Introduction to Refrigeration Standard EN 378

An introduction for refrigeration contractors and installers to standard EN 378:
" Refrigerating Systems and heat pumps – Safety and environmental requirements"

Preface

About this publication

European Standard EN 378 relates to safety and environmental requirements in the design, manufacture, construction, installation, operation, maintenance, repair and disposal of refrigerating systems and appliances regarding local and global environments.
This booklet introduces the Refrigeration Standard EN 378 to those responsible for refrigeration systems and heat pumps, and especially to Refrigeration, Air Conditioning and Heat Pump Contractors. Following the standard will assist Contractors to design, manufacture, install, commission and maintain refrigeration systems and heat pumps to ensure best practice. In addition, many requirements of local authorities for safety and environmental protection will be taken care of. The Standard shall be given the status of a national standard in each EU member state, either by publication of an identical text or by endorsement, at the latest by May 2017, and any conflicting national standards shall be withdrawn at the latest by May 2017."Readers should note that there may be additional EU directives, national or local legal requirements (e.g. in relation to ATEX, fire safety and building regulations and safety of pressure systems) and it is the responsibility of the Refrigeration Contractor to understand and comply with such requirements.
The Refrigeration Standard EN 378 is an important source of information which if followed can increase the level of safety of refrigeration installations and help prevent accidents. For all refrigerants there are risks associated with pressure, fire or explosion hazard, or toxicity; this means that both professionals and the public can be compromised if best practices are not followed. The booklet therefore focuses on important points related to the safe use of refrigerants.
To find the complete and precise information, one should buy and read the complete EN 378 standard; this will be available from the National Standards organisation in any EU member state.

References

EN 378-1:2016, EN 378-2:2016, EN 378-3:2016, EN 378-4:2016.

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- AREA - The Voice of European Refrigeration, Air Conditioning and Heat Pump Contractors

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Original concept

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The Introduction booklet is a private non-binding information document not intended as a substitute for EN 378, but assumes that the user uses the complete EN 378: 2016 as the basis for assessment and decision making.
AREA declines any and all liability for any measure taken or not taken on the basis of this document.
AREA welcomes comments relating to this publication which will be taken into account in the next revision: Please address comments to the Chairperson of the EN 378 / PED Task Force.

Contents

A few words about Global Warming

Refrigerants should be selected with due regard to their potential influence on the global environment (ODP, GWP) as well as their possible effects on the local environment. Evaluation of the environmental performance requires a lifecycle approach. With regard to global climate change the Total Equivalent Warming Impact approach is generally used as the basis (see Annex B of EN 378 Part 1).
The total equivalent warming impact (TEWI) is a way of assessing global warming by combining the direct contribution of refrigerant emissions into the atmosphere with the indirect contribution of the carbon dioxide and other gas emissions resulting from the energy required to operate the refrigerating system over its operational life.

Many factors influence the environmental impact of refrigerating systems, such as:

- Location of the system
- Energy efficiency of the components
- The type of refrigerant
- Service frequency
- Refrigerant leakage rate
- Minimization of heat load
- Control methods

Important points regarding natural and low-GWP refrigerants:

Refrigerant with high operating pressure

R744 (CO_2, Carbon Dioxide) (Safety class A1-refrigerant)

- The high operating pressure will often make these refrigerating systems classified as Category IV in the Pressure Equipment Directive (PED). This category sets the strictest requirements for CE-marking of refrigerating system assemblies.
- Where a release to atmosphere would bring the refrigerant condition to or below the triple point, the refrigerant may solidify. The arrangement of pressure relief devices and associated pipes shall therefore be designed to prevent any blockage of the refrigerant flow.
- Carbon Dioxide is heavier than air, so CO_2-detectors should not be placed on the ceiling or high on the wall, but near the floor. This factor also applies to emergency ventilation systems.

Flammable refrigerants

Safety class A2L refrigerants (low flammability e.g. R32, R1234yf)
Safety class A3 refrigerants (higher flammability e.g. R290)

- Refrigerating systems using flammable refrigerants shall be constructed so that any leaked refrigerant will not flow or stagnate so as to cause a fire or explosion hazard in areas within the equipment where components which could be a source of ignition are fitted.
- The flammability demands particular attention to charge limitations based on access categories, location classification of the refrigerating system and the Lower Flammability Limit (LFL) of the refrigerant.
- For proper placement of detectors and ventilation exhaust, one must establish whether the flammable refrigerant used is heavier or lighter than air.

Flammable and toxic refrigerant

Safety class B2L-refrigerant. R717 (ammonia)

- Refrigerating systems with ammonia demand particular attention to charge limitations because of the refrigerant's properties of both flammability and toxicity. In EN 378 Part 1, one can calculate the maximum refrigerant charge based on flammability or toxicity, and the lowest of these will apply as the upper limit.
- In addition to fire and personal protection requirements detailed in EN 378 Part 3, it is important to draw attention to the danger of panic that often follows an unexpected leakage of ammonia, largely due to the fact that it is very detectible by smell at extremely low and non-harmful concentrations.
- Ammonia gas is generally lighter than air, so detectors should be placed on the ceiling or high on the wall. This factor also applies to emergency ventilation systems.
- EN 378 also covers requirements for safety measures for leakage of ammonia in the liquid phase.

Why do we need a refrigeration standard?

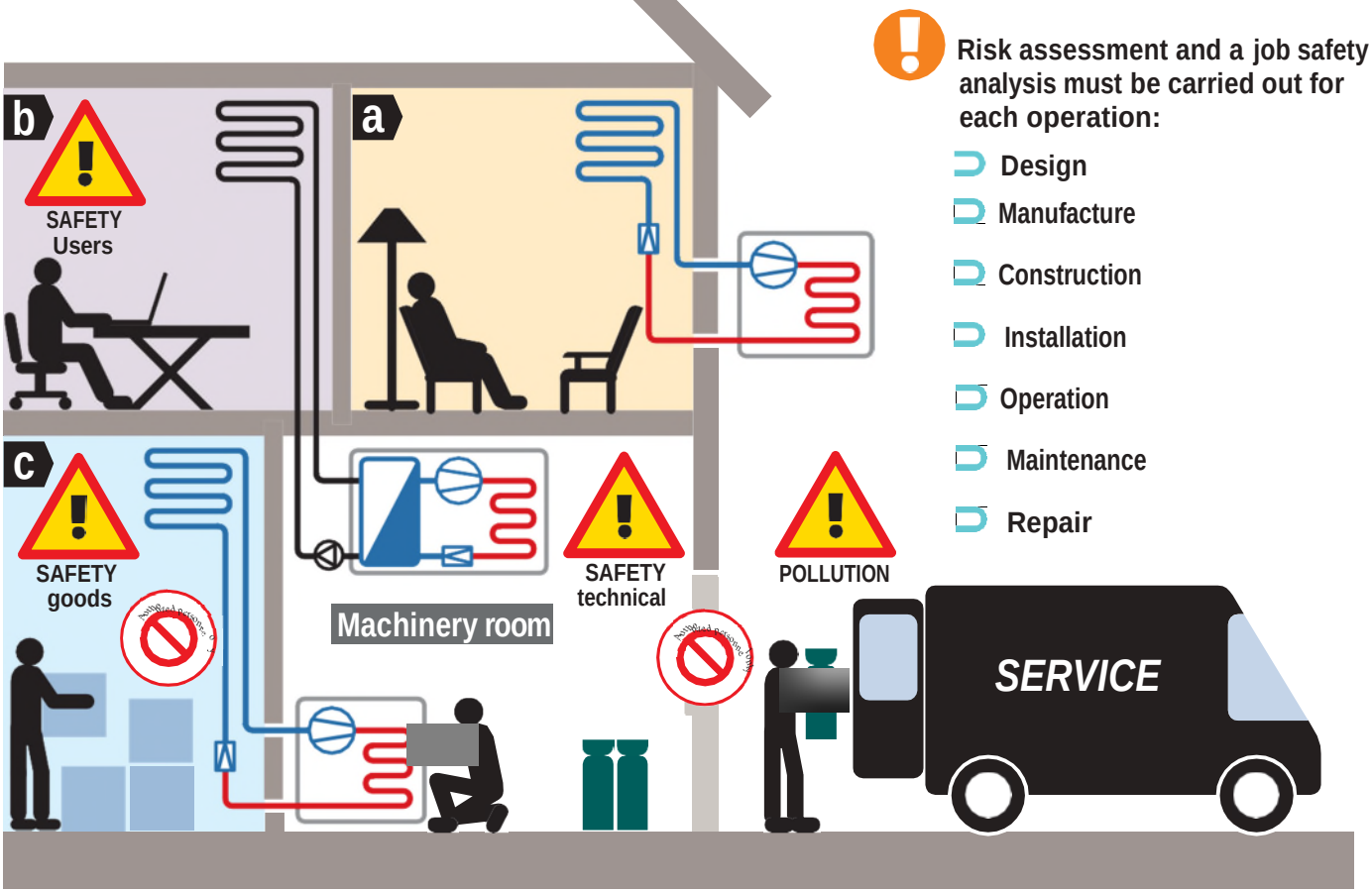
A Standard facilitates our everyday life. It increases safety and can be used to rationalize operations. Refrigeration Standard EN 378 ensures that applicable refrigerating systems are appropriate for their intended use.

