorption or adsorption system
refrigerating system in which refrigeration is achieved by evaporation of a refrigerant, the vapour then being absorbed or adsorbed by an absorbent or adsorbent medium respectively, from which it is subsequently expelled at a higher partial vapour pressure by heating and then liquefied by cooling

3.1.6
secondary cooling or heating system
system employing a fluid which transfers heat from the product or spaces to be cooled or heated or from another cooling or heating system to the refrigerating system without compression and expansion of the fluid

3.1.7
closed system
refrigerating system in which all refrigerant-containing parts are made tight by flanges, screwed fittings or similar connections

3.1.8
sealed system
refrigerating system in which all refrigerant containing parts are made tight by welding, brazing or a similar permanent connection

NOTE A connection that is tightness tested for a leakage rate of less than 3 g refrigerant per year under a pressure of at least 0,25 × PS and where the mechanical joints are prevented from improper use by the need of a special tool, glue etc.) is considered as a similar permanent connection. This may include valves with seal cap and capped service ports.

3.1.9
high pressure side
part of a refrigerating system operating at approximately the condenser or gascooler pressure

3.1.10
low pressure side
part of a refrigerating system operating at approximately the evaporator pressure

3.1.11
mobile system
refrigerating system which is normally in transit during operation

NOTE Mobile systems include the following: refrigerating systems in vessels, e.g. refrigerated cargo systems in ships, refrigerating systems in fishing boats, air conditioning on board, refrigerating systems for provisions; transport refrigerating systems, e.g. transport of refrigerated cargo by road, train and containers..

3.1.12
cascade system
two or more independent refrigeration circuits where the condenser of one systems rejects heat directly to the evaporator of another

3.1.13
transcritical cycle
refrigerating cycle whose compressor discharges refrigerant at a condition (pressure) above the critical point

3.1.14
assembly
discrete unit with defined function (e.g. a condensing unit) made up from several components. Assemblies are often connected together on-site to make a complete system

3.1.15
component
individual functional item or sub-assembly of a refrigerating system

NOTE Does not include parts of sub-assemblies e.g. seals, fasteners.

3.2 Occupancies, localities

3.2.1
machinery room (location)
complete enclosed room or space, vented by mechanical ventilation and only accessible to authorised persons, which is intended for the installation of components of the refrigerating system or of the complete refrigerating system. Other equipment may also be installed provided it is compatible with the safety requirements for the refrigerating system

3.2.2
special machinery room (location)
machinery room intended only for the installation of the complete refrigerating system or components of the refrigerating system. It is accessible only to competent personnel for the purposes of maintenance and repair

3.2.3
occupied space (occupancy)
complete enclosed space which is occupied for a significant period by people. Where the spaces around the apparent occupied space are, by construction or design, not adequately tight, these are also considered as part of the occupied space. These can be for example voids above false ceilings, crawl ways, ducts and movable partitions. The occupied space may be accessible to the public (for example supermarket) or only to trained persons (for example cutting up of meat). In an occupied space, both parts of a refrigerating system or the complete refrigerating system may be located/installed

3.2.4
air lock
isolating chamber provided with separate entrance and exit doors allowing passage from one place to another whilst isolating one from the other

3.2.5
lobby
entrance hall or large hallway serving as a waiting room

3.2.6
hallway
corridor for the passage of people

3.2.7
exit
opening in the outer wall, with or without a door or gate

3.2.8
exit passageway
passageway immediately in the vicinity of the exit through which people leave the building

3.2.9
cold room
room or cabinet, maintained by a refrigerating system at a temperature lower than ambient temperature

3.2.10
direct connection
connection between rooms where the dividing wall contains an opening, including those which can optionally be shut by a door, window or hatch

3.2.11
open air
unenclosed space, whether roofed or not

3.2.12
escape duct
duct indicated as an emergency exit

3.2.13
crawl space
space that is in general accessed for maintenance only and where it is not possible to walk or access by walking

3.3 Pressures

3.3.1
gauge pressure
pressure for which the value is equal to the difference between the absolute pressure and atmospheric pressure

NOTE All pressures are gauge pressures, unless otherwise indicated.

3.3.2
maximum allowable pressure
maximum pressure for which the equipment is designed, as specified by the manufacturer

NOTE 1 Limit to the operating pressure which should not be exceeded either when the system is working or not.

NOTE 2 The Pressure Equipment Directive 97/23/EC identifies the maximum allowable pressure by the symbol "PS".

NOTE 3 The subscript “max” is added to the symbol for maximum values.

3.3.3
design pressure
pressure chosen for the derivation of the calculation pressure of each component

NOTE It is used for determining the necessary materials, thickness and construction for components with regard to their ability to withstand pressure.

