



DPC: 25/30492895 DC

BSI Group Headquarters

389 Chiswick High Road London W4 4AL

Tel: +44 (0)20 8996 9000

Fax: +44 (0)20 8996 7400

www.bsigroup.com

Date: 03 July 2025

Origin: European

Latest date for receipt of comments: 26 August 2025

Project No. 2024/01413

Responsible committee: RHE/18 Refrigeration safety

Interested committees:

Title: Draft BS EN 378-2 Refrigerating systems and heat pumps - Safety and environmental requirements. Part 2: Design, construction, testing, marking and documentation.

Please notify the secretary if you are aware of any keywords that might assist in classifying or identifying the standard or if the content of this standard

- i) has any issues related to 3rd party IPR, patent or copyright
- ii) affects other national standard(s)
- iii) requires additional national guidance or information

WARNING: THIS IS A DRAFT AND MUST NOT BE REGARDED OR USED AS A BRITISH STANDARD. THIS DRAFT IS NOT CURRENT BEYOND 26 August 2025

This draft is issued to allow comments from interested parties; all comments will be given consideration prior to publication. No acknowledgement will normally be sent. **See overleaf for information on the submission of comments.**

No copying is allowed, in any form, without prior written permission from BSI except as permitted under the Copyright, Designs and Patent Act 1988 or for circulation within a nominating organization for briefing purposes. Electronic circulation is limited to dissemination by e-mail within such an organization by committee members.

Further copies of this draft may be purchased from BSI Shop <http://shop.bsigroup.com> or from BSI Customer Services, Tel: +44(0) 20 8996 9001 or email cservices@bsigroup.com. British, International and foreign standards are also available from BSI Customer Services.

Information on the co-operating organizations represented on the committees referenced above may be obtained from <https://standardsdevelopment.bsigroup.com/>.

Introduction

This draft standard is based on national and international discussions. Your comments on this draft are invited and will assist in the preparation of the consequent standard.

For international standards, comments will be reviewed by the relevant UK national committee before sending the consensus UK vote and comments to the international committee, which will then decide appropriate action. If the international standard is approved, it is usual for the text to be published as a British Standard.

For national standards, comments will be reviewed by the relevant UK national committee and the resulting standards published as a British Standard.

UK Vote

Please indicate whether you consider the UK should submit a negative (with supporting technical reasons) or positive vote on this draft. Please indicate if you are aware of any reason why this draft standard should not be published as a British Standard.

Submission of Comments

- **Annotated drafts are not acceptable and will be rejected.**
- All comments should be submitted online at <https://standardsdevelopment.bsigroup.com/>. You will need to register in order to comment.

Template for comments and secretariat observations

Date: xx/xx/20xx	Document: ISO/DIS xxxx
------------------	------------------------

1	2	(3)	4	5	(6)	7
MB	Clause No./ Subclause No./Annex (e.g. 3.1)	Paragraph/ Figure/Table/Note	Type of comment	Comment (justification for change) by the MB	Proposed change by the MB	Secretariat observations on each comment submitted
	3.1	Definition 1	ed	Definition is ambiguous and needs clarifying.	Amend to read '...so that the mains connector to which no connection...'	
	6.4	Paragraph 2	te	The use of the UV photometer as an alternative cannot be supported as serious problems have been encountered in its use in the UK.	Delete reference to UV photometer.	

English Version

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

Systèmes frigorifiques et pompes à chaleur - Exigences de sécurité et d'environnement - Partie 2: Conception, construction, essais, marquage et documentation

Kälteanlagen und Wärmepumpen - Sicherheitstechnische und umweltrelevante Anforderungen - Teil 2: Konstruktion, Herstellung, Prüfung, Kennzeichnung und Dokumentation

This draft European Standard is submitted to CEN members for enquiry. It has been drawn up by the Technical Committee CEN/TC 182.

If this draft becomes a European Standard, CEN members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration.

This draft European Standard was established by CEN in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CEN member into its own language and notified to the CEN-CENELEC Management Centre has the same status as the official versions.

CEN members are the national standards bodies of Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Republic of North Macedonia, Romania, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Türkiye and United Kingdom.

Recipients of this draft are invited to submit, with their comments, notification of any relevant patent rights of which they are aware and to provide supporting documentation.

Warning : This document is not a European Standard. It is distributed for review and comments. It is subject to change without notice and shall not be referred to as a European Standard.



EUROPEAN COMMITTEE FOR STANDARDIZATION
COMITÉ EUROPÉEN DE NORMALISATION
EUROPÄISCHES KOMITEE FÜR NORMUNG

CEN-CENELEC Management Centre: Rue de la Science 23, B-1040 Brussels

Contents	Page
European foreword	4
Introduction	6
1 Scope.....	7
2 Normative references.....	7
3 Terms, definitions, symbols and abbreviated terms	11
3.1 Abbreviated terms.....	11
4 Significant hazards	11
5 Safety requirements.....	11
5.1 General safety and environmental requirements.....	11
5.2 Safety requirements for components and piping	12
5.3 Miscellaneous components.....	15
6 Requirements for assemblies.....	20
6.1 General.....	20
6.2 Design and construction.....	20
6.3 Testing.....	44
6.4 Marking and documentation	49
Annex A (normative) Additional requirements for refrigerating systems containing R717.....	54
A.1 Systems with a refrigerant charge above 50 kg.....	54
A.2 Systems with a refrigerant charge above 3 000 kg.....	54
A.3 Pumps.....	54
Annex B (normative) Determination of category for components and refrigerating system assemblies	55
B.1 General.....	55
B.2 Classification of the refrigerant.....	55
B.3 Determine the maximum allowable pressure of the assembly.....	55
B.4 Determine the state (liquid or gas) of the refrigerant.....	55
B.5 Determination of category of components	55
B.6 Determination of category of the assembly	61
Annex C (normative) Requirements for intrinsic safety test	62
C.1 General.....	62
C.2 Determination of the maximum pressure during abnormal operation	62
C.3 Strength pressure test.....	63
C.4 Test results.....	63
Annex D (informative) List of significant hazards	64
D.1 List of significant hazards	64
Annex E (informative) Examples for arrangement of pressure relief devices in refrigerating systems	66