A refrigerating system is a complex technical installation with many hazards. Risks associated with refrigerating systems are:

- **Mechanical,** from moving parts of machinery.
- **Electrical,** multiple power circuits with both high and low voltage.
- **Thermal,** compressors, heat exchangers and pipes with very high or low surface temperatures, as well as expansion and contraction of material.
- **Chemical,** refrigerants, oils, heat transfer fluids, and insulation can cause:
  - fire
  - poisoning
  - pollution

Life cycle of the refrigerating system

EN 378 applies to all stages of the life of a refrigerating system (except for final disposal of equipment)



Risk assessment and a job safety analysis must be carried out for each operation:

- Design
- Manufacture
- Construction
- Installation
- Operation
- Maintenance
- Repair

EN 378 covers most types and sizes of refrigerating systems

EN 378 applies to:

a) refrigerating systems (which includes heat pumps), stationary or mobile, of all sizes

b) secondary cooling or heating systems;

c) the location of the refrigerating systems;

d) Parts replaced and components added to existing refrigerating systems after publication of EN 378 if they are not identical in function and capacity;

e) new refrigerating systems,

f) extensions or modifications of existing systems,

g) existing stationary systems being transferred to and operated on another site.

h) the conversion of a system to another refrigerant type.

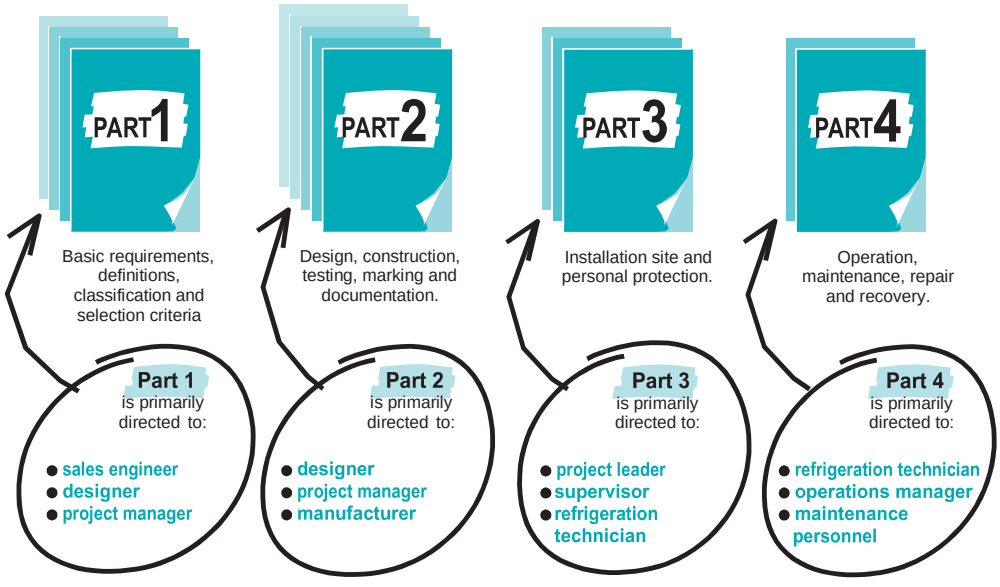
EN 378 does not apply to:

a) refrigerating systems and heat pumps which were manufactured before the date of publication of EN 378

b) Systems using refrigerants other than those listed in Annex E of EN 378 Part 1

c) vehicle air conditioning systems covered by a specific product standard (e.g. ISO 13043)

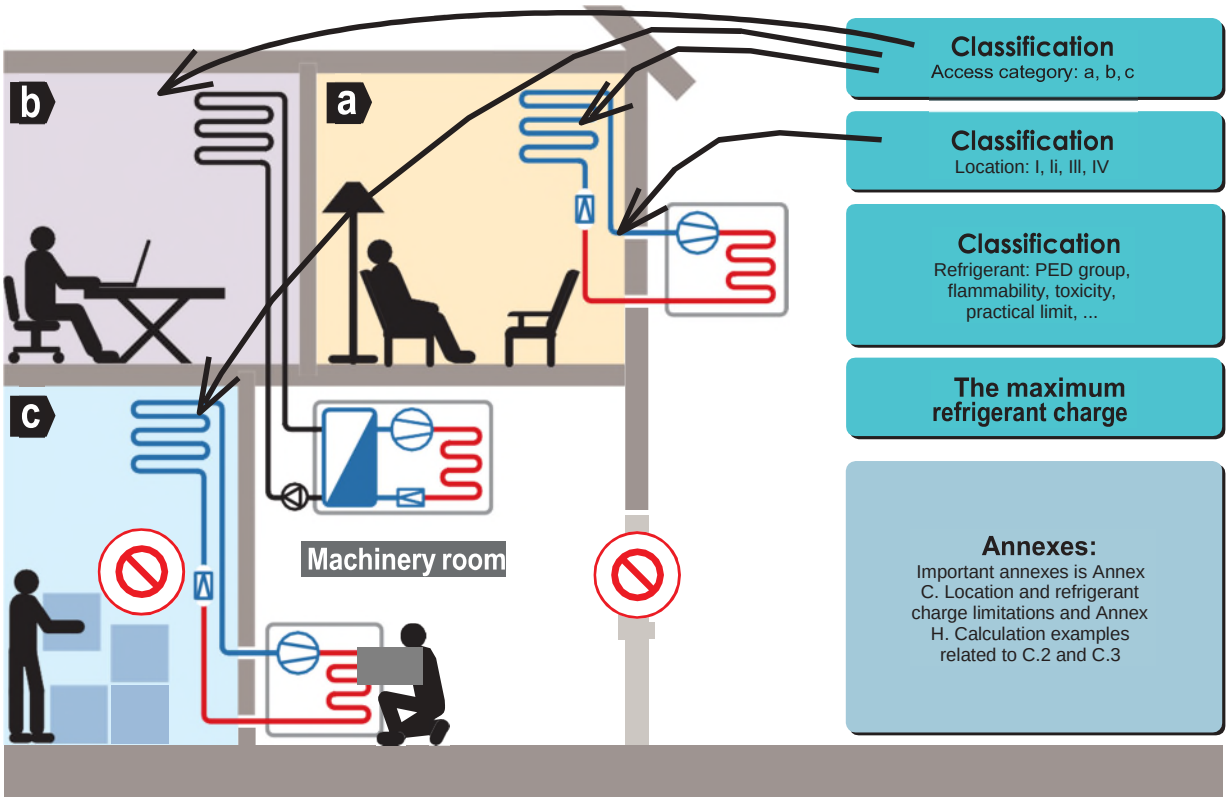
EN 378 consists of four parts

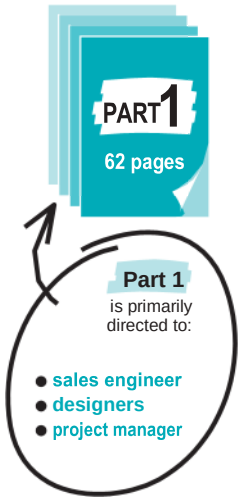


Part 1, 2, 3, and 4 are intended for different roles

	EN378 PART	Part 1	Part 2	Part 3	Part 4
PEOPLE INTERESTED	Plant/Equipment Designer	■	■		
	Plant/Equipment Manufacturer		■	■	
	Plant/Equipment Installer	■	■	■	
	Service/Maintenance personnel		■	■	■
	Building / Plant Owner / Operator / Manager	■		■	■
	Building Designer	■		■	
LIFECYCLE ACTIVITY INTERESTED (activity according to EN 13313, Competence of Personnel)	Design	■	■		
	Pre-assembling		■		
	Installation	■	■	■	
	Putting into Operation		■	■	■
	Commissioning		■		■
	Operating			■	■
	In-service Inspection		■		■
	Leakage checking		■		■
	General Maintenance		■	■	■
	Circuit Maintenance		■		■
	Decommissioning				■
	Removing Refrigerant				■
	Dismantling				■

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





Part 1 contains definitions of direct and indirect systems, classification of access category a, b, or c, location classification of refrigerating systems I, II, III or IV, division of refrigerants according to flammability and toxicity (A1, A2L, A2, A3, B1, B2L, B2 and B3), and Annex E, which lists technical and chemical information about each individual refrigerant.

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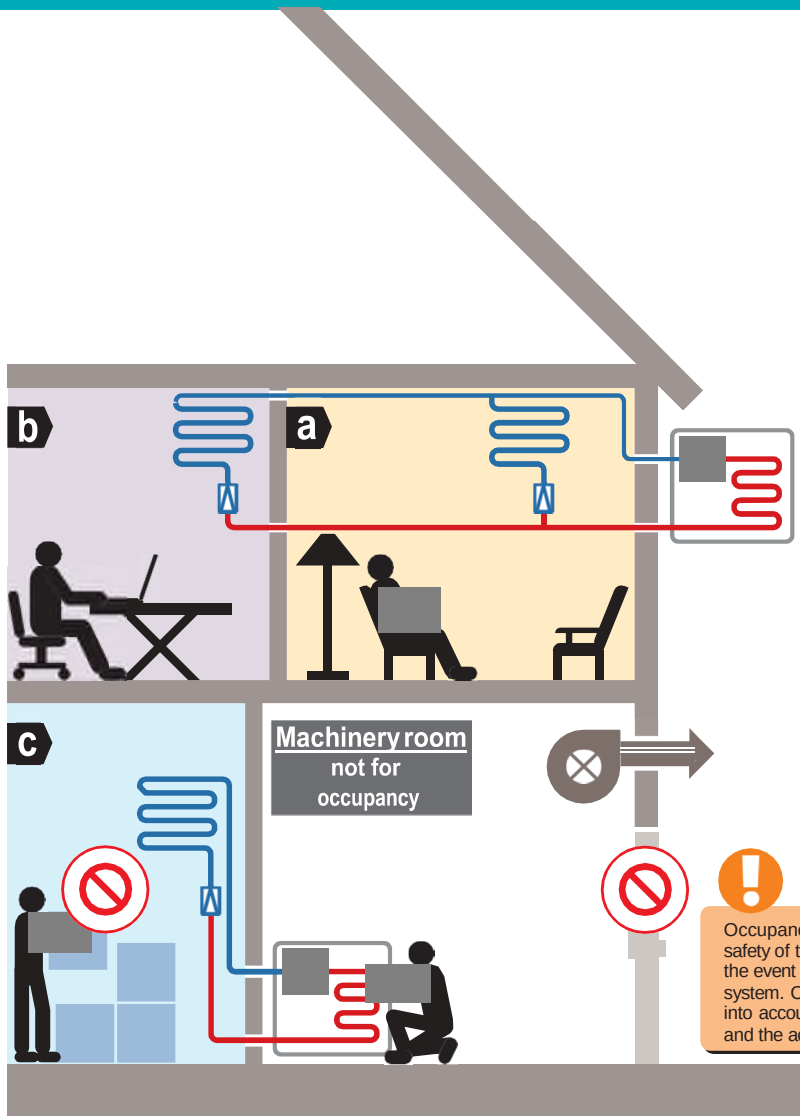
ANNEXES:

Clause 5.1 Access categories



Occupancies are categorised in three different access categories; a, b, and c.

a Hospitals, courts or prisons, theatres, supermarkets, schools, lecture halls, public transport termini, hotels, dwellings, restaurant

b Business or professional offices, laboratories, places for general manufacturing and where people work

c Manufacturing facilities, e.g. for chemicals, food, beverage, ice, icecream, refineries, cold stores, dairies, abattoirs, non-public areas in supermarkets

Occupancies are categorised with respect to the safety of the persons who may be directly affected in the event of abnormal operation of the refrigerating system. Considerations of safety in refrigerating systems take into account the site, the number of people occupying the site and the access categories.

Clause 5.3 Location classification of refrigerating systems

There are four classes of location for refrigerating systems

Category	Description
I	The refrigerating system or refrigerant-containing parts are located in the occupied space.
II	All compressors and pressure vessels are either located in a machinery room or in the open air. Coils and pipework including valves may be located in an occupied space.
III	All refrigerant-containing parts are located in a machinery room or open air
IV	All refrigerant-containing parts are located in a ventilated enclosure.

I


II


III

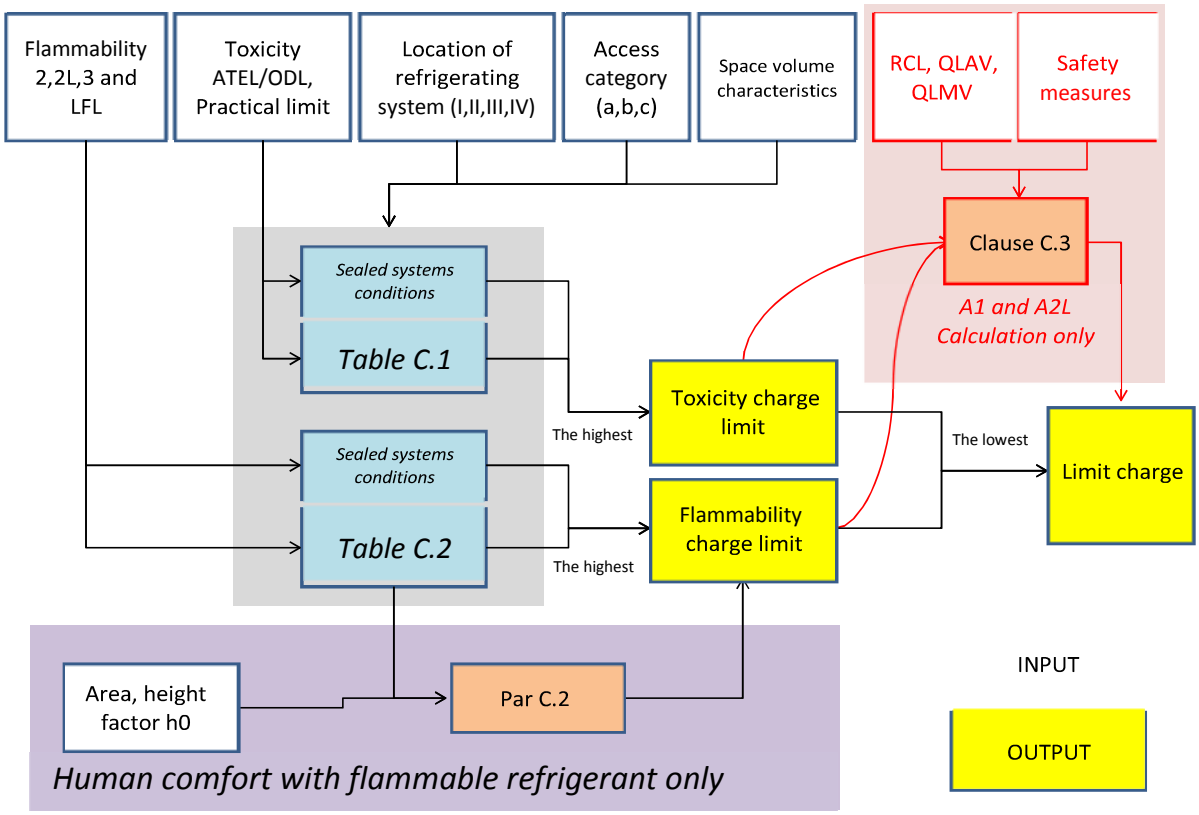
IV

EN 378, Part 1, Annex C - Refrigerant charge limit requirements

- The most important parameters for determining the maximum refrigerant charge are the flammability of the refrigerant and/or toxicity, location classification of refrigerating systems and access category.

- For Al and A2L refrigerants, there is also a possibility to increase the maximum refrigerant charge if additional safety measures are implemented (e.g. natural or mechanical ventilation, safety shut-off valves and safety alarm in conjunction with a gas detection device, etc.). See Clause C.3.

Maximum limit refrigerant charge calculation:



See page 13 , information about refrigerants, and page 14, examples of Table C.1 and Table C.2.

Annex E - Safety classification and information about refrigerants

Annex E provides information about chemical name, chemical formula, safety class, PED fluid group, practical limit, acute-exposure toxicity limit (ATEL) or oxygen deprivation limit (ODL), lower flammability limit (LFL), and other information necessary to calculate the maximum refrigerant charge.

IMPORTANT: Systems using refrigerants other than those listed in Annex E of EN 378 are not covered by the standard

Example of table of refrigerants in Annex E:

Refrigerant number	Chemical name b	Chemical formula	Safety class	PED m fluid group	Practical limit d	ATEL/ ODL	LFL h	Vapour density 25°C, 101,3 kPa a	Molecular mass a	Normal boiling point a	ODP a e	GWP l	GWP a f (AR5)	Auto ignition temperature
							(kg/m3)	(kg/m3)		(°C)		(100 yr ITH)	(100yr ITH)	(°C)
1270	Propene (propylene)	$CH_3CH = CH_2$	A3	1	0,008 i	0,001 7 j k	0,046	1,72	42,1	– 48	0	2	2	455
600	Butane	$CH_3CH_2CH_2 CH_3$	A3	1	0,008 9 i	0,002 4 j k	0,038	2,38	58,1	0	0	4	4	365
717	Ammonia	NH_3	B2L	1	0,000 35 i	0,000 22 j	0,116	0,700	17,0	– 33	0	0	0	630
744	Carbon dioxide	CO_2	A1	2	0,1 i	0,072 j	NF	1,80	44,0	– 78 c	0	1	1	ND

NA signifies not applicable. ND signifies not determined. NF signifies non-flammable.

a The vapour density, molecular mass, normal boiling point, ODP and GWP (AR5) are not part of EN 378 **and are provided** for information purposes only.

b The preferred chemical name is followed by the popular name in parentheses.

c Sublimation temperature. Triple point is −56,6 °C at 5,2 bar.

d Determined according to 5.2 of this standard.

e Adopted under the Montreal Protocol.

f Data from IPCC Assessment Report V (AR5); for HCs which are not included in AR5, data from F-Gas regulation N° 517/2014.

g Acute-Toxicity Exposure Limit (ATEL) or Oxygen Deprivation Limit (ODL), whichever is lower values taken from ISO 817.

h Lower Flammability Limit.

i Practical limit values are grandfathered according to 5.2.

j ATEL/ODL values are changed in comparison to EN 378–1:2008+A2:2012 according to data from ISO 817.

k No cardiac NOEL value available, value determined according to ISO 817.

l Data from European F-Gas regulation N° 517/2014; for CFCs and for HCFCs which are not included in F-Gas regulation N° 517/2014, data from IPCC assessment report IV.

m PED = Pressure Equipment Directive 2014/68/EU.

n According to the test conditions in ISO 817, the refrigerant is classed as 2L, however the PED fluid group is 2, based on CLP Regulation (EC) 1272/2008.

One table based on toxicity, one table based on flammability

- Refrigerant charge limits shall be calculated according to Table C.1 and Table C.2 depending on the toxicity and/or the flammability of the refrigerant.
- Where more restrictive national or regional regulations exist, they take precedence over the charge limit requirements of EN 378.

