NORMA EUROPEA

Sistemi di refrigerazione e pompe di calore - Requisiti di sicurezza e ambientali - Parte 3: Sito di installazione e protezione delle persone

UNI EN 378-3

APRILE 2021

Refrigerating systems and heat pumps - Safety and environmental requirements - Part 3: Installation site and personal protection

La norma specifica i requisiti per la sicurezza delle persone e dei beni, fornisce una guida per la tutela dell'ambiente e stabilisce procedure per il funzionamento, la manutenzione e la riparazione di impianti di refrigerazione e il recupero dei refrigeranti.
Il termine "sistema di refrigerazione" utilizzato nella presente norma europea comprende le pompe di calore.
La presente parte 3 della norma è applicabile al sito di installazione (spazio dell'impianto e dei servizi). Specifica i requisiti del sito per la quanto riguarda la sicurezza, che potrebbe essere richiesta a causa di, ma non direttamente correlata con, il sistema di refrigerazione e i materiali accessori.
La presente norma si applica:

a) a sistemi di refrigerazione, fissi o mobili, di tutte le dimensioni salvo per i sistemi di climatizzazione per veicoli oggetto di specifiche norme di prodotto, per esempio la ISO 13043;
b) per sistemi di raffreddamento o riscaldamento secondari;
c) alla posizione dei sistemi di refrigerazione;
d) alle parti sostituite e alle componenti aggiunte dopo l'adozione di questa norma se non sono identiche nella funzione e nella capacità.

I sistemi che utilizzano refrigeranti diversi da quelli elencati nell'appendice E della norma EN 378 1:2016+A1:2020 non sono coperti dalla presente norma.

TESTO INGLESE

La presente norma è la versione ufficiale in lingua inglese della norma europea EN 378-3:2016+A1 (edizione ottobre 2020).

La presente norma sostituisce la UNI EN 378-3:2017.

ICS 27.080; 27.200

PREMESSA NAZIONALE

La presente norma costituisce il recepimento, inglese della norma europea EN 378-3:2016+A1 (edizione ottobre 2020), che assume così lo status di norma nazionale italiana.

La presente norma è stata elaborata sotto la competenza dell'ente federato all'UNI

CTI - Comitato Termotecnico Italiano

La presente norma è stata ratificata dal Presidente dell'UNI ed è entrata a far parte del corpo normativo nazionale il 22 aprile 2021.

EUROPEAN STANDARD
NORME EUROPÉENNE
EUROPÄISCHE NORM

EN 378-3:2016+A1

October 2020

ICS 27.080; 27.200

Supersedes EN 378-3:2016

English Version

Refrigerating systems and heat pumps - Safety and environmental requirements - Part 3: Installation site and personal protection

Systèmes frigorifiques et pompes à chaleur - Exigences de sécurité et d'environnement - Partie 3 : Installation in situ et protection des personnes

Kälteanlagen und Wärmepumpen - Sicherheitstechnische und umweltrelevante Anforderungen - Teil 3: Aufstellungsort und Schutz von Personen

This European Standard was approved by CEN on 3 September 2016 and includes Amendment 1 approved by CEN on 17 August 2020.

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Ref. No. EN 378-3:2016+A1:2020 E

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European foreword

This document (EN 378-3:2016+A1:2020) has been prepared by 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 April 2021, and conflicting national standards shall be withdrawn at the latest by April 2021.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN shall not be held responsible for identifying any or all such patent rights.

This document includes Amendment 1 approved by CEN on 17 August 2020.

This document supersedes A1 EN 378-3:2016 A1.

The start and finish of text introduced or altered by amendment is indicated in the text by tags A1 A1.

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.*

The main changes in part 3 with respect to the previous edition are listed below:

— harmonisation as far as possible with ISO 5149:2014 and ISO 817:2014;

— clarification of when to use of 'special machinery room', and modify to "separate refrigeration machinery room";

— consideration of requirements for 2L refrigerants;

— inclusion of Clause 6 additional measures to support A1 EN 378-1:2016+A1:2020 A1, C.3;

— modification of requirements for sprinkler systems.

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, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, Former Yugoslav Republic of Macedonia, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and the United Kingdom.

Introduction

The introduction of EN 378-1 is applicable.

1 Scope

This European Standard specifies the requirements for the safety of persons and property, provides guidance for the protection of the environment and establishes procedures for the operation, maintenance and repair of refrigerating systems and the recovery of refrigerants.

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

This Part 3 of the European Standard is applicable to the installation site (plant space and services). It specifies requirements on the site for safety, which may be needed because of, but not directly connected with, the refrigerating system and its ancillary components.

This standard applies:

a) to refrigerating systems, stationary or mobile, of all sizes except to vehicle air conditioning systems covered by a specific product standard e.g. ISO 13043;

b) to secondary cooling or heating systems;

c) to the location of the refrigerating systems;

d) to replaced parts and added components after adoption of this standard if they are not identical in function and in the capacity.

Systems using refrigerants other than those listed in of [A1] EN 378-1:2016+A1:2020 [A1], Annex E are not covered by this standard.

This standard does not apply to goods in storage.

This standard is not applicable to refrigerating systems which were manufactured before the date of its publication as a European Standard except for extensions and modifications to the system which were implemented after publication.

This standard is applicable to new refrigerating systems, extensions or modifications of already existing systems, and for existing stationary systems, being transferred to and operated on another site.

This standard also applies in the case of the conversion of a system for another refrigerant type, in which case conformity with the relevant clauses of parts 1 to 4 of the standard shall be assessed.