Annex F (informative) Checklist for external visual inspection.....	69
Annex G (informative) Stress corrosion cracking.....	71
G.1 General.....	71
G.2 Stress corrosion in copper	71
G.3 Stress corrosion in steel.....	71
G.4 Factors that influence stress corrosion cracking.....	72
Annex H (informative) Leak simulation test for A2L, A2, A3, B2L, B2, B3 refrigerants	74
Annex I (informative) Commissioning procedure.....	76
Annex J (informative) Information on effective ignition sources	77
Annex K (informative) Protection of piping/fatigue test.....	79
Annex ZA (informative) Relationship between this European Standard and the essential requirements of EU Directive 2014/68/EU [OJ L 189, 27.6.2014] aimed to be covered.....	81
Annex ZB (informative) Relationship between this European Standard and the essential requirements of Directive 2006/42/EC aimed to be covered.....	83
Annex ZC (informative) Relationship between this European Standard and the essential requirements of Regulation (EU) 2023/1230 aimed to be covered.....	85
Bibliography	87

European foreword

This document (prEN 378-2:2025) has been prepared by Technical Committee CEN/TC 182 “Refrigerating systems, safety and environmental requirements”, the secretariat of which is held by DIN.

This document will supersede EN 378-2:2016.

prEN 378-2:2025 includes the following significant technical changes with respect to EN 378-2:2016:

- Update of normative references to refer to latest editions;
- Harmonizing requirements with Regulation (EU) 2023/1230 of the European Parliament and of the Council of 14 June 2023 on machinery and repealing Directive 2006/42/EC of the European Parliament and of the Council and Council Directive 73/361/EEC (Text with EEA relevance);
- replaced obligations to economic operators with neutral requirements;
- modified requirements with references to product standards.

Following detailed changes are worth noting:

- updated subclause [6.2.2.3](#) “Damage limitation requirements in the inlet to event of external fire”
- Moved requirements for protection of piping from [6.2.3.3](#) “Requirements for piping” to requirements for 6.2.3.5 “Drain”;
- Added requirements for external impact to [6.2.3.3](#) “Requirements for piping”;
- Changed heading of [6.2.5](#) to “Protection devices for limiting the pressure and included additional information in 6.2.5.1;
- updated [6.2.6](#) “Application of protection devices”, modified Figure 1 and the requirements for protection of secondary cooling and heating system;
- Added a new heading for [6.2.8](#) “Measures to prevent impact from operational effects due to refrigerant flow / shift” and added new requirements 6.2.8.2 “other operational effects”;
- modified [6.2.10](#) “Protection against extreme temperature surfaces;
- removed 6.2.12 “vibration and drop test”;
- Updated subclause [6.2.13](#) “Protection against fire and explosion hazards”;
- Modified heading and subclause [6.2.14](#) “Requirements for location class IV”;
- added a new subclause [6.2.17](#) “Refrigerant detection systems”;
- Modified subclause [6.3.3](#); “Tightness test”
- Added new subclause [6.3.5](#) “Protection of piping”;

- Added new informative Annex L “Protection of piping /fatigue test”.

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, installing, testing, marking and documentation;*
- *Part 3: Installation site and personal protection;*
- *Part 5: Safety classification and information about refrigerants .*

EN ISO 5149-4 applies for operation, maintenance, repair and recovery.

This document has been prepared under standardization requests addressed to CEN by the European Commission. The Standing Committee of the EFTA States subsequently approves these requests for its Member States.

For relationship with EU Legislation, see informative Annexes ZA, ZB and ZC, which are integral parts of this document.

Introduction

The introduction of prEN 378-1:2025 is applicable.

This document is a type C standard as stated in EN ISO 12100:2010.

The machinery concerned and the extent to which hazards, hazardous situations and hazardous events are covered are indicated in the scope of this document.

When provisions of this type C standard are different from those which are stated in type A or B standards, the provisions of this type C standard take precedence over the provisions of the other standards, for machines that have been designed and built according to the provisions of this type C standard.

1 Scope

This document 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 document includes heat pumps.

This Part 2 of this standard is applicable to the design, construction and installation of refrigerating systems including piping, components and materials. It includes ancillary equipment not covered in EN 378-1, EN 378-3 or prEN 378-5 which is directly associated with these systems. It also specifies requirements for testing, commissioning, marking and documentation. Requirements for secondary heat transfer circuits are excluded except for any protection requirements associated with the refrigerating system. Ancillary equipment includes, for example, fans, fan motors, electrical motors and transmission assemblies for open compressor systems.

This document applies to:

- a) refrigerating systems, stationary or mobile, of all sizes except to vehicle air conditioning systems covered by a specific product standard, e.g. ISO 13043:2011 [\[1\]](#);
- b) secondary cooling or heating systems;
- c) the location of the refrigerating systems;
- d) replaced parts and added components after adoption of this document if they are not identical in function and in the capacity.

Systems using refrigerants other than those listed in prEN 378-5 are not covered by this document.

This document does not apply to goods in storage.

This document 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 document 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 document also applies in the case of the conversion of a system to another refrigerant type.

Designation, classification, and selected properties of the refrigerant such as:

- refrigerant number, e.g. R717;
- safety classes A1, A2L, A2, A3, B1, B2L, B2, B3;
- lower flammability limits (LFL)

are specified in prEN 378-5.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 5149-4:2022, *Refrigerating systems and heat pumps — Safety and environmental requirements — Part 4: Operation, maintenance, repair and recovery*

prEN 378-3:2025, *Refrigerating systems and heat pumps - Safety and environmental requirements - Part 3: Installation site and personal protection*

EN 809:1998+A1:2009,¹ *Pumps and pump units for liquids - Common safety requirements*

ISO 817:2024, *Refrigerants — Designation and safety classification*

EN 837-1:1996,² *Pressure gauges - Part 1: Bourdon tube pressure gauges - Dimensions, metrology, requirements and testing*

EN 837-2:1997, *Pressure gauges - Part 2: Selection and installation recommendations for pressure gauges*