Toxicity class	Access category		Location classification			
			I	II	III	IV
A	a		Toxicity limit × Room volume or see C.3	No charge restriction [a]	No charge restriction [a]	The charge requirements based on toxicity shall be assessed according to location I, II or III, depending on the location of the ventilated enclosure
	b	Upper floors without emergency exits or Below ground floor level	Toxicity limit × Room volume or see C.3			
		Other	No charge restriction [a]			
	c	Upper floors without emergency exits or Below ground floor level	Toxicity limit × Room volume or see C.3			
		Other	No charge restriction [a]			

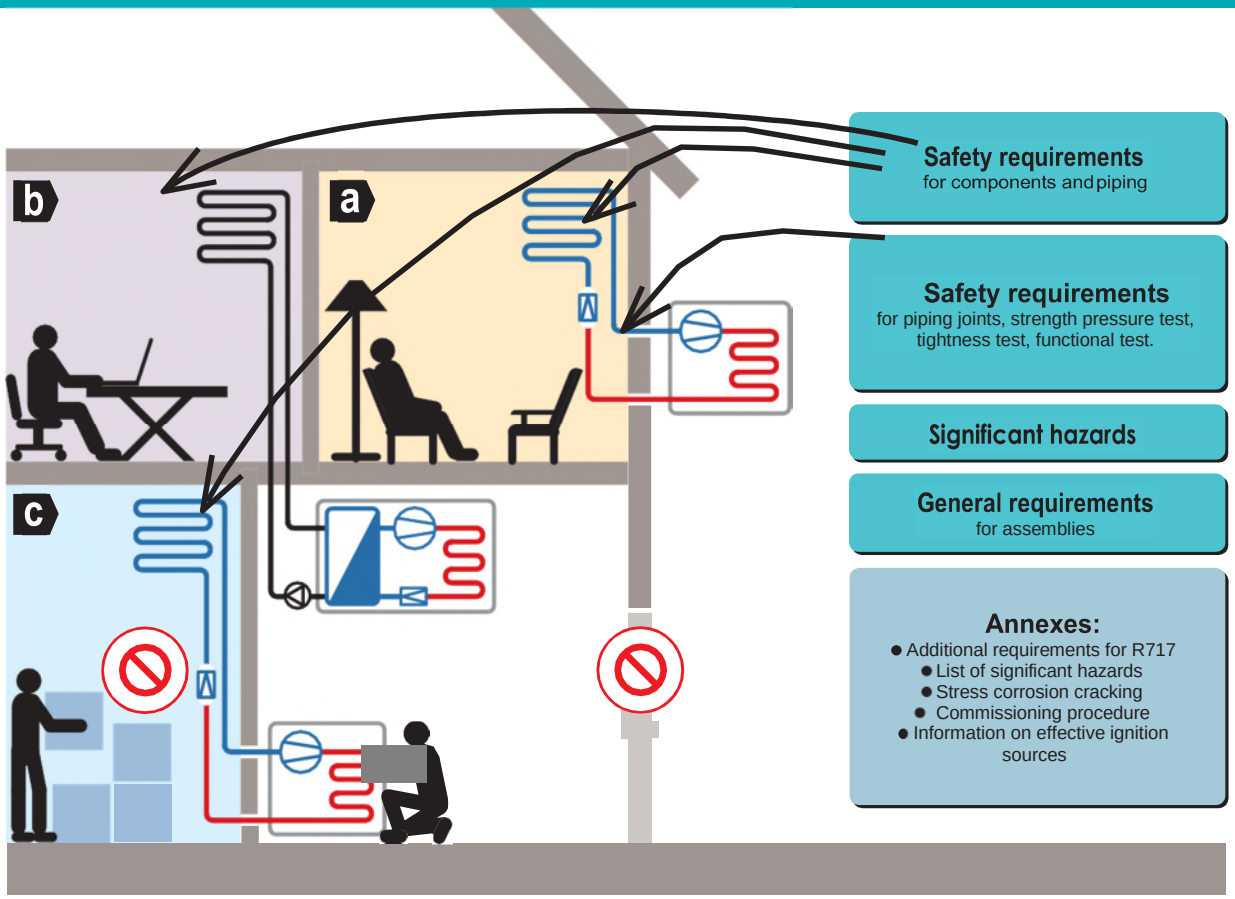
Example of charge limit requirements for refrigerating systems based on toxicity (From Table C.1)

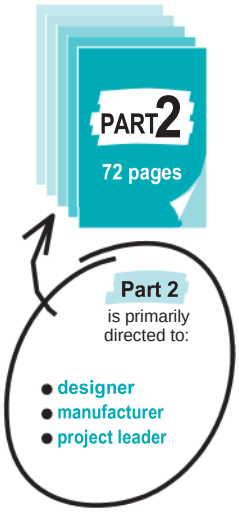
Flammability class	Access category			Location classification			
				I	II	III	IV
3	a	Human comfort		According to C.2 and not more than the greater of m_2 or 1,5 kg		Not more than 5 kg [c]	Refrigerant charge not more than m_3
		Other applications	Below ground	Only sealed systems: 20 % × LFL × Room volume and not more than 1 kg			
			Above ground	Only sealed systems: 20 % × LFL × Room volume and not more than 1,5 kg			
	b	Human comfort		According to C.2. and not more than the greater of m_2 or 1,5 kg		Not more than 10 kg [c]	
		Other applications	Below ground	20 % × LFL × Room volume and not more than 1 kg [a]			
			Above ground	20 % × LFL × Room volume and not more than 2,5 kg			
	c	Human comfort		According to C.2. and not more than the greater of m_2 or 1,5 kg.		No charge restriction [c]	
		Other applications	Below ground	20 % × LFL × Room volume and not more than 1 kg [c]			
			Above ground	20 % × LFL × Room volume and not more than 10 kg [c]	20 % × LFL × Room volume and not more than 25 kg [c]		

[a] m_2 = 26 m^3 × LFL. [b] m_3 = 130 m^3 × LFL.
[c] For open air, EN 378–3:2016, 4.2 applies and, for machinery rooms, EN 378–3:2016, 4.3 applies.

Example of charge limit requirements for refrigerating systems based on flammability (From Table C.2)

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





Part 2 of the standard is primarily for manufacturers and includes requirements for pressure (maximum allowable pressure, strength test), pipe fittings, valves, pressure relief devices (e.g. safety relief valves).
Part 2 is harmonized with the Pressure Equipment Directive (PED), which means that if one follows the standard one will at the same time meet the related requirements of PED.

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

CONTENT:

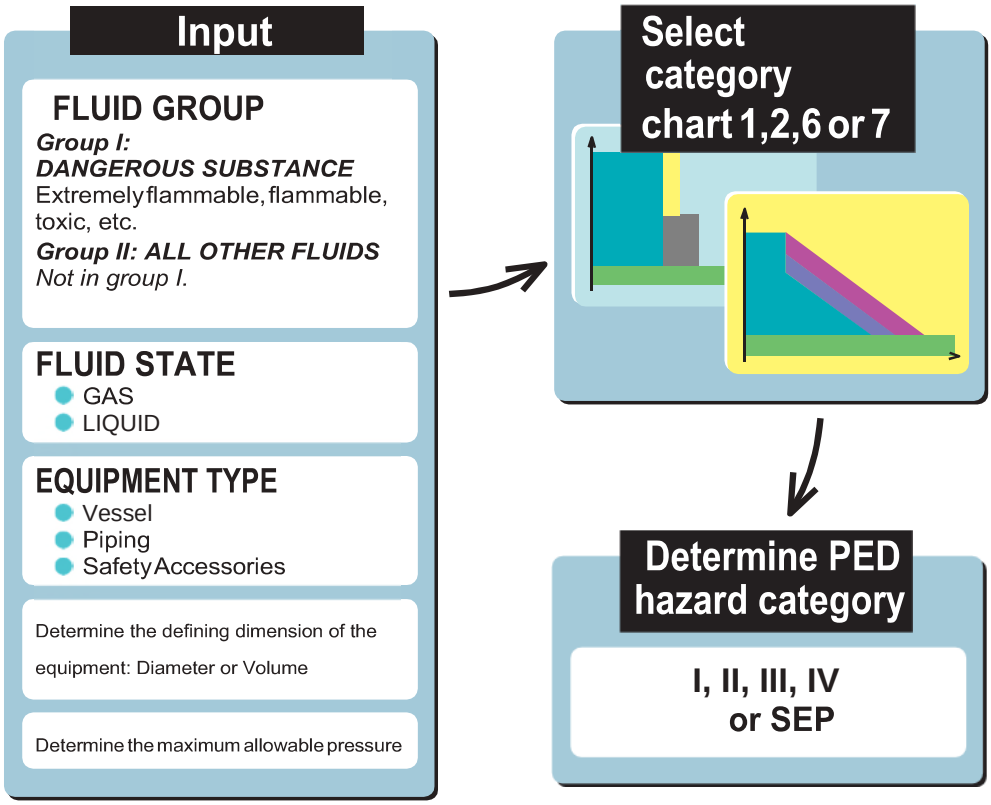
ANNEXES:

Protection devices:

Sections 6.2.5 and 6.2.6 of EN 378 Part 2 deal with the application of protection devices to refrigerating systems and secondary heat transfer circuits.
Protection devices include safety switching devices for limiting pressure and pressure relief valves for relieving excessive pressure.
EN 378 provides four flow charts (Figure 1, Parts A B C and D) to allow the refrigerating system designer to determine the appropriate devices for each part of the system.