2 Normative references

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

[A1] EN 378-1:2016+A1:2020, *Refrigerating systems and heat pumps - Safety and environmental requirements - Part 1: Basic requirements, definitions, classification and selection criteria* [A1]

EN 378-2:2016, *Refrigerating systems and heat pumps — Safety and environmental requirements — Part 2: Design, construction, testing, marking and documentation*

EN 1363 (all parts), *Fire resistance tests*

EN 1364 (all parts), *Fire resistance tests for non-load bearing elements*

EN 1365 (all parts), *Fire resistance tests for load bearing elements*

EN 1366-1, *Fire resistance tests for service installations — Part 1: Ventilation ducts*

EN 1366-2, *Fire resistance tests for service installations — Part 2: Fire dampers*

EN 1507, *Ventilation for buildings — Sheet metal air ducts with rectangular section — Requirements for strength and leakage*

EN 1634 (all parts), *Fire resistance and smoke control tests for door and shutter assemblies, openable windows and elements of building hardware*

EN 12236, *Ventilation for buildings — Ductwork hangers and supports — Requirements for strength*

EN 12845, *Fixed firefighting systems — Automatic sprinkler systems — Design, installation and maintenance*

EN 14624, *Performance of portable leak detectors and of room monitors for halogenated refrigerants*

EN 60079-10-1, *Explosive atmospheres — Part 10-1: Classification of areas — Explosive gas atmospheres (IEC 60079-10-1)*

EN 60204-1:2006, *Safety of machinery — Electrical equipment of machines — Part 1: General requirements (IEC 60204-1:2005)*

EN 60529, *Degrees of protection provided by enclosures (IP Code) (IEC 60529)*[eXtyles1]

EN ISO 13850, *Safety of machinery — Emergency stop function — Principles for design (ISO 13850)*

EN ISO 14122-2, *Safety of machinery — Permanent means of access to machinery — Part 2: Working platforms and walkways (ISO 14122-2)*

ISO 13043, *Road vehicles — Refrigerant systems used in mobile air conditioning systems (MAC) — Safety requirements*

ISO 817, *Refrigerants — Designation and safety classification*

IEC 60364, *Low-voltage electrical installations*

3 Terms, definitions and abbreviated terms

For the purposes of this document, the terms, definitions and abbreviated terms given in A1 EN 378-1:2016+A1:2020 A1, apply.

4 Location of refrigerating equipment

4.1 A1 General

Refrigerating equipment may be sited outside the building in the open air or in a machinery room or in occupied areas or in unoccupied areas not designated as a machinery room.

NOTE 1 The refrigerating equipment can be contained in a ventilated enclosure provided by the manufacturer. Requirements for this enclosure are given in EN 378-2:2016, 6.2.15.

The location of refrigeration systems with group A2L, A2, B2L, B2, A3, B3 refrigerants shall be assessed with regard to flammability and classified according to the requirements of EN 60079-10-1 for the hazardous zone.

NOTE 2 The assessment according to EN 60079-10-1 considering the LFL and type of release can conclude that the hazardous area is of negligible extent. ⟨A1⟩

4.2 Refrigerating equipment located in the open air

Refrigerating systems sited in the open air shall be positioned to avoid leaked refrigerant flowing into a building or otherwise endangering people and property. The refrigerant shall not be able to flow into any ventilation fresh air opening, doorway, trap door or similar opening in the event of a leak. Where a shelter is provided for refrigerating equipment sited in the open air it shall have natural or forced ventilation.

A room, where at least one of the longer walls is open to the outside air by means of louvres with 75 % free area and covering at least 80 % of the wall area (or the equivalent if more than one wall is to outside), is considered as being in the open air.

For refrigeration systems installed outside in a location where a release of refrigerant can stagnate e.g. below ground, then the installation shall comply with the requirements for gas detection and ventilation of machinery rooms (see 5.13, Clauses 8 and 9). For refrigerants of class 2L, 2 and 3 requirements regarding ignition sources in EN 378-2:2016, 6.2.14 shall apply where appropriate.

4.3 Refrigerating equipment located in a machinery room

When a machinery room is chosen for the location of the refrigerating equipment it shall meet the requirements specified in 5.1 to 5.14.

A risk analysis based on the safety concept for the refrigerating system (as determined by the manufacturer and including the charge and safety classification of the refrigerant used) shall be conducted to determine whether it is necessary to place the refrigerating system in a separate refrigeration machinery room.

NOTE 1 National regulations may set specific requirements for the use of separate refrigeration machinery rooms.

For systems below ground using class 3 flammable refrigerants with a charge greater than 'm_2', an additional gas detector and audible/visual alarm shall be used and shall meet the requirements for detectors in this standard.

NOTE 2 Additional requirements may be needed for refrigerating systems containing B2L, B2, B3, A2L, A2, and A3 refrigerants as specified in 5.14.

NOTE 3 A housing which is sufficiently large for people to enter is a machinery room.

4.4 ⟨A1⟩ Refrigerating equipment located in the occupied space

The refrigerant charge shall be as specified in EN 378-1:2016+A1:2020, Annex C for the access category and location class of the equipment. Where the charge calculation is according to EN 378-1:2016+A1:2020, C.3. then the alternative provisions listed in Clause 6 of this standard shall apply. Where appropriate the installation in the occupied space shall comply with Clause 8 and Clause 9 of this standard. ⟨A1⟩

4.5 Refrigerating equipment located in an unoccupied space not designated a machinery room

Where compressors or pressure vessels are located in an unoccupied space which is sealed from any occupied space the location shall be treated as a machinery room in accordance with Clause 5.