EN 837-3:1996, *Pressure gauges - Part 3: Diaphragm and capsule pressure gauges - Dimensions, metrology, requirements and testing*

EN 1012-3:2013, *Compressors and vacuum pumps - Safety requirements - Part 3: Process compressors*

EN 1092-1:2018, *Flanges and their joints - Circular flanges for pipes, valves, fittings and accessories, PN designated - Part 1: Steel flanges*

EN 1736:2008, *Refrigerating systems and heat pumps - Flexible pipe elements, vibration isolators, expansion joints and non-metallic tubes - Requirements, design and installation*

EN 1861:1998, *Refrigerating systems and heat pumps - System flow diagrams and piping and instrument diagrams - Layout and symbols*

FprEN ISO 3744:2024, *Acoustics - Determination of sound power levels of noise sources using sound pressure - Engineering methods for an essentially free field over a reflecting plane (ISO/FDIS 3744:2024)*

EN ISO 4126-1:2013, *Safety devices for protection against excessive pressure - Part 1: Safety valves (ISO 4126-1:2013)*

EN ISO 4126-2:2019, *Safety devices for protection against excessive pressure - Part 2: Bursting disc safety devices (ISO 4126-2:2018)*

EN ISO 4871:2009, *Acoustics - Declaration and verification of noise emission values of machinery and equipment (ISO 4871:1996)*

EN ISO 7010:2020, *Graphical symbols - Safety colours and safety signs - Registered safety signs (ISO 7010:2019, Corrected version 2020-06)*

EN ISO 10675-1:2021, *Non-destructive testing of welds - Acceptance levels for radiographic testing - Part 1: Steel, nickel, titanium and their alloys (ISO 10675-1:2021)*

¹ As impacted by EN 809:1998+A1:2009/AC:2010.

² As impacted by EN 837-1:1996/AC:1998.

EN ISO 10675-2:2021, *Non-destructive testing of welds - Acceptance levels for radiographic testing - Part 2: Aluminium and its alloys (ISO 10675-2:2021, Corrected version 2022-02)*

EN ISO 11202:2010,³ *Acoustics - Noise emitted by machinery and equipment - Determination of emission sound pressure levels at a work station and at other specified positions applying approximate environmental corrections - Amendment 1 (ISO 11202:2010/Amd 1:2020)*

EN ISO 11688-1:2009, *Acoustics - Recommended practice for the design of low-noise machinery and equipment - Part 1: Planning (ISO/TR 11688-1:1995)*

EN ISO 12100:2010, *Safety of machinery - General principles for design - Risk assessment and risk reduction (ISO 12100:2010)*

EN ISO 21922:2021,⁴ *Refrigerating systems and heat pumps - Valves - Requirements, testing and marking (ISO 21922:2021)*

EN 12237:2003, *Ventilation for buildings - Ductwork - Strength and leakage of circular sheet metal ducts*

EN 12263:1998, *Refrigerating systems and heat pumps - Safety switching devices for limiting the pressure - Requirements and tests*

EN 12693:2008, *Refrigerating systems and heat pumps - Safety and environmental requirements - Positive displacement refrigerant compressors*

EN 12735-1:2020, *Copper and copper alloys - Seamless, round tubes for air conditioning and refrigeration - Part 1: Tubes for piping systems*

EN 12735-2:2024, *Copper and copper alloys - Seamless, round tubes for air conditioning and refrigeration - Part 2: Tubes for equipment*

EN 12799:2000, *Brazing - Non-destructive examination of brazed joints*

EN ISO 24664:2024, *Refrigerating systems and heat pumps - Pressure relief devices and their associated piping - Methods for calculation*

EN 13445-3:2021, *Unfired pressure vessels - Part 3: Design*

EN 13480-3:2024, *Metallic industrial piping - Part 3: Design and calculation*

EN ISO 13732-1:2008, *Ergonomics of the thermal environment - Methods for the assessment of human responses to contact with surfaces - Part 1: Hot surfaces (ISO 13732-1:2006)*

EN ISO 13732-3:2008, *Ergonomics of the thermal environment - Methods for the assessment of human responses to contact with surfaces - Part 3: Cold surfaces (ISO 13732-3:2005)*

EN ISO 13849-1:2023, *Safety of machinery - Safety-related parts of control systems - Part 1: General principles for design (ISO 13849-1:2023)*

EN ISO 13857:2019, *Safety of machinery - Safety distances to prevent hazard zones being reached by upper and lower limbs (ISO 13857:2019)*

³ As impacted by EN ISO 11202:2010/A1:2021.

⁴ As impacted by EN ISO 21922:2021/A1:2024.

prEN 378-2:2025 (E)

EN ISO 14120:2015, *Safety of machinery - Guards - General requirements for the design and construction of fixed and movable guards (ISO 14120:2015)*

EN 14276-1:2020, *Pressure equipment for refrigerating systems and heat pumps - Part 1: Vessels - General requirements*

EN 14276-2:2020, *Pressure equipment for refrigerating systems and heat pumps - Part 2: Piping - General requirements*

EN ISO 14903:2025, *Refrigerating systems and heat pumps - Qualification of tightness of components and joints (ISO 14903:2025)*

EN ISO 17638:2016, *Non-destructive testing of welds - Magnetic particle testing (ISO 17638:2016)*

EN ISO 17640:2018, *Non-destructive testing of welds - Ultrasonic testing - Techniques, testing levels, and assessment (ISO 17640:2018)*

EN ISO 21922:2021, *Refrigerating systems and heat pumps - Valves - Requirements, testing and marking (ISO 21922:2021)*

EN ISO 22712:2023, *Refrigerating systems and heat pumps - Competence of personnel (ISO 22712:2023)*

EN 62233:2008, *Household and similar electrical appliances - Electromagnetic fields - Methods for evaluation and measurement*

EN IEC 60079-10-1:2021, *Explosive atmospheres - Part 10-1: Classification of areas - Explosive gas atmospheres*

EN 60204-1:2018, *Safety of machinery - Electrical equipment of machines - Part 1: General requirements*

EN IEC 60335-2-34:2023, *Household and similar electrical appliances - Safety - Part 2-34: Particular requirements for motor-compressors*