Section 6.2.14 deals with protection against fire and explosion hazards

PED: Determination of category for equipment



Once it is determined that the equipment is covered by the PED, the classification has 6 steps:

1. Determine the type of pressure equipment being considered
2. Determine the state of the fluid in the equipment
3. Determine the hazard group of the fluid in the equipment
4. Select the appropriate hazard category chart
5. Determine the maximum allowable pressure and the defining dimension of the equipment
6. Determine the PED hazard category

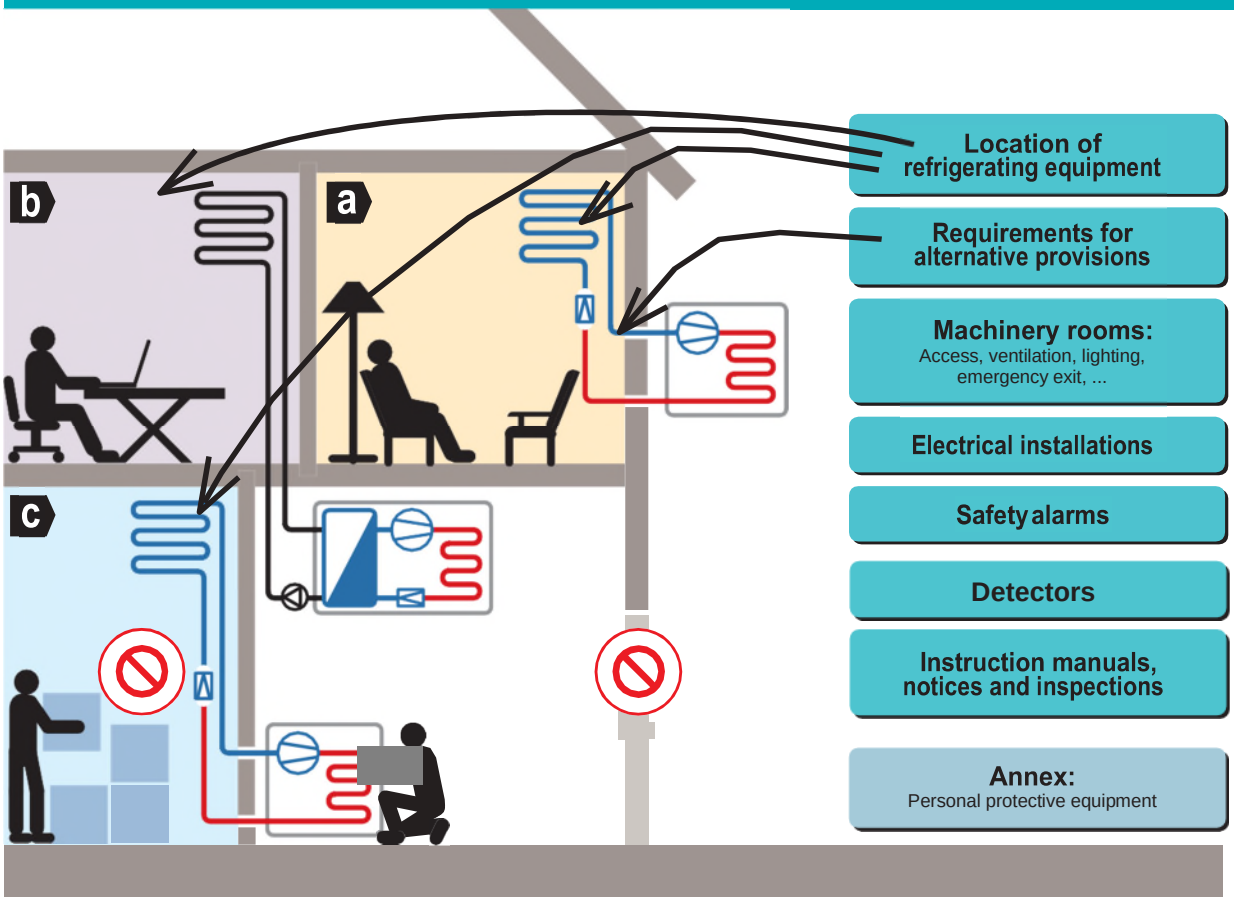
Pressure Testing:

Section 6.3 of EN 378 Part 2 deals with testing of refrigerating systems before they are put into service. Four tests are detailed:

a) strength pressure test;
b) tightness test;
c) functional test of safety switching devices for limiting the pressure;
d) conformity test of the complete installation.

For the strength pressure test, Section 6.3.2 provides guidance on when to use 1.1 x Ps or 1.43 x Ps for components and piping joints. Testing requirements for piping of Category I are different to those for Category II.

Part 3: Installation site and personal protection



PART 3
23 pages

Part 3 is primarily directed to:

- project manager
- supervisor
- refrigeration technician

Part 3 describes the safety of personnel and buildings, defining requirements for machinery rooms (size, walls, ventilation) together with specific requirements for flammable and toxic refrigerants. There are also requirements for leak detectors, alarm systems, personal protective equipment and first aid in this section.

CONTENT:

Clause 5 Machinery rooms

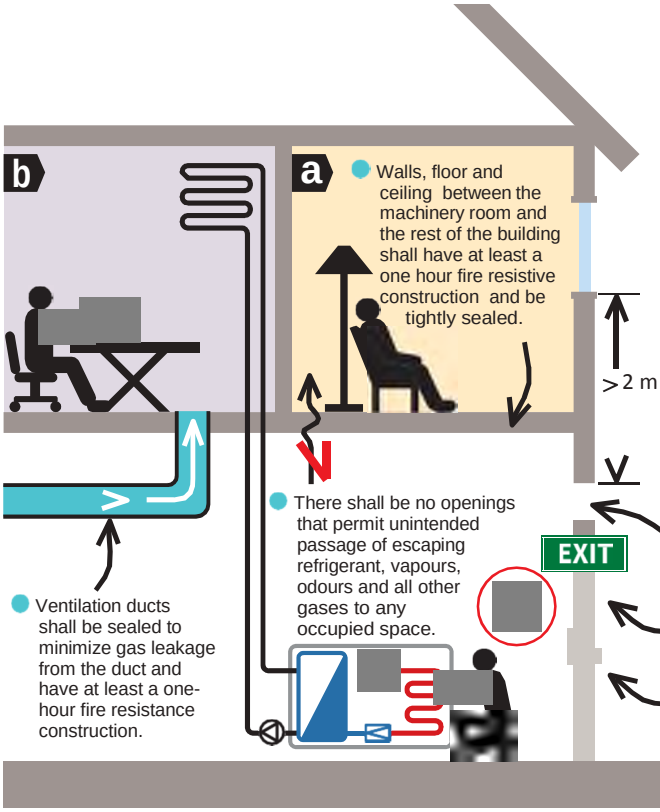
EN 378 distinguishes between machinery rooms intended to contain components of the refrigerating system and other equipment, and separate refrigeration machinery rooms intended to contain only components of the refrigerating system.

The advantage of a separate refrigeration machine room is the possibility to perform inspection, maintenance and repair, and even let an alarm close down the power supply to the refrigeration system only, without having to take into account any other equipment.

The many requirements for a machinery room to be in accordance with EN 378 are listed in Clause 5:

- **5.1. Access to machinery rooms**
- **5.2. Venting from or through the machinery room**
- **5.3. Combustion equipment and air compressors**
- **5.4. Open flame**
- **5.5. Storage**
- **5.6. Remote emergency switch**
- **5.7. Exterior openings of the machinery room**
- **5.8. Piping and ducting**
- **5.9. Normal lighting**
- **5.10. Emergency lighting**
- **5.11. Dimensions and accessibility**
- **5.12. Doors, walls and ducts**
- **5.13. Ventilation**
- **5.14. Machinery rooms for groups A2L, A2, A3, B2L, B2 and B3 refrigerants**

Machinery rooms: Building requirements and personal safety



The dimensions of the machinery room …

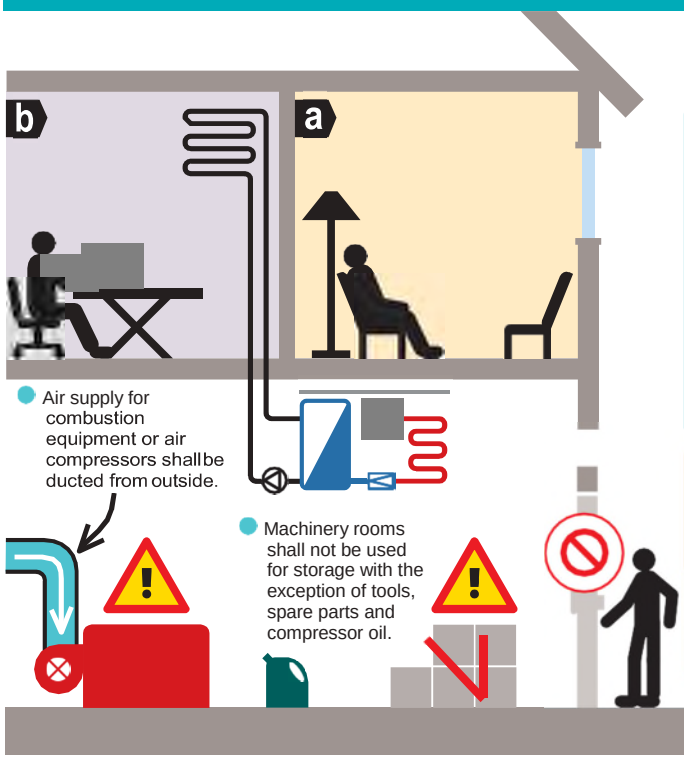
… shall allow easy installation and sufficient room for service, maintenance, operation, repair and disassembly of the refrigerating equipment, including sufficient space for persons wearing personal protection equipment. There shall be clear headroom of at least 2,1 m below equipment situated over gangways and permanent work places.

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.