Where equipment (not including compressors and pressure vessels) containing non-permanent joints is located in an unoccupied space which is sealed from any occupied space the requirements of Clause 5 shall be applied, but if mechanical ventilation is required according to 5.13, ventilation shall be from an

extractor hood positioned adjacent to the equipment and the ventilation rate shall be more than 0,05 m^3/s per ventilator. In the case of equipment subject to adverse conditions, for example severe vibration or a corrosive atmosphere, the ventilation rate shall be more than 0,5 m^3/s per extractor hood. If mechanical ventilation is required, refrigerant detectors shall activate the ventilation at 50 % of the ATEL, except for refrigerants with a characteristic odour at concentrations below ATEL/ODL (such as R-717), or 25 % of the LFL, whichever is lower.

NOTE 1 Severe vibration could be caused by unbalanced dynamic loads or hydraulic shock during defrost operation.

NOTE 2 The ventilation rate is deemed sufficient to ventilate a volume of 18 m^3.

For any equipment, if the space cannot be sealed from any occupied space then the refrigerating equipment shall be considered as located in the occupied space and the requirements for such spaces shall apply.

4.6 Refrigerating equipment located in a ventilated enclosure within an occupied space

The ventilated enclosure containing the refrigerating system shall have a ventilation duct as specified by the manufacturer. The duct shall be as specified by the manufacturer see EN 378-2. The room into which the ventilated enclosure is installed shall be at least ten times the volume of the enclosure and shall have sufficient make up air to replace any exhausted air. The ventilation from the enclosure shall be to open air.

4.7 Piping duct or shaft

Where hand operated shut-off devices are mounted in a piping duct or shaft designed for human entry, the duct or shaft shall have more than one escape exit. The duct shall have a height of at least 1,2 m.

5 Machinery rooms

5.1 Access to machinery rooms

Machinery rooms should not be used as occupied spaces. The operator shall ensure that access is permitted only by instructed personnel doing the necessary maintenance to the machinery room or general plant. If machinery rooms are occupied for significant periods, e.g. used as a building maintenance workspace, they shall be considered as occupied spaces under access category c, authorised access, given in EN 378-1.

A separate refrigeration machinery room shall not be used as an occupied space.

5.2 Venting from or through the machinery room

Refrigerant shall be prevented from entering neighbouring rooms, staircases, courts, gangways or building draining systems and the escaping gas shall be vented outdoors.

There shall be no airflow to an occupied space through a machinery room unless the air is ducted and sealed to prevent any refrigerant leakage from entering the air stream.

5.3 Combustion equipment and air compressors

Where combustion equipment or air compressors are located in a machinery room containing refrigerating equipment, the combustion air supply for combustion engines or boilers or the supply air for air compressors shall be ducted from outside in such a manner as to prevent any refrigerant from entering the air intake.

5.4 Open flame

Open (naked) flames shall not be permitted in machinery rooms, except for welding, brazing or similar activity and then only provided the refrigerant concentration is monitored and adequate ventilation is ensured. Such open flames shall not be left unattended.

5.5 Storage

Machinery rooms shall not be used for storage with the exception of tools, spare parts and compressor oil for the installed equipment. Any refrigerants, or flammable or toxic materials shall be stored as required by national regulations.

5.6 Remote emergency switch

A remote switch for stopping the refrigerating system shall be provided outside the room, near to the machinery room door. A similar acting switch shall be located at a suitable location inside the room. The switches shall meet the requirements for emergency switches in accordance with EN ISO 13850 and EN 60204-1.

NOTE For gas fired refrigeration systems specific measures may be required including local regulations.

5.7 Exterior openings of the machinery room

Exterior openings shall not be situated within 2 m of building emergency exit staircases or other building openings, e.g. windows, doors, ventilation inlets.

5.8 Piping and ducting

All piping and ventilation ducting that passes through walls, ceiling and floors of machinery rooms, shall be sealed where it passes through the walls ceiling or floors. The seal shall have at least the same fire resistance as the walls, ceiling or floor.

NOTE 1 Discharge pipes from relief devices may diffuse the charge into the air by adequate means but away from any air intake to the building or discharge into an adequate quantity of a suitable absorbing material.

NOTE 2 Relief devices for refrigerants in group A1 can discharge into the machinery room provided the system charge is less than the limits set in [A1] EN 378-1:2016+A1:2020 [A1], Annex C. Such discharges of refrigerant should take place so that persons and property are not endangered.

5.9 Normal lighting

Fixed lighting shall be selected and positioned in spaces containing refrigerating equipment to provide adequate illumination for safe operation. The illumination level and location shall be as required by national regulations. Filament light bulbs shall be protected by "splash safe" covers (EN 60529 IPX 4) in machinery rooms containing R-717 refrigerating systems.

5.10 Emergency lighting

A fixed or portable emergency lighting system shall be provided, adequate to allow operation of controls and evacuation of personnel, when normal lighting fails. The illumination level and location shall be as required by national regulations.

5.11 Dimensions and accessibility

The dimensions of the machinery room shall allow easy installation and sufficient room for service, maintenance, operation, repair and disassembly of the refrigerating equipment, including sufficient space for persons wearing personal protection equipment.

If necessary, catwalks and fixed ladders shall be provided in order to avoid standing or walking on piping, fittings, their supports and supporting structures and on components during the operation, maintenance, inspection and repair of the refrigerating system.