EN IEC 60335-2-40:2023, *Household and similar electrical appliances - Safety - Part 2-40: Particular requirements for electrical heat pumps, air-conditioners and dehumidifiers*

EN IEC 60335-2-89:2022,⁵ *Household and similar electrical appliances - Safety - Part 2-89: Particular requirements for commercial refrigerating appliances and ice-makers with an incorporated or remote refrigerant unit or motor-compressor*

EN IEC 61000-6-1:2019, *Electromagnetic compatibility (EMC) - Part 6-1: Generic standards - Immunity standard for residential, commercial and light-industrial environments*

EN IEC 61000-6-2:2019, *Electromagnetic compatibility (EMC) - Part 6-2: Generic standards - Immunity standard for industrial environments*

EN IEC 61000-6-3:2021, *Electromagnetic compatibility (EMC) - Part 6-3: Generic standards - Emission standard for equipment in residential environments*

⁵ As impacted by EN IEC 60335-2-89:2022/AC:2023-11.

EN IEC 61000-6-4:2019, *Electromagnetic compatibility (EMC) - Part 6-4: Generic standards - Emission standard for industrial environments*

EN 61508-1:2010, *Functional safety of electrical/electronic/programmable electronic safety-related systems - Part 1: General requirements*

EN IEC 62061:2021, *Safety of machinery - Functional safety of safety-related control systems*

prEN 378-1:2025, *Refrigerating systems and heat pumps - Safety and environmental requirements - Part 1: Basic requirements, definitions, classification and selection criteria*

prEN 378-3:2025, *Refrigerating systems and heat pumps - Safety and environmental requirements - Part 3: Installation site and personal protection*

prEN 378-5:2025, *Refrigerating systems and heat pumps - Safety and environmental requirements - Part 5: Safety classification and information about refrigerants*

prEN 14624:2025, *Performance of portable locating leak detectors and of fixed gas detectors for all refrigerants*

3 Terms, definitions, symbols and abbreviated terms

For the purposes of this document, the terms, definitions, symbols and abbreviated terms given in EN 378-1 and the following apply.

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

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

3.1 Abbreviated terms

For the purposes of this document, abbreviated terms given in prEN 378-1:2025 and the following apply.

DN	Nominal size (see prEN 378-1:2025, 3.5.14)
PS	Maximum allowable pressure in bar (1 bar = 0,1 MPa) (see prEN 378-1:2025, 3.3.1)
LFL	Lower flammability limit in kg/m ³ (see prEN 378-1:2025, 3.7.15)

4 Significant hazards

The list of significant hazards related to the Machinery Directive is given in [Annex D](#).

5 Safety requirements

5.1 General safety and environmental requirements

5.1.1 General

Safety and environmental requirements are specified for components and piping in [5.2](#) and [5.3](#) and for assemblies in [Clause 6](#).

Refrigerating systems complying with product standards such as

- EN IEC 60335-2-40:2023 for electrical heat pumps, air-conditioners and dehumidifiers;
- EN IEC 60335-2-89:2022 for commercial refrigerating appliances with an incorporated or remote refrigerant condensing unit or compressor

are in compliance with this document up to and including category I as determined in [Annex B](#), provided they are also compliant with the applicable safety requirements for machinery or low voltage. For refrigerating systems of category II and higher, as determined in [Annex B](#), the relevant requirements for pressure safety in [Clause 5](#) and [Clause 6](#) apply.

5.1.2 Hazards to persons, property and environment

Refrigerating systems and components shall be designed and constructed with the intention to eliminate possible hazards to persons, property and the environment. Deliberate discharge of refrigerants shall only be permitted in a manner which is not harmful to persons, property and the environment and in accordance with national laws.

5.2 Safety requirements for components and piping

5.2.1 General requirements

Components and piping shall comply with the related standards or requirements as indicated in [Table 1](#). Requirements for components not included in [Table 1](#) and which are below category II as defined in [Clause B.5](#) are indicated in [5.3](#).

NOTE Components that are declared to comply with the relevant directives using an alternative method also comply with the requirements of this document.

Where the product standards for components or piping are not harmonized for the EC provisions in relation to pressure or if the essential requirements of such provisions are not covered, then the relevant requirements for pressure shall be confirmed by risk assessment.

Table 1 — Components and piping requirements

COMPONENT	related standard AND requirements
Heat exchangers: — pipe coil without air (tube in tube) — multi-tubular (shell and tubes)	EN 14276-1:2020 or EN 13445-3:2021 if applicable combined with 5.2.2 of this document
Plate heat exchangers	EN 14276-1:2020 or EN 13445-3:2021 if applicable combined with 5.2.2 of this document
Headers, coils and grids with air as secondary fluid	EN 14276-2:2020 or EN 14276-1:2020 if applicable combined with 5.2.2.2 of this document
Receiver/accumulator/economizer	EN 14276-1:2020 or EN 13445-3:2021 if applicable combined with 5.2.2 of this document
Oil separator	EN 14276-1:2020 or EN 13445-3:2021 if applicable combined with 5.2.2 of this document

COMPONENT		related standard AND requirements
Drier		EN 14276-1:2020 or EN 13445-3:2021 if applicable combined with 5.2.2 of this document
Filter		EN 14276-1:2020 or EN 13445-3:2021 if applicable combined with 5.2.2 of this document
Muffler		EN 14276-1:2020 or EN 13445-3:2021 if applicable combined with 5.2.2 of this document
Hermetic positive displacement motor-compressor		EN 14276-1:2020 , EN IEC 60335-2-34:2023 or EN 12693:2008, EN 12693:2008
Semi-hermetic positive displacement motor-compressor		EN IEC 60335-2-34:2023 or EN 12693:2008
Open positive displacement compressor		EN 12693:2008
Non positive displacement compressor		EN 14276-1:2020, EN 1012-3:2013 or EN 13445-3:2021 if applicable combined with EN 60204-1:2018
Pump	general requirements	EN 809:1998+A1:2009, and combined with 5.2.2.2 and 5.2.2.4 of this document
	additional requirements for pumps in refrigerating systems and heat pumps with R-717	Annex A
Piping		EN 14276-2:2020 or EN 13480-3:2024
Piping joints: permanent joints		EN 14276-2:2020
Piping joints: detachable joints		5.2.2.2 and 5.2.2.3 of this document
Flexible piping		EN 1736:2008
Valves	general	EN ISO 21922:2021
	isolating valves	EN ISO 21922:2021
	hand operated valves	EN ISO 21922:2021
	valves with seal cap	EN ISO 21922:2021
	pressure relief valve	EN ISO 24664:2024 and EN ISO 4126-1:2013 combined with 5.2.2 of this document
Safety switching devices for limiting the pressure		EN 12263:1998 combined with 5.2.2.2 of this document