- Exterior openings shall not be situated within 2 m of building emergency exit staircases or other building openings, e.g. windows, doors, ventilation inlets.
- At least one emergency exit shall open directly to the open air or it shall lead to an emergency exit passageway.
- The doors shall be tight fitting and self-closing, and have at least a one-hour fire resistance construction.

Machinery rooms: Combustion equipment, air compressors, storage and open flame.



Machinery room:

Machinery room according to definition in EN378, Part 1, Clause 3.2. 1.: "enclosed room or space, with mechanical ventilation, sealed from public areas and not accessible to the public, which is intended to contain components of the refrigerating system »

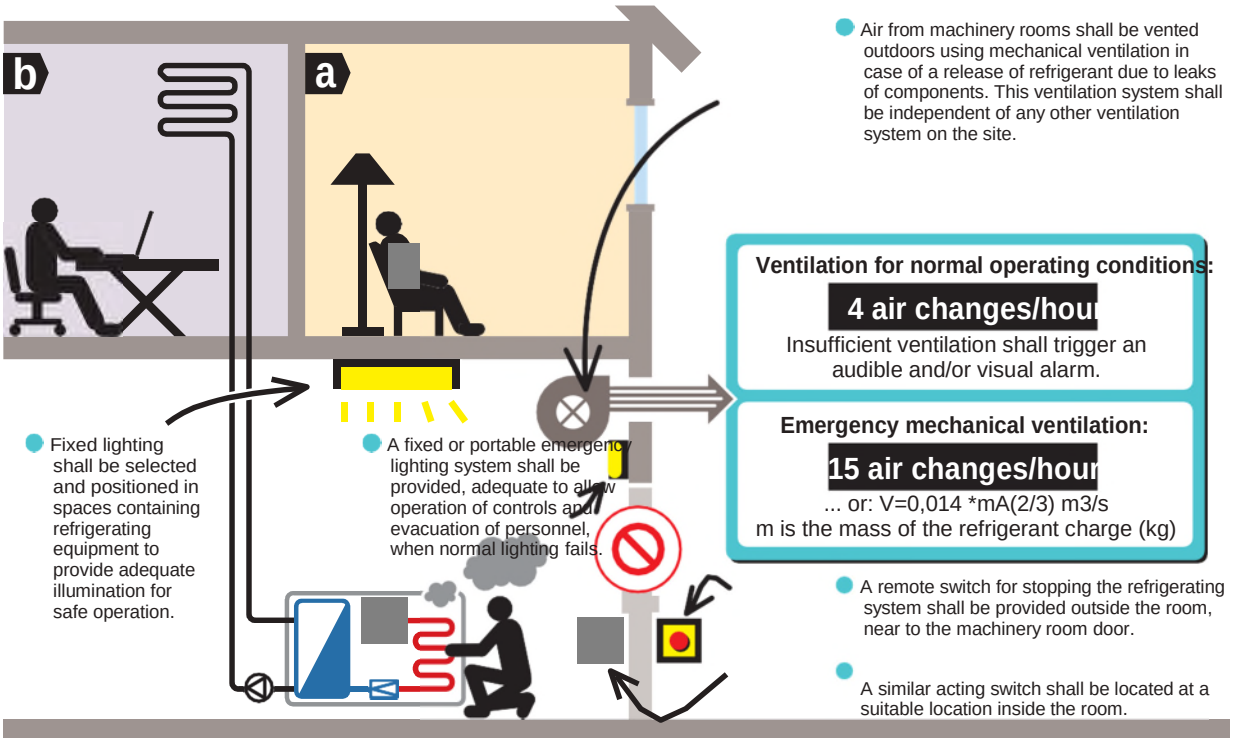
Separate refrigeration machinery room according to definition in EN 378, Part 1, Clause 3.2.2.: "Machinery room intended to contain only components of the refrigerating system, accessible only to competent personnel for the purposes of inspection, maintenance and repair»

Open flame

Open flames shall not be permitted in machinery rooms, except when the refrigerant concentration is monitored and adequate ventilation is ensured.

Such open flames shall not be left unattended

Machinery rooms: Lighting, ventilation, and emergency switches



- 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.

Ventilation for normal operating conditions:

4 air changes/hour

Insufficient ventilation shall trigger an audible and/or visual alarm.

Emergency mechanical ventilation:

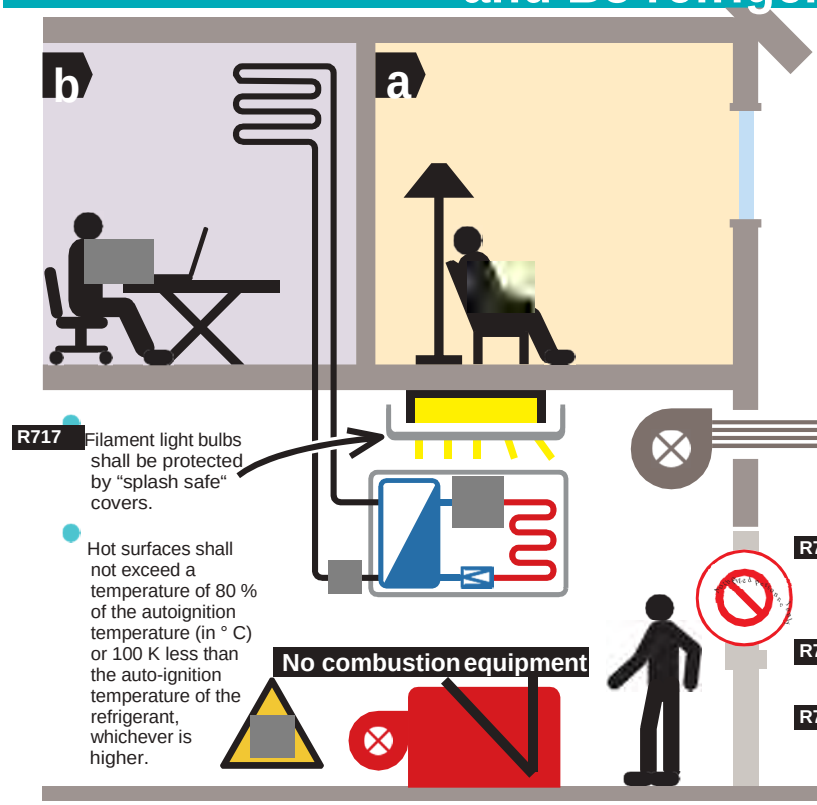
15 air changes/hour

... or: V=0,014 *mA(2/3) m3/s

m is the mass of the refrigerant charge (kg)

- Fixed lighting shall be selected and positioned in spaces containing refrigerating equipment to provide adequate illumination for safe operation.
- A fixed or portable emergency lighting system shall be provided, adequate to allow operation of controls and evacuation of personnel, when normal lighting fails.
- 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.

Machinery rooms: Groups A2L, A2, A3, B2L, B2 and B3 refrigerants.



Risk assessment

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.

Emergency mechanical 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.

- R717 Filament light bulbs shall be protected by “splash safe“ covers.
- Hot surfaces shall not exceed a temperature of 80 % of the autoignition temperature (in ° C) or 100 K less than the auto-ignition temperature of the refrigerant, whichever is higher.
- R717 To prevent R-717 spill reaching surface waters, a catchment system shall be designed and installed in accordance with national regulations.
- R717 Easily accessible eye wash facilities (e.g. eye wash bottle) for all systems shall be provided.
- R717 Water sprinkler systems shall not be installed in machinery rooms with R-717 refrigerating systems unless certain conditions are fulfilled

Electrical installations

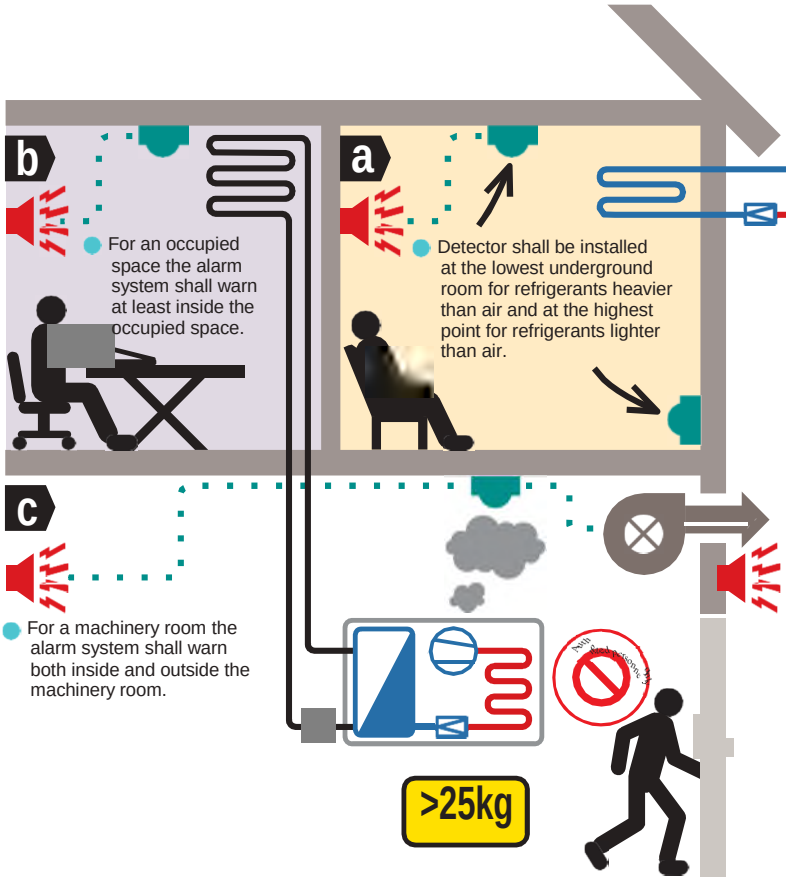
- The general electrical installation of the refrigerating and other equipment including lighting, power, etc., shall conform to national regulations.
- The electrical power supply to a refrigerating system shall be electrically arranged so that it can be switched off independently of the electricity supply to other electrical equipment in general and, in particular, to any lighting system, ventilation unit, alarm and other safety equipment.