There shall be clear headroom of at least 2,1 m below equipment situated over gangways and permanent work places. The requirements for work staging shall be according to EN ISO 14122-2.

NOTE Headroom is defined by 2,1 m above the walking surface.

5.12 Doors, walls and ducts

5.12.1 Doors and openings

Machinery rooms shall have doors opening outward and sufficient in number to ensure persons can escape in an emergency.

The doors shall be tight fitting and self-closing. They shall be so designed that they can be opened from inside (anti-panic system). The doors shall have at least a one-hour fire resistance construction, using materials and construction tested in accordance with EN 1634. There shall be no openings that permit unintended passage of escaping refrigerant, vapours, odours and all other gases to any occupied space.

5.12.2 Emergency

Provision shall be made to facilitate immediate exit from the machinery room in the event of an emergency.

At least one emergency exit shall open directly to the open air or it shall lead to an emergency exit passageway.

5.12.3 Walls, floor and ceiling

Walls, floor and ceiling between the machinery room and the rest of the building shall have at least a 1 h fire resistive construction and be tightly sealed. They shall be of materials and construction, which are in accordance with EN 1363, EN 1364 and EN 1365.

NOTE Requirements regarding fire resistive construction of walls, doors, floor and ceiling may be provided in local regulations.

5.12.4 Service ducts

Service ducts shall conform to the requirements of EN 1366-1 and EN 1366-2, and they shall be sealed to minimize escaped refrigerant leakage into the service duct, and shall have at least the same fire resistance as walls and doors.

Service ducts, including walkways and crawl spaces, containing piping for refrigerants shall be vented to a safe place to prevent a dangerous accumulation of refrigerant in the event of a leak. Service ducts shall not be used for ventilation or conditioned air.

5.12.5 Ventilation ducts

Sheet metal for normal and emergency ventilation ducts shall be in accordance with EN 1507 and supported as required by EN 12236. After erection all duct seams and joints shall be sealed to minimize gas leakage from the duct. The ventilation duct shall have at least the same fire resistance as the doors and walls of the machinery room.

5.13 Ventilation

5.13.1 General

The ventilation of machinery rooms shall be sufficient both for normal operating conditions and emergencies.

Air from machinery rooms shall be vented outdoors using mechanical ventilation in case of a release of refrigerant due to leaks of components. This ventilation system shall be independent of any other ventilation system on the site.

Provision shall be made for a sufficient supply of outside replacement air and a good distribution of that air over the machinery room avoiding dead zones.

Openings for outside air shall be positioned to avoid re-circulation into the room.

5.13.2 Ventilation for normal operating conditions or when machinery room is occupied

Ventilation shall be in accordance with national regulations with a minimum of 4 air changes per hour when the machinery room is occupied. In the event that the necessary ventilation rate cannot be achieved an audible and/or visual alarm shall be initiated and, where relevant, electrical supplies shall be terminated.

5.13.3 Emergency mechanical ventilation

If gas detection is required in the machinery room, the emergency mechanical ventilation system shall be activated by a detector(s), located in the machinery room. The detector(s) shall be as specified in Clause 9.

Emergency mechanical ventilation shall be provided with two independent emergency controls one located outside the machinery room, and the other inside.

5.13.4 Required airflow for emergency mechanical ventilation

Airflow of the mechanical ventilation shall be at least the quantity obtained by Formula (1):

$$\dot{V} = 0{,}014 \times m^{2/3} \qquad (1)$$

where

$\dot{V}$ is the air flow rate in m^3/s;

m is the mass of refrigerant charge, in kg, in the refrigerating system with the largest charge, any part of which is located in the machinery room;

0,014 is a conversion factor with units of $m^3/s\ kg^{2/3}$.

An emergency ventilation system with 15 air changes per hour is sufficient.

5.13.5 Mechanical ventilation openings

Mechanical ventilation openings shall be made in the position and of sizes to permit sufficient airflow considering the characteristics of the refrigerant, the choice of intake or exhaust and the performance of the ventilator. The intake and exhaust openings shall be arranged to evacuate the refrigerant under all conditions of leaking refrigerant.

5.14 Machinery rooms for groups A2L, A2, A3, B2L, B2 and B3 refrigerants

5.14.1 General

Machinery rooms with group A2L, A2, B2L, B2, A3, B3 refrigerants shall be assessed with regard to flammability and classified according to the requirements of EN 60079-10-1 for the hazardous zone.

NOTE The assessment according to EN 60079-10-1 considering the LFL and type of release may conclude that the hazardous area is of negligible extent.

Refer to Clause 7 for requirements regarding electrical installation.

5.14.2 Location

5.14.2.1 General

The machinery room shall be located in accordance with local and national regulations.

NOTE Requirements may depend on the amount of charge in the refrigerating system.

5.14.2.2 Emergency exhaust ventilation

The emergency exhaust ventilation fan shall be either:

a) in the air flow with the motor outside the airflow, or

b) rated for hazardous areas as required in EN 378-2:2016, 6.2.14.

The fan shall be located to avoid pressurization of the exhaust ductwork in the machinery room.

The fan shall not cause sparks to occur if it contacts the duct material.

The outlet from the exhaust ventilation shall be in accordance with national regulations. The outlet shall not be restricted but have means of keeping rubbish, leaves and birds from entering. The bottom of any rising ductwork open to the outside shall have a drain with a trap for rainwater and with access for inspection.

For doors communicating to other areas inside the building and where the gas detector is not able to detect refrigerants when these doors are opened, emergency ventilation shall be initiated when a door is opened for more than 60 s.