COMPONENT	related standard AND requirements
Bursting disc	EN ISO 4126-2:2019 and EN ISO 24664:2024 combined with 5.2.2.2 of this document
Liquid level indicators	EN ISO 21922:2021 combined with 5.2.2.2 of this document
Gauges	EN 837-1:1996, EN 837-2:1997 and EN 837-3:1996 combined with 5.2.2.2 of this document
Brazing and soldering materials	5.3.1.3 e), f) of this document
Welding materials	EN 14276-2:2020

If the component contains electrical parts, and if the component standard does not cover electrical safety, then the component shall fulfil the electrical requirements of EN IEC 60335-2-40:2023, EN IEC 60335-2-89:2022 or EN 60204-1:2018 as relevant.

5.2.2 Specific requirements

5.2.2.1 General

In addition to the requirements of [5.2.1](#), the following requirements are applicable for incorporation of specific components and piping into the refrigerating system. For components listed in [Table 1](#), [5.2.2](#) and subclauses apply only when specifically stated in [Table 1](#).

5.2.2.2 Tightness

A tightness test shall be performed according to the type approval procedure as specified in EN ISO 14903:2025.

Components, not covered by the scope of EN ISO 14903:2025 shall be tested with detection equipment having a sensitivity equivalent to 3 g/year of refrigerant leakage or better, under a pressure of at least $0,25 \times PS$. The acceptance criterion is that no leak shall be detected.

NOTE This method can be specified in the components standard (see [Table 1](#)).

[Clause 6](#) may require components incorporated in assemblies to conform to specified tightness control levels according to EN ISO 14903:2025.

Tightness tests shall be conducted only after the component has passed a strength pressure test or has been verified by a type test for strength pressure.

For environmental and safety reasons, nitrogen, helium, carbon dioxide or mixtures of low level hydrogen are preferred test gases.

Mixtures of air and flammable test gas shall be avoided. Air may be used if the hazard of ignition is eliminated, and worker safety is ensured. Oxygen shall not be used for tightness tests.

5.2.2.3 Piping joints

Joints shall be designed so that they will not be damaged due to freezing of water on the outside. They shall be suitable for the pipe, the piping material and the pressure, temperature and fluid.

Coated (e.g. galvanized) pipes shall not be welded, unless all coating has been completely removed from the joint area. Welded joints shall be suitably protected.

5.2.2.4 Refrigerant liquid pumps

Refrigerant liquid pumps shall be provided with the following information as a minimum, which shall be durable and permanently affixed:

- a) manufacturer;
- b) type designation;
- c) serial number;
- d) year of manufacture;
- e) maximum allowable pressure (PS).

5.3 Miscellaneous components

5.3.1 Materials

5.3.1.1 General

The material of the component shall be suitable for the intended temperature and pressure range and compatible with the fluids used in the refrigerating system. The material of the component shall conform to relevant standards.

Restrictions for use of dangerous or hazardous substances and preparations shall be taken into account.

NOTE For example as required in EC/1907/2006 (REACH) and 2011/65/EU (RoHS).

5.3.1.2 Ferrous materials

- a) Cast iron and malleable iron

Cast iron and malleable iron shall only be used, when suitable for the particular application in accordance with the requirements of this document.

NOTE 1 Since some grades of cast iron are brittle, their application is dependent on temperature, stress and design consideration.

NOTE 2 Malleable iron has two general classifications with several different grades in each. These grades can have very different mechanical properties.

- b) Steel, cast steel, carbon steel, low alloy steel and high alloy steel.

Steel, cast steel, carbon steel, low alloy steel and high alloy steel may be used for all components and piping in contact with refrigerant or heat-transfer fluid. Where there is a combination of low temperatures and high pressure, or where corrosion risks or thermal stresses are present, the impact strength of the steel shall comply with EN ISO 21922:2021, 6.2, taking into account the thickness, the lowest operating temperature and the welding properties of the component.

NOTE 3 Guidance on stress corrosion cracking in carbon steel is given in Annex G.

High alloy steel can be necessary where there is a combination of low temperatures and high pressure, or where corrosion risks or thermal stresses are present.

- c) Stainless steel

When using stainless steel, care shall be taken to ensure that the grade of stainless steel is compatible with the process fluids and possible atmospheric impurities, such as for example sodium chloride (NaCl) or sulphuric acid (H₂SO₄).

5.3.1.3 Non-ferrous materials and their alloys (cast, forged, rolled and drawn)

a) Copper and copper alloys

Copper in contact with refrigerants shall be oxygen-free or de-oxidized, for example Cu-DHP as specified in EN 12735-1:2020 and EN 12735-2:2024.

Copper and alloys with a high percentage of copper shall not be used for parts carrying R-717 unless their compatibility has been proved by test or experience.

NOTE 1 Guidance on stress corrosion cracking in copper pipe is given in Clause G.2.

b) Aluminium and aluminium alloys

Aluminium used for gaskets for use with R-717 shall be of at least 99,5 % purity. Aluminium alloys containing more than 2 % magnesium shall not be used with halogenated refrigerants unless their compatibility has been proved by test or experience.

Methyl chloride (CH₃Cl) shall not be used in contact with aluminium and its alloys.

Aluminium and aluminium alloys may be used in any part of the refrigerant circuit provided it is compatible with the refrigerants and the lubricants being used.

c) Magnesium and magnesium alloys

Magnesium and magnesium alloys shall not be used unless their compatibility with refrigerants has been proved by test or experience.

d) Zinc and zinc alloys

Zinc shall not be used in contact with R-717, except in electro zinc plated components.