Marking of equipment where an explosive atmosphere can be formed.

Marking of area where an explosive atmosphere can be formed.

- 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.

Alarms and detectors



- For an occupied space the alarm system shall warn at least inside the occupied space.
- Detector shall be installed at the lowest underground room for refrigerants heavier than air and at the highest point for refrigerants lighter than air.
- For a machinery room the alarm system shall warn both inside and outside the machinery room.

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.

When the concentration of the refrigerant can exceed the practical limit in accordance with EN 378, Part 1, Annex C, detectors shall at least actuate an alarm and in the case of the machinery room the emergency mechanical ventilation.

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.

- 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.

- In the case of a detector failure, the emergency sequence should be activated as if refrigerant had been detected

• Clause 9.3.1 describes general requirements. • Clause 9.3.2 describes detectors for groups A2L, B2L (except for R717), A2, B2, A3 and B3 refrigerants.
• Clause 9.3.3 describes detectors for R717.

Instruction manuals, notices and inspections

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) flames are prohibited. Additionally, warning notices shall be displayed prohibiting unauthorised operation of the system.

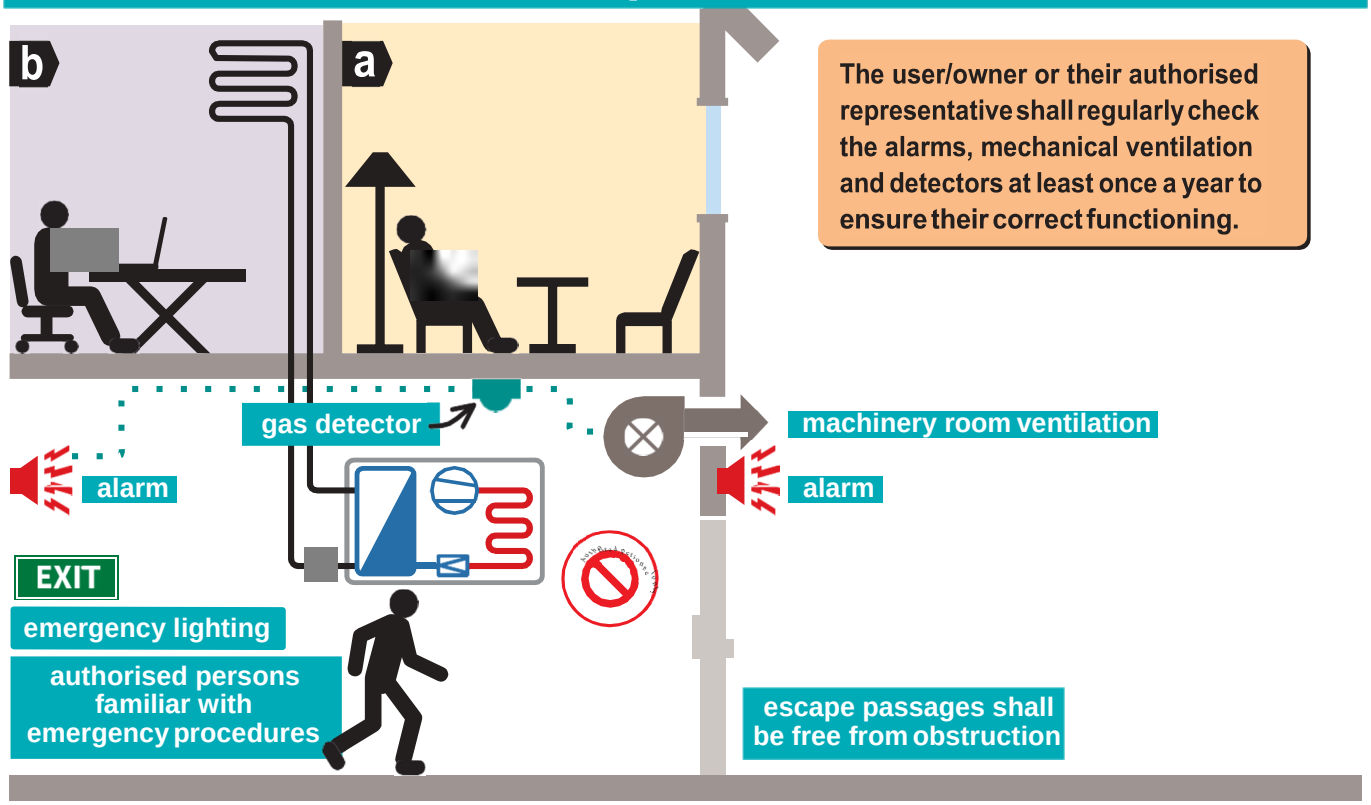
Door to machinery room should be clearly marked with:

- No access for unauthorized personnel
- Smoking and open flame prohibited
- Unauthorized operation of the refrigeration system is prohibited

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.

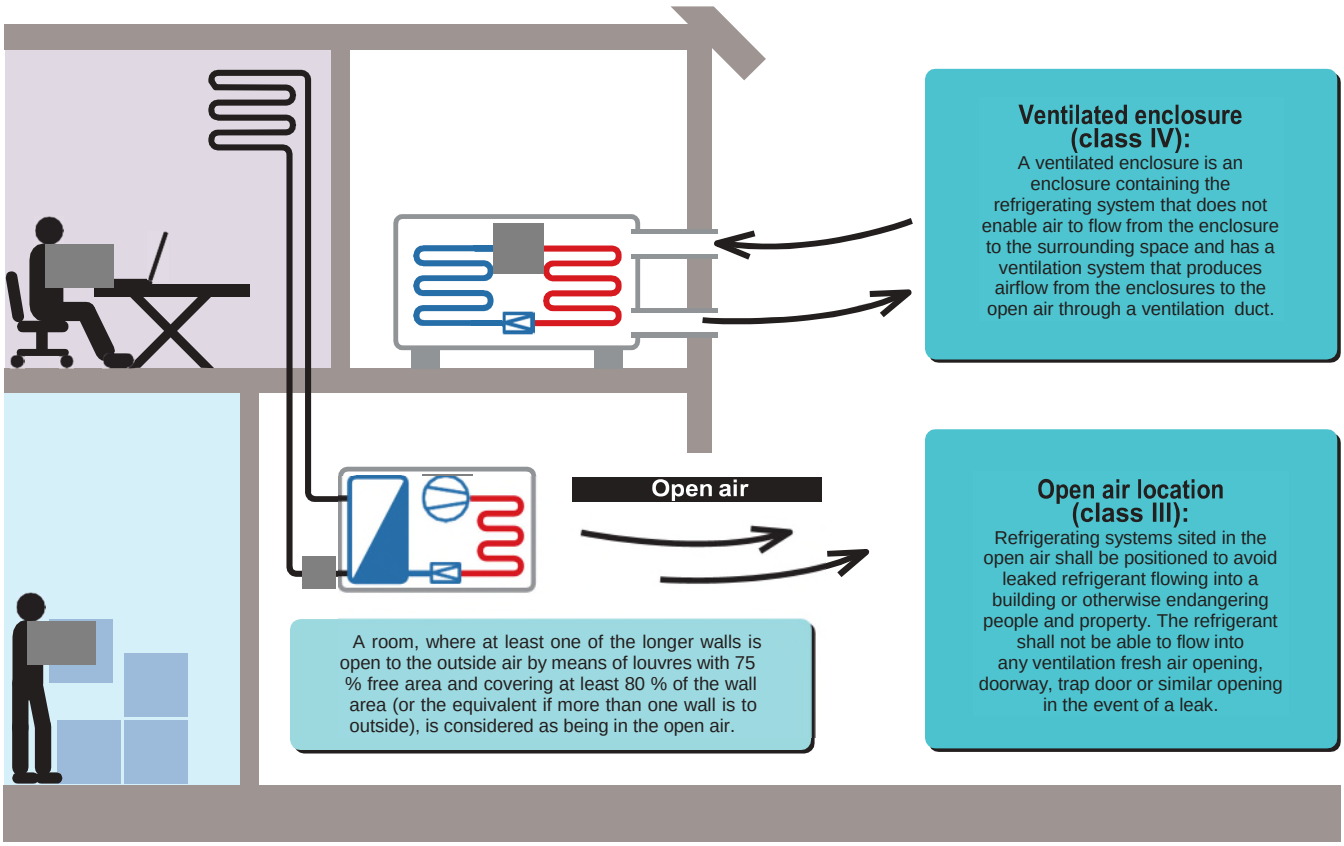
A notice indicating the procedures to be adopted in the event of an alarm shall be clearly visible within the occupied space

Visual inspection 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.