5.14.3 Additional requirements for R-717

5.14.3.1 Drainage

To prevent R-717 spill reaching surface waters, a catchment system shall be designed and installed in accordance with national regulations. The machinery room floor shall be designed in order to prevent liquid R-717 from spilling out from the room. The drain from the catchment system shall be normally closed.

5.14.3.2 Specific equipment for emergency washing

For R-717 easily accessible eye wash facilities (e.g. eye wash bottle) for all systems shall be provided. For systems with a refrigerant charge over 1 000 kg an emergency shower, providing at least 1 l/s flow at between 25 °C and 30 °C shall be located outside the emergency exit from the machinery room.

5.14.3.3 A1 Fire sprinkler systems

If fire suppression systems of the water sprinkler type are installed in machinery rooms with R-717 refrigerating systems then the following conditions shall be fulfilled:

— The sprinkler heads are individually actuated at 141 °C or higher (high temperature according to EN 12845);

— There is no manual override of the activation of the sprinkler system;

— The sprinkler installation conforms to the requirements of EN 12845.

NOTE 1 The addition of water to a pool of ammonia liquid can cause the rapid evolution of large amounts of ammonia gas in the atmosphere resulting in increased risk of injury to persons in the vicinity.

NOTE 2 A pre-action system where an actuated water valve in the sprinkler supply is controlled by a fire detection system can be used to reduce the probability of accidental discharge of any of the sprinkler heads.

NOTE 3 The provision for a remote sump in the drainage system from the machinery room will reduce the risk of environmental pollution from the run-off water. ⟨A1⟩

⟨A1⟩

5.14.3.4 Doors and openings

Machinery rooms where the refrigerant charge is above the practical limit for the volume of the room shall have a door that either opens directly to the outside air or through a dedicated anteroom equipped with self-closing, tight-fitting doors to an emergency exit passageway. ⟨A1⟩

5.14.4 Maximum surface temperature

Hot surfaces shall not exceed a temperature of 80 % of the auto-ignition temperature (in °C) or 100 K less than the auto-ignition temperature of the refrigerant, whichever is higher.

⟨A1⟩ *deleted text* ⟨A1⟩

6 Requirements for alternative provisions

6.1 General

These additional measures only apply to systems described in ⟨A1⟩ EN 378-1:2016+A1:2020 ⟨A1⟩, C.3.

Where an indoor unit is in or the piping passes through an occupied space having a volume of such size that the total charge exceeds the allowable charge specified in ⟨A1⟩ EN 378-1:2016+A1:2020 ⟨A1⟩, C.3, then the alternative provisions in Clause 6 may be applied to ensure safety.

6.2 Occupied space

If the indoor unit is installed at a height less than 1,8 m, an indoor unit fan, circulator or mechanical ventilation shall be provided to avoid the risk of refrigerant stagnating in the event of a leak and shall operate continuously or be turned on by a detector. If a dilution transfer opening at the floor level is provided such as a gap below the door, low level installation without air mixing is acceptable.

The space where the indoor unit is installed shall be categorised as general access according to EN 378-1. Indoor units shall not be used in a sealed room without ventilation to the outside of the room.

The indoor equipment and pipes shall be securely mounted and guarded such as accidental rupture of equipment cannot occur, from such events as moving furniture or reconstruction activities.

6.3 Ventilation

6.3.1 General

[A1] EN 378-1:2016+A1:2020 [A1], C.3.2.2 and C.3.2.3, may require employing ventilation as a safety measure.

Ventilation shall be made to a place where sufficient air is available to dilute the leaked refrigerant such as outdoors or a large occupied space. The indoor place used to provide ventilation air shall have sufficient volume, including the volume of the room in which the indoor unit is installed to ensure that the quantity limit with minimum ventilation (QLMV) value is not exceeded. Indoor ventilation shall be made to a room that has enough volume to satisfy the QLMV value in total with the occupied space volume. Natural ventilation to outdoors shall not be taken into account.

NOTE QLMV values can be found in [A1] EN 378-1:2016+A1:2020 [A1], Annex C and the limitations as in [A1] EN 378-1:2016+A1:2020 [A1], C.3 apply.

6.3.2 Dilution transfer openings (air transfer openings for dilution) for natural convection

Dilution transfer openings shall be provided in both high and low level locations. For these dilution transfer openings, the sum of areas at high level and the sum of the areas at low level shall each be at least the area as determined from Formula (2). This area may be divided into two or more openings in each high and low location. These shall be located near the floor and near the ceiling respectively. If the ceiling is suspended and the wall is not provided between the next rooms above the ceiling then the upper opening is not necessary.

$$A=0{,}003\ 2 \times m/(QLMV \times V) \qquad (2)$$

where

A is the required opening area, expressed in m^2;

m is the refrigerant charge, expressed in kg;

V is the room volume, expressed in m^3;

$QLMV$ is the quantity limit with minimum ventilation as given in [A1] EN 378-1:2016+A1:2020 [A1], C.3.2 in kg/m^3.

The lower edge of the lower opening shall be a height of 0,2 m or less from the floor. The upper edge of the upper opening shall be equal to or higher than the upper edge of the door opening.

6.3.3 Mechanical ventilation

6.3.3.1 Required airflow

For $Q \times RCL/10 < 1$, the actual, not nominal, airflow of the mechanical ventilation shall be at least the quantity that satisfies Formula (3). For $Q \times RCL/10 \geq 1$ the airflow shall be determined according to Formula (4)

$$m=-\frac{10\times V}{Q}\times\ln\left(1-\frac{Q\times RCL}{10}\right) \qquad (3)$$

$$Q=\frac{10}{RCL} \qquad (4)$$

where

m is the refrigerant charge in kg;

V is the room volume expressed in m^3;

10 is the expected maximum leak rate, in kg/h;

Q is the ventilation airflow in m^3/h;

RCL is the refrigerant concentration limit in kg/m^3, as given in ISO 817.