Methyl chloride (CH₃Cl) shall not be used in contact with zinc.

e) Soldering alloys

Soldering alloys shall not be used for refrigerant containment purposes.

f) Brazing alloys

Brazing alloys shall not be used unless their compatibility with refrigerants and oils has been proved by test or experience.

g) Tin and lead tin alloys

Tin and lead tin alloys may be corroded by halogenated refrigerants and shall not be used unless their compatibility has been proved by test or experience.

NOTE 2 Copper free lead antimony or lead tin alloys can be used for valve seats.

5.3.1.4 Non-metallic materials

a) Gasket and packing materials

Gasket and packing materials for sealing joints and for sealing stuffing boxes on valves, etc. shall be resistant to the refrigerants, oils and lubricants used and shall be suitable for the expected range of pressures and temperatures.

NOTE See EN ISO 14903:2025 [2].

b) Glass

Glass may be used in refrigerant circuits and for electrical terminal insulators, indicators and sight glasses, but it shall be resistant to the pressures, temperatures and chemical actions which may occur.

c) Asbestos

Asbestos shall not be used.

d) Plastics

When plastics are used, they shall be suitable for the mechanical, electrical, thermal, chemical and long term creep conditions to which they are subjected.

e) Elastomers

When elastomers are used, they shall be suitable for the mechanical, electrical, thermal and chemical conditions occurring, chemically and physically compatible with refrigerant or refrigerant-oil mixtures with which they are in contact, and they shall not create fire hazards.

5.3.2 Testing

5.3.2.1 Tests

All the components shall undergo the following tests:

- a) strength pressure test (refer to [5.3.2.2](#));
- b) tightness test (refer to [5.2.2.2](#));
- c) functional test.

The results of these tests shall be recorded.

NOTE Some or all of these tests can be conducted after the component has been incorporated into an assembly.

5.3.2.2 Strength pressure test for miscellaneous components

5.3.2.2.1 General

The strength pressure test shall be one of the following methods:

- individual strength-pressure test according to [5.3.2.2.2](#), or
- strength-pressure type test according to [5.3.2.2.3](#), or
- fatigue test according to [5.3.2.2.4](#).

The test criteria specified in [5.3.2.2.5](#) shall apply.

5.3.2.2.2 Individual strength pressure test

Components shall be designed with a thickness according to standards of similar components of [Table 1](#) and each component shall be strength pressure tested individually at a pressure which is no less than $1,43 \times PS$.

Individual strength pressure tests shall be carried out pneumatically or hydrostatically. Pneumatic tests shall be by means of air or some other non-hazardous gas. A hydrostatic pressure test by means of water or some other liquid may be accepted under the condition that the refrigeration circuit shall not be contaminated when the test is complete.

Precautions shall be taken to prevent danger to people and to minimize risk to property.

5.3.2.2.3 Strength pressure type test

Components shall be type tested at a test pressure value which is no less than $3 \times PS$.

If the continuous operating temperature of the component is less than or equal to

- 125 °C for copper or aluminium, or
- 200 °C for steel,

the test temperature of the component part or assembly shall be at least 20 °C.

If the continuous operating temperature of the component exceeds

- 125 °C for copper or aluminium, or
- 200 °C for steel,

the test temperature of the parts or assemblies that are at these temperatures, and subjected to the pressure, shall be at least

- 150 °C for copper or aluminium and
- 260 °C for steel.

For other materials or higher temperatures, the effects of temperature on the material fatigue characteristics shall be evaluated.

5.3.2.2.4 Fatigue test

Three test samples shall be subjected to a strength pressure test at a test pressure value not less than $2 \times PS$.

Three test samples, other than the samples used for the strength pressure test, shall be filled with fluid, and shall be connected to a pressure-driving source. The pressure shall be raised and lowered between the upper and lower cyclic values at a fixed rate for a total number of 250 000 cycles. The entire specified pressure excursion shall occur during each cycle. Pressure cycles shall be between 20 cycles per minute and 60 cycles per minute.

A non-compressible fluid should be used.

The following test pressures shall be applied:

For components at the low pressure side, PS of the low pressure side shall be applied for the first cycle. For components at the high pressure side, PS of the high pressure side shall be applied for the first cycle. The pressure of the test cycles shall be as follows:

- the upper pressure value shall not be less than $0,7 \times PS$ and the lower pressure value shall not be greater than $0,2 \times PS$. The upper pressure value shall not be less than $0,9 \times PS$ for water heat exchangers in heat pumps,
- for the final test cycle, the test pressure shall be increased to a pressure value not less than $1,4 \times PS$ (2 times $0,7 \times PS$). The pressure value shall not be less than $1,8 \times PS$ (2 times $0,9 \times PS$) for water heat exchangers in heat pumps

If the continuous operating temperature is less than or equal to

- 125 °C for copper or aluminium, or
- 200 °C for steel,

the test temperature of the component part or assembly shall be at least 20 °C.

If the continuous operating temperature of the component exceeds

- 125 °C for copper or aluminium, or
- 200 °C for steel,

the fatigue test temperature of the parts or assemblies that are at these temperatures, shall be at least 10 K above the continuous operating temperature.

Static test pressure shall be increased by the ratio of allowable stress of material at room temperature to that at the highest continuous operating temperature.

For other materials, the effects of temperature on the fatigue characteristics shall be evaluated to determine the test conditions.

5.3.2.2.5 Acceptance criteria

In the case of individual strength pressure test at minimum $1,43 \times PS$, permanent deformation shall not result from this test.

In the case of strength pressure type test, the samples tested shall withstand a pressure not less than $3 \times PS$ without rupture.

In the case of the fatigue test, the samples tested shall not rupture, burst, or leak after completion of this test.

5.3.3 Marking

For miscellaneous components no special marking is required.