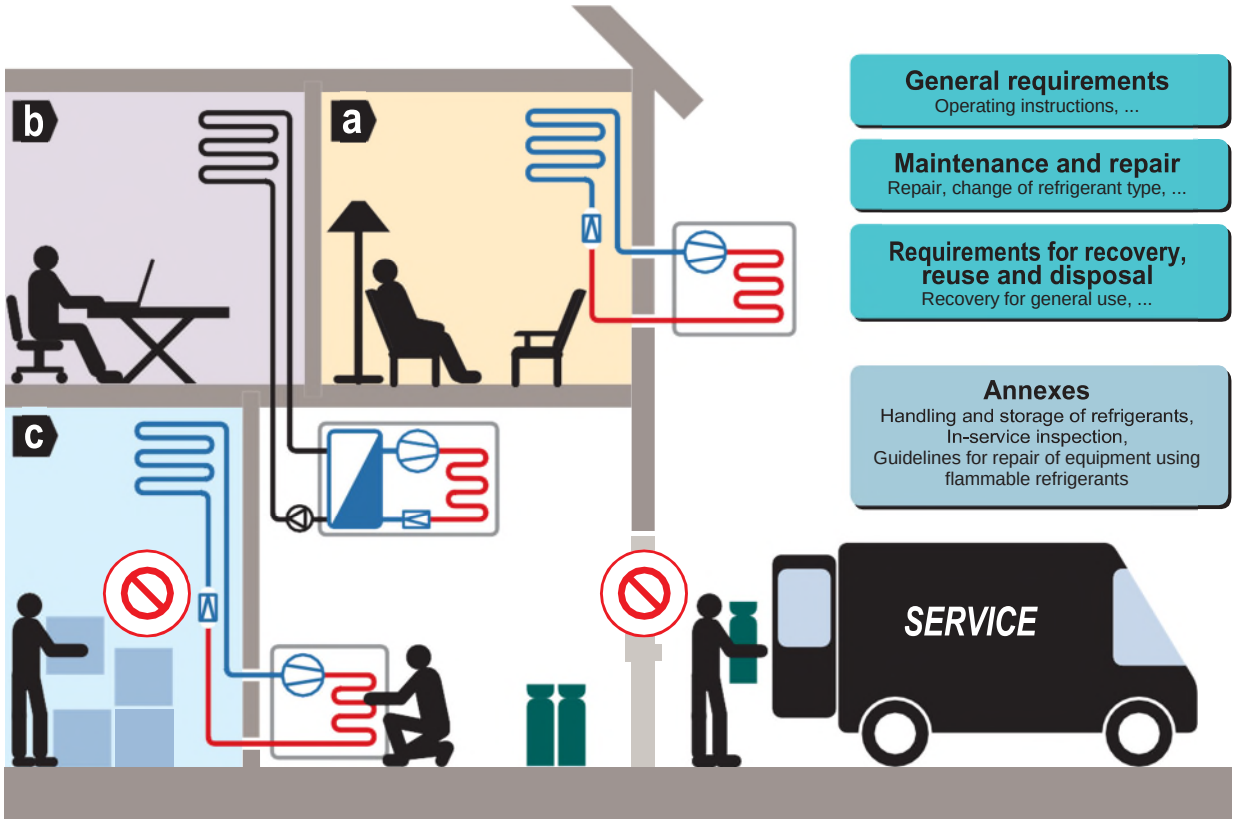
Location of refrigerating equipment



EN 378, Part 3, Clause 4, defines requirements and directions for location of refrigerating equipment. There are greater limitations for equipment located in occupied spaces than for a machinery room, open air or ventilated enclosure located within an occupied space.

EN 378, Part 1, Clause 5, defines access categories and refrigerating system classification.

Part 4: Operation, maintenance, repair and recovery

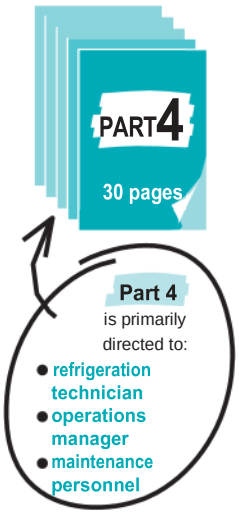


General requirements
Operating instructions, ...

Maintenance and repair
Repair, change of refrigerant type, ...

Requirements for recovery, reuse and disposal
Recovery for general use, ...

Annexes
Handling and storage of refrigerants,
In-service inspection,
Guidelines for repair of equipment using flammable refrigerants



CONTENTS:

ANNEXES:

Part 4 of the standard contains many useful tips for the refrigeration technician, such as Clause 5 ”Maintenance and repair”, and Appendix D ”In-service inspection”. The standard also emphasizes requirements for recycling, reuse and disposal of refrigerant.
Currently safe use of flammable refrigerants is emphasised. Therefore particular points from Appendix E are highlighted on the following page.

Annex E (informative) Guidelines for repairs of equipment using flammable refrigerants

The following is an extract from Annex E.

E.1 General requirements for equipment

Only competent persons that are trained in the use of flammable refrigerants are permitted to open equipment housings or to break into the refrigerant circuit.

E2.2 Repairs to sealed components

The relevant power feed should be switched off before the sealed components are opened. If it is not necessary to switch off the relevant electrical components for repair work, the concentration in the atmosphere in the area concerned should be monitored continuously in order to be able to warn people about a potentially dangerous situation.

E.3 Repairs to refrigerating system

The following procedure should be followed before working on the refrigerant circuit:

- **a)** remove refrigerant (specify the residual pressure);
- **b)** purge circuit with inert gas (e.g. nitrogen);
- **c)** evacuate to a pressure of 0,3 (abs.) bar (or 0,03 MPa);
- **d)** purge again with inert gas (e.g. nitrogen);
- **e)** open the circuit.

The area should be checked with an appropriate refrigerant detector prior to and during any hot work to make the technician aware of a potentially flammable atmosphere.
If compressors or compressor oils are to be removed, it should be ensured that it has been evacuated to an acceptable level to ensure that there is no flammable refrigerant remaining within the lubricant.
Only refrigerant recovery equipment designed for use with flammable refrigerants should be employed.
In the case of refrigerating systems with an indirect system, the heat-transfer fluid should be checked for the possible presence of refrigerant.
After any repair work, the safety devices, for example refrigerant detectors and mechanical ventilation systems, should be checked and the results recorded.
It should be ensured that any missing or illegible label on components of the refrigerant circuit is replaced.
Sources of ignition should not be used when searching for a refrigerant leak.

Annex E (informative) Guidelines for repairs of equipment using flammable refrigerants

E.4 Requirements for the competent persons

Maintenance and repair requiring the assistance of other skilled personnel should be carried out under the supervision of the person competent in the use of flammable refrigerants. Any person conducting servicing or maintenance on a system or associated parts of the equipment should be competent according to EN 13313.

Persons working on refrigerating systems with flammable refrigerants should have competence in safety aspects of flammable refrigerant handling supported by evidence of appropriate training. This will include the following requirements

- knowledge of legislation, regulations and standards relating to flammable refrigerants;
- detailed knowledge of and skill in handling flammable refrigerants, personal protective equipment, refrigerant leakage prevention, handling of cylinders, charging, leak detection, recovery and disposal.

Evacuation:

Section 5.3.8 of EN 378 Part 4 deals with the vacuum procedure for refrigerating assemblies.
A vacuum level of less than 270 Pa (absolute) is required for systems in general, with a deeper vacuum for smaller systems as required.
A repeat evacuation (e.g. double or triple evacuation) can be carried out as determined by the competent person.
The aim of the evacuation process is to ensure all moisture is removed from the system prior to charging, and to ensure there are no leaks. (It should be noted that some low-temperature systems operate in a sub-atmospheric vacuum, e.g. ammonia systems evaporating below -33.3C.

Legislation*

EN 378 provides a means of proving conformity with some relevant European directives. While all four parts of the first edition (2000) were harmonised with European Directive 97/23/EC (The "Pressure Equipment Directive") when the standard was revised in 2008 it was concluded that it was only appropriate to harmonise part 2 ("Design, construction, testing, marking and documentation") with the PED 2014/68/EU. EN 378 Part 2 was also harmonized at that time with European Directive 98/37/EC (The "Machinery Directive"). Harmonisation means that, once the link between the directive and the standard has been cited in the Official Journal of the European Union and at least one member state has implemented it as their national standard, compliance with specific clauses can be presumed to indicate conformity with the equivalent essential safety requirements of the directive.

EN 378 is not, however, a legal requirement in its own right. It is possible to install a system in compliance with all relevant regulations, including PED and MD, without following the requirements of EN 378. It is also not a complete design guide for refrigerating systems. It only addresses topics that are not fully covered elsewhere. For example it does not give complete guidance on electrical safety, only on aspects which are relevant to refrigeration and which are not adequately addressed elsewhere. It does not provide presumption of conformity with all relevant European directives, only those which are specifically mentioned in Annex Z in each of the four parts. At present this means that conformity can only be presumed with respect to design, construction, testing, marking and documentation requirements for the PED and the MD, not for any other directives and not for any other aspects of the directives. In particular compliance with EN 378 gives no presumption of conformity with directive 99/92/EC (The "ATEX Workplace" directive") or directive 2006/95/EC (The "Low Voltage directive").
Any system using a "dangerous substance" as defined in CLP Regulation is required to meet the requirements of those regulations. Following the requirements of EN 378 in full does not provide a presumption of conformity with regard to flammability.

Below is listed a summary of relevant EU legislation, not intended to be a comprehensive guide to EU law:

- Machinery Directive (MD)
- Pressure Equipment Directive (PED)
- ATEX 'Equipment' Directive: equipment and protective systems intended for use in potentially explosive atmospheres
- ATEX 'Workplace' Directive: occupational health and safety in potentially explosive atmospheres
- CLP Regulation (for Classification, Labelling and Packaging)
- F-gas Regulation
- Low Voltage Directive (LVD)
- ADR Regulations for drivers: The European Agreement Concerning the International Carriage of Dangerous Goods by Road

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