NOTE "ln" means natural logarithm.

A simplified calculation is given in Formula (5). The airflow that satisfies this formula can be employed instead of the value obtained above. However as a consequence of the simplification, it provides a higher airflow value.

$$Q = \frac{10}{RCL} \tag{5}$$

where

10 is the expected maximum leak rate, in kg/h;

Q is the ventilation airflow in m^3/h;

RCL is the Refrigerant concentration limit in kg/m^3, as given in ISO 817.

6.3.3.2 Mechanical ventilation openings

The lower edge of the mechanical ventilation opening shall be as low as possible, and no higher than 0,2 m from the floor.

Exhaust ventilation openings shall be located a sufficient distance from intake openings to prevent re-circulation to the occupied space. In addition to the opening for the extract ventilation, there shall be openings in the room of at least the same opening area as the extract opening.

6.3.3.3 Operation of mechanical ventilation

Mechanical ventilation shall be operated continuously or shall be switched on by the detector in accordance with Clause 9.

6.4 Safety shut off valves

6.4.1 General

If safety shut off valves are employed as a safety measure according to [A1] EN 378-1:2016+A1:2020 [A1], C.3.2 then they shall be provided at appropriate position in a refrigerating circuit. In the event of refrigerant leak, the valves shall shut off the refrigerant so that the amount of refrigerant leaked into the occupied space is less than the QLMV value in the occupied space.

The RCL value, as given [A1] EN 378-1:2016+A1:2020 [A1], Table C.3 or ISO 817, shall be used instead of QLMV for the lowest underground floor of the building. Valves shall isolate the refrigeration circuit from the occupied space under the control of a detector in accordance with Clause 9. The manufacturer or installer of the equipment shall provide the data necessary to calculate the amount of refrigerant that may leak into the occupied space. The data shall include at least the amount of refrigerant that can be leaked considering the response time of the sensor and the controller that activates the valves and the remaining amount of refrigerant that is contained in each section of the refrigeration system after the valves are closed. These amounts shall be taken into account to determine the refrigerant amount leaked into the occupied space. The data shall include the location of the valve in the refrigeration

system and the position of the detectors in the relevant rooms. The data shall be included in the installation documentation according to EN 378-2:2016, 6.4.3.1.

6.4.2 Location

Shut off valves shall be located outside of the occupied space and shall be positioned to enable access for maintenance by an authorised person.

6.4.3 Design

Valves shall be designed to close in the event of an electric power failure e.g. spring return solenoid valves.

Valves in the refrigeration circuit shall be able to shut off the refrigerant flow in the event of a leak of refrigerant without unduly affecting the refrigerant flow in normal operation.

7 Electrical installations

7.1 General requirements

The general electrical installation of the refrigerating and other equipment including lighting, power, etc., shall conform to national regulations and the provisions in series IEC 60364 as appropriate.

NOTE Additional guidance can be found in IEC/TR 61200–52.

7.2 Main power supply

The electrical power supply to a refrigerating system shall be electrically arranged so that it can be switched off independently of the electricity supply to other electrical equipment in general and, in particular, to any lighting system, ventilation unit, alarm and other safety equipment. The connection of the main power supply to the refrigerating machinery shall be in accordance with EN 60204-1:2006, Clauses 4 and 5.

7.3 Electrical equipment in machinery rooms with refrigerating systems containing flammable refrigerants

Electrical equipment shall be selected to be suitable for use in the zones identified in 5.14.1.

For 2L refrigerants, electrical equipment shall be deemed to comply with the requirements if the electrical supply is isolated when the refrigerant concentration reaches 25 % of the lower flammable limit or less. Equipment which remains live in the event of the refrigerant concentration exceeding the main alarm level, for example alarms, gas detectors, ventilation fans and emergency lighting, shall be suitable for operation in a hazardous area.

This clause applies to all electrical equipment and power supplies in the room, not only the refrigerating system.

8 Safety alarms

8.1 General

If alarms are employed to warn of a leak in the machinery room or the occupied space the alarm shall warn of a refrigerant leak in accordance with 8.3. The alarm shall be turned on by the signal from the detector in accordance with Clause 9. The alarm shall also alert an authorised person to take appropriate action.

8.2 Alarm system power

In cases where an alarm system is installed the power source of the alarm system shall be from a power source independent of the mechanical ventilation or other refrigerating systems which the alarm system is protecting.

NOTE Back up power using batteries can be used for the alarm system.

8.3 Alarm system warning

The alarm system shall warn both audibly and visibly such as both a loud (15 dB(A) above the background level) buzzer and a flashing lamp.

For a machinery room the alarm system shall warn both inside and outside the machinery room. The alarm outside the machinery room may be installed in a supervised location.

For an occupied space the alarm system shall warn at least inside the occupied space.

For access category a (see EN 378-1) the alarm system shall also warn at a supervised location such as the night porter's location as well as the occupied space.

8.4 Additional alarm system requirements for R-717 systems with charges above 3 000 kg

The refrigerating system user/owner shall ensure that a continuously attended station is provided as a central alarm station. Specialised personnel shall be present on site within 60 min of an alarm. The personnel may also be informed of the alarm by technical equipment, e.g. mobile telephone, pager, etc.