5.3.4 Documentation

The following documents for components shall be provided:

- a) results of tests;
- b) material test certificates shall be provided to ensure that the material used conforms with the required specification and that it is traceable from the final test through production up to receipt, preferably at the time of delivery and not later than the time of commissioning. Any required inspection certificate shall be prepared on behalf of and signed by the competent person who carried out the inspection, test, or checking;

NOTE Material certificates type 2.1 or type 2.2 in accordance with EN 10204:2004 [3] can be provided.

- c) documentation shall include the following specifications:
 - maximum allowable pressure;
 - maximum allowable temperature;
 - applicable refrigerant;

— applicable oil.

6 Requirements for assemblies

6.1 General

Refrigerating system assemblies using R717 as refrigerant shall also comply with the additional requirements as specified in Annex A.

Determination of the category of the assembly shall be done in accordance with Annex B.

Constructional, welding and brazing materials shall be suitable to withstand foreseeable mechanical, thermal and chemical stresses. They shall be compatible with the refrigerants, refrigerant and oil mixtures (with possible impurities and contaminants) or the heat-transfer media.

Where components, joints or parts are described as hermetically sealed, they shall comply with the requirements “hermetically sealed” according to EN ISO 14903:2025.

6.2 Design and construction

6.2.1 General

All components and piping selected for the assembly of the refrigerant circuit shall comply with [Clause 5](#).

The supports and bases of refrigerating systems shall withstand external forces for example:

- a) the mass of the vessels;
- b) the mass of the contents and equipment, including the mass of hydrostatic test fluid and the mass of ice which may form under foreseeable abnormal operating circumstances;
- c) the snow load;
- d) the wind load;
- e) the mass of stays, braces and interconnecting piping;
- f) the thermal movement of the piping and components;
- g) the forces arising from foreseeable misuse.

The supports and bases of refrigerating systems installed in areas with possible risk of earthquakes shall withstand the expected acceleration due to earthquakes.

Refrigerating systems shall be designed to prevent internal corrosion or other chemical impact within the refrigerant circuit.

EXAMPLE This can include the use of suitable filter drier in HFC systems / HC systems or the incorporation of a purger and / or a refrigerant/oil drier in large R717 systems.

The refrigerating system shall be equipped with service access ports in order to facilitate filling and removal of refrigerant and oil.

Protection against external impact on refrigerant-carrying components and piping shall be provided according to the conditions at the installation site.

Examples include fences, protection rails, suitable enclosures or the installation of the refrigerating system (or parts of it) in a separate refrigeration machinery room.

If the potential impact energy from a moving part can potentially result in damage to refrigerant containing parts they shall be protected from damage in the event of catastrophic failure of moving parts, e.g. fans.

6.2.2 Determination of the maximum allowable pressure

6.2.2.1 Maximum allowable pressure (PS)

The maximum allowable pressure shall be determined by taking into account factors such as:

- a) the maximum ambient temperature;
- b) the possible accumulation of non-condensable gases;
- c) the setting of any pressure relief device;
- d) the method of defrosting;
- e) the application (e.g. cooling or heating application);
- f) solar radiation; (e.g. impact on ice rinks during standstill);
- g) fouling;
- h) transport conditions including those specified in [6.2.12](#).

Based on the relevant factors, the maximum allowable pressures in the different parts of the refrigerating system shall be determined taking into account a maximum ambient temperature as appropriate for the installation site.

One of the following methods shall be used to determine the maximum allowable pressure (PS) of the different parts of the refrigerating system.

— Method 1

The calculation or testing method used for the determination of the maximum allowable pressure shall be documented. Where temperature differences between ambient temperature and condensing temperature are calculated, the method shall be verified by testing.

For the low temperature circuit of a cascade system, the maximum allowable pressure PS shall be determined. Provisions shall be made for standstill under all reasonably foreseeable conditions.

— Method 2

Table 2 is an alternative to Method 1. The minimum value of the maximum allowable pressure shall be determined by the minimum specified temperatures given in [Table 2](#) to determine the saturated refrigerant pressure. When the evaporators can be subject to high pressure e.g. during hot gas defrosting or reverse cycle operation, the high pressure side specified temperature shall be used.

The use of specified temperatures does not always result in saturated refrigerant pressure within the system. In the case of a limit charged system at standstill condition the isochoric behaviour shall be regarded (refrigerant charge compared to free inner volume of the system). In case of pressure stages operating above the critical point Method 1 shall be used.

Table 2 — Specified design temperatures

Ambient conditions	≤ 32 °C	≤ 38 °C	≤ 43 °C	≤ 55 °C
High pressure side with air cooled condenser	55 °C	59 °C	63 °C	67 °C
High pressure side with water cooled condenser or water heat pump	Maximum leaving water temperature + 8 K but not less than the design temperature at low pressure side			
High pressure side with evaporative condenser	43 °C	43 °C	43 °C	55 °C
Low pressure side with heat exchanger exposed to the outdoor ambient temperature	32 °C	38 °C	43 °C	55 °C
Low pressure side with heat exchanger exposed to the indoor ambient temperature	27 °C	33 °C	38 °C	38 °C
NOTE 1 For the high pressure side, the specified temperatures are considered the maximum that will occur during operation. This temperature is higher than the temperature during compressor shut down (standstill). For the low pressure side and/or intermediate pressure side, it is sufficient to base the calculation of pressure on the expected temperature during compressor standstill period. These temperatures are minimum temperatures and thus determine that the system will not be designed for maximum allowable pressure lower than the saturated refrigerant pressure corresponding to these minimum temperatures. NOTE 2 For zeotropic blends the maximum allowable pressure (PS) is the pressure at the bubble point.				

NOTE 1 The pressure at which the system or part of the system usually operates is lower than the maximum allowable pressure PS.

NOTE 2 Excessive stress can result from gas pulsations.

NOTE 3 For determination of the ambient conditions EN 60721-2-1:2014 [19] can be used.

6.2.2.2 Component maximum allowable pressure

The maximum allowable pressure for each component shall not be less than the maximum allowable pressure of the system or part of the system.

The selection of materials for components shall take into account the impact strength at all temperatures to which they may be exposed.

NOTE 1 The application of certain materials at low temperatures can request special consideration due to risk of brittle fracture.

When selecting components for the refrigerating system, the impact of the test pressure defined according to 6.3.3 shall be taken into account.