3.3.4
strength test pressure
pressure that is applied to test the strength of a refrigerating system or any part of it

3.3.5
tightness test pressure
pressure that is applied to test a system or any part of it for pressure tightness

3.3.6
surge limit
pressure at which the volume flow of a centrifugal compressor becomes unstable

3.4 Components of refrigerating systems

3.4.1
refrigerating installation
assembly of components of a refrigerating system and all the apparatus necessary for its operation

3.4.2
refrigerating equipment
components forming a part of the refrigerating system, e.g. compressor, condenser, generator, absorber, adsorber, liquid receiver, evaporator, surge drum

3.4.3
compressor
device for mechanically increasing the pressure of a refrigerant vapour

3.4.4
motorcompressor
fixed combination of electrical motor and compressor in one unit

3.4.4.1
hermetic motorcompressor
combination of a compressor and electrical motor, both of which are enclosed in the same housing, with no external shaft or shaft seals, the electrical motor operating in a mixture of oil and refrigerant vapour

3.4.4.2
semihermetic (accessible hermetic) motorcompressor
combination consisting of a compressor and electrical motor, both of which are enclosed in the same housing, having removable covers for access, but having no external shaft or shaft seals, the electrical motor operating in a mixture of oil and refrigerant vapour

3.4.4.3
canned rotor motorcompressor
motorcompressor within a sealed housing not enclosing the motor windings and having no external shaft

3.4.5
open compressor
compressor having a drive shaft penetrating the refrigerant-tight housing

3.4.6
positive displacement compressor
compressor in which compression is obtained by changing the internal volume of the compression chamber

3.4.7
non-positive displacement compressor
compressor in which compression is obtained without changing the internal volume of the compression chamber

3.4.8
pressure vessel
any refrigerant containing parts of a refrigerating system other than:

— semihermetic and open type compressors;

— coils (including their headers) consisting of pipes with air as secondary fluid;

— piping and its valves, joints and fittings;

— control devices;

— pressure switches, gauges, liquid indicators;

— safety valves, fusible plugs, bursting discs;

— pumps

NOTE 1 This definition is in aligned to directive 97/23/EC.

NOTE 2 The semihermetic and open type compressors used in refrigerating systems may be subject to the exclusion article 1.3.10 of the directive 97/23/EC of M29/05/1997 by referring to the working party group guidelines WPG 1/11, 1/12 and 2/34.

3.4.9
condenser
heat exchanger in which vaporised refrigerant is liquefied by removal of heat

3.4.10
gas cooler
heat exchanger in a transcritical system in which supercritical refrigerant is cooled by removal of heat

3.4.11
liquid receiver
vessel permanently connected to a system by inlet and outlet pipes for accumulation of liquid refrigerant

3.4.12
accumulator
vessel capable of holding liquid refrigerant and permanently connected between the exit of the evaporator and suction of the compressor

3.4.13
evaporator
heat exchanger in which liquid refrigerant is vaporised by absorbing heat from the substance to be cooled

3.4.14
coil (grid)
part of the refrigerating system constructed from bent or straight pipes or tubes suitably connected and serving as a heat exchanger (evaporator or condenser)

3.4.15
compressor unit
combination of one or more compressors and the regularly furnished accessories

3.4.16
condensing unit
combination of one or more compressors, condensers, liquid receivers (when required) and the regularly furnished accessories

3.4.17
surge drum
vessel containing refrigerant at low pressure and temperature and connected by liquid feed and vapour return pipes to an evaporator(s)

3.4.18
internal gross volume
volume calculated from the internal dimensions of a vessel, no account being taken of the volume of any internal parts

3.4.19
internal net volume
volume calculated from the internal dimensions of a vessel, and excluding the volume of the permanent internal parts

3.4.20
type approved component
component for which examination is performed on one or more samples of this component in accordance with a recognised standard for type approval

3.5 Piping and joints

3.5.1
piping
all piping covered in the scope of EN 14276-2 such as pipes or tubes (including hoses, bellows, fittings, or flexible pipes) for interconnecting the various parts of a refrigerating system

3.5.2
joint
connection made between two parts

3.5.3
welded joint
joint obtained by the joining of metal parts in the plastic or molten state

3.5.4
brazed joint
joint obtained by the joining of metal parts with alloys which melt at temperatures in general higher than 450 °C but less than the melting temperatures of the joined parts

3.5.5
soldered joint
joint obtained by the joining of metal parts with metallic mixtures or alloys which melt at temperatures in general less than 450 °C

3.5.6
soft soldered joint
joint obtained by joining of metal parts with metallic mixtures or alloys which melt below 200 °C

3.5.7
flanged joint
joint made by bolting together a pair of flanged ends

3.5.8
flared joint
metal-to-metal compression joint in which a conical spread is made on the end of the tube