9 Detectors

9.1 General

When the concentration of the refrigerant can exceed the practical limit in accordance with [A1] EN 378-1:2016+A1:2020 [A1], Annex C, detectors shall at least actuate an alarm and in the case of the machinery room the emergency mechanical ventilation. They shall conform to the requirements given in 9.2 to 9.4 as appropriate.

9.2 Location of detectors

The location of detectors shall be chosen in relation to the refrigerant and they shall be located where the refrigerant from the leak will concentrate.

The positioning of the detector shall be done with due consideration of local airflow patterns, accounting for location sources of ventilation and louvers. Consideration shall also be given to the possibility of mechanical damage or contamination.

At least one detector shall be installed in each machinery room or the occupied space being considered and/or at the lowest underground room for refrigerants heavier than air and at the highest point for refrigerants lighter than air.

9.3 Type and performance of detectors

9.3.1 [A1] General

Any suitable detector may be used and shall give an electrical signal at the pre-set value of the refrigerant or oxygen concentration (the pre-set value) that activates the shut-off valves, the alarm system, the mechanical ventilation or other emergency controls.

Detectors shall be continuously monitored for functioning. In the case of a detector failure, the emergency sequence should be activated as if refrigerant had been detected.

The pre-set value for the refrigerant detector at 30 °C or 0 °C, whichever is more critical, shall be set at not more than 25 % of the LFL or 50 % of the ATEL/ODL, whichever is the lower value, as given in EN 378-1:2016+A1:2020, Annex E. The pre-set value for the oxygen deprivation detector shall be 18 % or higher.

To ensure that the output signal is triggered at the pre-set value, the sensitivity tolerance of the detector, as declared by the detector manufacturer, shall be considered. The sensitivity of the detector shall consider voltage fluctuation of ± 10 % of power line voltage.

An appropriate maintenance period shall be established for each type of detector used.

Oxygen deprivation sensors shall not be used for indicating refrigerant leaks.

The detectors for monitoring halogenated refrigerants shall comply with EN 14624. In addition, for all detectors the response time of the detector shall be 30 s or less at a concentration of 1,6 times the pre-set value.

NOTE 1 Sensors can be affected by the presence of gas or vapour other than that the equipment is intended to detect. Ensure that if sensors are used, this will not compromise the safety or integrity of the installation.

NOTE 2 EN 60079-29-2 specifies requirements for selection, installation, use and maintenance of detectors of flammable gases. A1

9.3.2 Refrigerant detectors for A2, A2L, B2L (except for R-717), B2, A3 and B3 refrigerants

A refrigerant detector for a group A2L, A2, B2L (except for R-717), B2, A3 and B3 refrigerant shall activate the alarm signal at a level not exceeding 25 % of the LFL of the refrigerant. The detector shall continue to activate at higher concentrations. The detector shall be set lower for the toxicity, if applicable (see 8.1). It shall automatically activate an alarm, start mechanical ventilation and stop the system when it triggers.

9.3.3 R-717 detectors

In order to warn against the danger of explosion or fire in equipment in machinery rooms, and for control purposes where the charge size is more than 50 kg, an R-717 detector is required which shall function at a concentration not exceeding:

— 350 mg/m^3 (volume fraction of 500 × 10^{-6}) (pre-alarm);

— 21 200 mg/m^3 (volume fraction of 30 000 × 10^{-6}) (main alarm).

At the pre-alarm level, an alarm and the mechanical ventilation shall be activated.

At the main alarm level,

— the refrigerating system shall be stopped automatically;

— the power supply to the machinery rooms shall be isolated automatically;

— the mechanical ventilation shall be stopped if appropriate provisions are not made (see 5.14.2.2).

Where the machinery rooms only house the compressors or compressor units, at least one detector shall be placed over the compressors or units. The site of refrigerant pumps in either the machinery room or other areas shall also be monitored by a detector, mounted above and near the pumps.

Detectors shall be suitable for their use and calibrated by a competent organization.

R-717 detectors shall be incorporated in the heat transfer circuit of indirect systems, for example water or glycol circuits, to detect the presence of refrigerant in the circuit, if the R-717 charge is greater than 500 kg (see also EN 378-2:2016, 6.2.6.8). These detectors shall initiate an alarm in the machinery room, and where practicable in the control system operator interface, but they shall not trigger beacons or klaxons, and they shall not initiate an evacuation.

9.4 Installation

The installation of the detector shall allow access for checking, repair or replacement by an authorized person.

The detector shall be installed so its function can be verified easily.

The detector shall be protected to prevent tampering or unauthorised resetting of the pre-set value.

10 Instruction manuals, notices and inspections

10.1 Instruction manual

The instructions given with the installation shall clearly state the required emergency procedures for the building in the event of the alarm system operating. (An) authorised person(s) shall be designated for the machinery room and each occupied space who shall know these procedures and have the authority to act on them.

NOTE Requirements for instructions for refrigerating systems are given in EN 378–2.

10.2 Warning notice

Machinery rooms shall be clearly marked as such on the entries together with warning notices that unauthorised persons shall not enter and that smoking, open (naked) lights or flames are prohibited. Additionally, warning notices shall be displayed prohibiting unauthorised operation of the system.

A notice indicating the procedures to be adopted in the event of an alarm shall be clearly visible within the occupied space. The notice shall also state that, in the event of an emergency, only authorised persons conversant with emergency procedures shall decide whether to enter the machinery room.