NOTE 2 This is of special relevance when selecting compressor according to EN IEC 60335-2-34:2023.

6.2.2.3 Damage limitation requirements in the event of external fire

The pressure rise in case of external fire is not regarded as an operational condition. However, damage limitation requirements as appropriate for the refrigerating system shall be regarded. This may include measures as listed in Table 3. Other alternatives reaching the same level of safety may be applied.

Table 3 — Examples for measures to meet damage limitation requirements

Measures	Additional information
Application of suitable pressure relief devices	Calculation according to EN ISO 24664:2024
Place the refrigerating system in a separate refrigeration machinery room which complies with prEN 378-3:2025	
Allow migration of the refrigerant into other parts of the refrigerating system	The worst case condition shall be considered.

In case of application of pressure relief devices, a higher setting than $1 \times PS$ may be chosen provided the respective part of the refrigerating system is designed to meet damage limitation requirement for this higher setting. This may be demonstrated by calculation or testing.

6.2.3 Piping

6.2.3.1 Foreseeable misuse of piping

For piping where misuse can be foreseen e.g. climbing, storage, hanging of tools or similar misuse, adequate countermeasures shall be taken.

NOTE Examples of countermeasures are sufficient strength, protection or warning labels.

6.2.3.2 Piping joints and fittings

6.2.3.2.1 General

Piping joints and fittings shall comply with the requirements of EN 14276-2:2020.

Where joints are used on piping, damage caused by freezing or vibration shall be avoided.

NOTE Painting, coating, ice grooves are examples of countermeasures to avoid damage by freezing.

Joints other than brazed or welded shall be so made and located to minimize tension, compression, bending, or torsion of pipe. Pipe support shall be provided as necessary

considering static and dynamic effects of the weight of the joint and joining components as well as possible displacement of the pipes due to flexible support of movable components. Operation, assembling, handling, transportation, and maintenance shall be taken into account.

6.2.3.2.2 Non-metallic flexible hoses

For hermetically sealed systems the use of non-metallic flexible hoses shall be limited to the following:

- The hoses shall be of class 1 according to EN 1736:2008.
- The total maximum length of the non-metallic flexible hoses installed on the system shall fulfil [Formula \(1\)](#):

$$\sum l_i \times d_i \times \pi \times 10g / m^2 \text{ year} + \sum l_j \times d_j \times \pi \times 200g / m^2 \text{ year} < 1,5g / \text{year} \quad (1)$$

where

l_i	is the length of the flexible hose in metres where the temperature of the refrigerant is lower than or equal to 32 °C;
l_j	is the length of the flexible hose in metres where the temperature of the refrigerant is higher than 32 °C;
d_i	is the internal diameter of the flexible hose in metres where the temperature of the refrigerant is lower than or equal to 32 °C;
d_j	is the internal diameter of the flexible hose in metres where the temperature of the refrigerant is higher than 32 °C;
10 g/m ² year	is the allowable permeability at 32 °C for class 1 flexible hoses;
200 g/m ² year	is the allowable permeability at 100 °C for class 1 flexible hoses.

6.2.3.2.3 Permanent joints

Welded or brazed joints shall comply with the requirements of EN 14276-2:2020. Other permanent joints shall comply with the requirements of EN ISO 14903:2025.

6.2.3.2.4 Detachable joints

6.2.3.2.4.1 General

In general, detachable joints shall only be used where permanent joints are not appropriate for technical reasons.

It is recommended that in insulated piping the positions of detachable joints are permanently marked. At that position, it is recommended that insulation can be easily removed for inspection.

6.2.3.2.4.2 Flanged joints

Flanged joints shall be arranged so that the connected parts can be dismantled with minimum distortion stress of the piping.

It is preferable to use standardized flanges for steel piping according to EN 1092-1:2018 and copper piping according to EN 1092-3 [15].

The joints shall be solid and resistant enough to avoid any danger of the gasket being blown out. Flanges with a groove and tongue or projection and recess are preferred. Dismantling should be

possible without forcing the jointed components. Care shall be taken not to overstress bolts due to cold operation by applying a defined pre-stress.

6.2.3.2.4.3 Flared joints

Flared joints shall be restricted to use with annealed pipe only, and to pipe sizes not exceeding a diameter of 20 mm outside diameter.

When copper piping is used, the material shall comply with the requirements of EN 12735-1:2020 or EN 12735-2:2024.

The pipe ends shall be cut at a right angle to the axes (perpendicular) and checked to be free of burrs.

For flare connections of copper pipes, the appropriate torque and conditions shall apply as indicated in Table 4. The flares shall be tightened with the designated torque by means of a torque wrench and appropriate spanner.

Table 4 — Standard tightening torque

Nominal outside diameter (according to EN 12735-1:2020 and EN 12735-2:2024)			Minimum wall Thickness (mm)	Tightening torque (Nm)
Metric series (mm)	Imperial series			
	(mm)	(in)		
6			0,80	14 — 18
	6,35	1/4	0,80	14 — 18
	7,94	5/16	0,80	33 — 42
8			0,80	33 — 42
	9,52	3/8	0,80	33 — 42
10			0,80	33 — 42
12			0,80	50 — 62
	12,7	1/2	0,80	50 — 62
15			0,80	63 — 77
	15,88	5/8	0,95	63 — 77
18			1,00	90 — 110
	19,06	3/4	1,00	90 — 110

A torque other than the value specified in Table 4 may be applied, if specified in the installation manual.

When making flared joints, care should be taken to ensure that the flare is of the correct size and that the torque used to tighten the nut is not excessive. Care should be taken not to flare piping that has been work hardened.

Flared joints shall be subjected only to forces arising from the system pressure and those exerted by the flare nut in making the joint. Flexible section(s) in the connected pipe, support of it and associated components shall be provided as necessary to prevent extraneous tension, bending or torsion forces acting on the joint. Consider static (weight or tensile/compressive forces) and dynamic (mass × acceleration, including vibration) forces that may arise during assembly, handling, transport, operation or maintenance. Appropriate clamping of the flared pipe connections shall be used to avoid breaking caused by excessive vibrations.