Refrigerating systems which contain more than 10 kg of A3 and B3 refrigerants that are located in open air shall be clearly marked on the entrances to the restricted area, together with warning notices indicating that unauthorised persons shall not enter and that smoking, naked flames and other potential sources of ignition are prohibited.

10.3 Visual inspection of the site

The installation site shall be checked to ensure that services and equipment related to the refrigerating system are correctly installed and functioning prior to delivering the site to the owner. In particular the following shall be checked for correct installation and function:

a) escape and access routes for passage are free from obstruction;

b) openings for ventilation (including dilution transfer openings) are free from obstruction;

c) mechanical ventilation of the machinery room;

d) refrigerant detectors;

e) alarms and backup power, where required;

f) emergency lighting;

g) availability and access to personal protective equipment.

These shall be documented after commissioning.

10.4 Maintenance of the site

The user/owner or their authorised representative shall regularly check the alarms, mechanical ventilation and detectors at least once a year to ensure their correct functioning. Dilution transfer openings (see Clause 6), for example between rooms, in occupied spaces shall be checked to confirm no obstruction which will block the free passage of air. A logbook shall be maintained. The results of these checks shall be recorded in the logbook.

NOTE For maintenance of the refrigerating system see EN 378–4.

11 Heat sources and temporary high temperatures at the site

If evaporators or air coolers are installed in the proximity of heat sources, effective measures shall be taken to prevent the evaporators or coolers being exposed to excessive heat, which will give rise to high pressure.

Condensers and receivers shall not be located in the proximity of heat sources.

If any of the refrigerant containing parts can reach a temperature which is above the temperature corresponding with the maximum allowable pressure (e.g. on account of an electrical defrosting system, a defrosting system using hot water or cleaning by means of hot water or steam), the liquid contained in it shall be able to escape to some other part of the system in which the higher temperature does not prevail.

NOTE If necessary, the system can be equipped with a receiver, which is permanently connected to the apparatus in question (See EN 378–2).

Annex A
(informative)

Personal protective equipment

A.1 General requirements

A.1.1 Type of protective equipment

Personal protective equipment agreed by the local rescue services and appropriate to the quantity and type of refrigerant should be readily available.

A.1.2 Accessibility

The equipment for personal safety should be readily accessible.

A.1.3 Location

The equipment for personal safety should be carefully located free from improper interference, usually outside the room in which the refrigerant may escape, but near to the entry to this room.

A.1.4 Check and maintenance

Personal protective equipment and equipment for emergency use should be regularly checked and maintained in accordance with the manufacturer's recommendations. When defects or deficiencies are discovered, the equipment should be replaced without delay.

The extent of personal protective equipment and equipment for emergency use provided should be agreed with the local rescue service (fire brigade), e.g. the types and numbers of respiratory protective devices required.

During planned maintenance of refrigerating systems the equipment for personal safety should be agreed, provided and maintained by the maintenance company.

A.1.5 Temperature

Respiratory protective devices should be suitable for use at a temperature down to the temperature achieved by the system or ambient climate conditions depending on the application.

A.1.6 Respirators

Filter protection respirators should be suitable for the refrigerant used and/or for the decomposition products which may arise from it due to the action of a naked flame or fire.

Spare filter inserts should always be available.

Face mask or gas masks are not allowed to be used for refrigerants which suppress the content of oxygen e.g. CFC/HCFC/HFCs, HCs and R-744.

Filter inserts are usually identified by a colour code and a character code for the vapour in question. (see EN 14387).

The respirator should fit the person who may usually be expected to use it, and who is fully conversant with its use. Personnel should be thoroughly and regularly instructed in how to use the respirator.

In refrigerating systems where several persons are employed for the purpose of operating and maintaining the system, each and every one should have access to a respirator of suitable type with which they are fully familiar.

Respiratory protective devices should be maintained in accordance with the manufacturer's instructions/ recommendations and checked periodically, even if not used. When respirators with a filter insert are used, the length of time the respirator was used should be noted on each occasion. The insert should be changed as necessary. The date of procurement of new inserts should be noted.

A.2 Normal use

Personal protective equipment should be provided for use by every person doing maintenance, repair and recovery as follows:

a) for all refrigerants and irrespective of the properties of the refrigerant:

   — protective gloves and protection for eyes;

b) for R-717:

   — respiratory protection devices in accordance with EN 132, EN 133, EN 134, EN 135, EN 136, EN 14593-1, EN 14593-2 and EN 14594.

A filter protection respirator should always be used (with filter insert designed to afford protection from decomposition products) for refrigerating systems containing group A1 refrigerant when welding or brazing is carried out in the presence of refrigerant.

A.3 Emergency use

A.3.1 General

Equipment for emergency use should be provided as follows:

— respiratory protective devices in accordance with EN 132, EN 133, EN 134, EN 136, EN 137, EN 14387 and EN 14594;

— first aid equipment;

— filter protection respirator (full face mask) or a self-contained breathing apparatus.

A.3.2 Respiratory protective devices

Respiratory protective devices should be suitable for the refrigerant used. If self-contained breathing apparatus is held on site (with the agreement of the local rescue service) it should be maintained by qualified people at regular intervals, and should only be used by suitably trained personnel who are familiar with and can operate the brand and model of equipment available.

A.3.3 First aid equipment

First aid equipment, medicines and special chemicals related to the refrigerants in use together with protective blankets etc. should be available and stored outside the machinery room but near to its entry.

Special attention should be paid to equipment for rapid treatment of eye injuries.

Medicines and other chemicals in the first aid equipment should be provided only after consultation with medical experts.

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