

SLOVENSKI STANDARD

SIST EN 378-2:2008+A1:2009

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

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

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

Ta slovenski standard je istoveten z: EN 378-2:2008+A1:2009

ICS:

27.080	V[] [[q ^Á:] æ ^	Heat pumps
27.200	Hladilna tehnologija	Refrigerating technology

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April 2009

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

Systèmes de réfrigération 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 European Standard was approved by CEN on 13 October 2007 and includes Amendment 1 approved by CEN on 14 March 2009.

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This European Standard exists 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 Management Centre has the same status as the official versions.

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Foreword

This document (EN 378-2:2008+A1:2009) has been prepared by Technical Committee CEN/TC 182 “Refrigerating systems, safety and environmental requirements”, the secretariat of which is held by DIN.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by October 2009, and conflicting national standards shall be withdrawn at the latest by December 2009.

This document includes Amendment 1, approved by CEN on 2009-03-14.

This document supersedes A1 EN 378-2:2008 A1.

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

A1 This document has been prepared under a mandate given to CEN by the European Commission and the European Free Trade Association and supports essential requirements of the EU Directive(s).

For relationship with EU Directive(s), see informative Annexes ZA, ZB and ZC, which are integral parts of this document. A1

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

- *Part 1: Basic requirements, definitions, classification and selection criteria*
- *Part 2: Design, construction, installing, testing, marking and documentation*
- *Part 3: Installation site and personal protection*
- *Part 4: Operation, maintenance, repair and recovery*

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

EN 378-2:2008+A1:2009 (E)**Introduction**

The introduction of EN 378-1:2008 is applicable.

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

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

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.

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1 Scope

This European Standard is applicable to the design, construction and installing of refrigerating systems including piping, components and materials and including ancillary equipment directly associated with such systems. It also specifies requirements for testing, commissioning, marking and documentation. In case the heat transfer fluid is not gaseous at atmospheric pressure, the requirements for circuits for heat transfer fluids are excluded except for any safety devices associated with the refrigerating system. It is not applicable to refrigerating systems with air or water as refrigerant and does not cover the requirements for equipment to be used in a potentially explosive atmosphere.

The following ancillary equipment includes:

- fan and fan motor;
- electrical motor and transmission for open compressor systems.

This European Standard specifies the requirements relating to stationary and mobile refrigerating systems of all sizes, including heat pumps.

Systems using refrigerants other than those listed in Annex E of EN 378-1:2008 are not covered by this standard as long as a safety class is not assigned.

Basic safety requirements for refrigerating systems as defined in EN 378-1 are applicable for this standard.

Basic requirements for the installation site as defined in EN 378-3 apply.

This European Standard is not applicable to refrigeration systems and heat pumps which are manufactured before the date of its publication as EN.

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2 Normative references

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

EN 294:1992, *Safety of machinery — Safety distance to prevent danger zones being reached by the upper limbs*

EN 378-1:2008, *Refrigerating systems and heat pumps — Safety and environmental requirements — Part 1: Basic requirements, definitions, classification and selection criteria*

EN 378-3:2008, *Refrigerating systems and heat pumps — Safety and environmental requirements — Part 3: Installation site and personal protection*

EN 378-4:2008, *Refrigerating systems and heat pumps — Safety and environmental requirements — Part 4: Operation, maintenance, repair and recovery*

EN 809:1998, *Pumps and pump units for liquids — Common safety requirements*

EN 837-1:1996, *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 953:1997, *Safety of machinery — Guards* **SIS General requirements for the design and construction of fixed and movable guards**

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EN 1050:1996, *Safety of machinery — Principles for risk assessment*

EN 1290:1998, *Non-destructive examination of welds — Magnetic particle examination of welds*

EN 1435:1997, *Non-destructive examination of welds — Radiographic examination of welded joints*

EN 1714:1997, *Non-destructive examination of welds — Ultrasonic examination of welded joints*

EN 1736:2000, *Refrigerating systems and heat pumps — Flexible pipe elements, vibration isolators and expansion joints — Requirements, design and installation*

EN 1779:1999, *Non-destructive testing — Leak testing — Criteria for method and technique selection*

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

EN 12178:2003, *Refrigerating systems and heat pumps — Liquid level indicating devices — Requirements, testing and marking*

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

EN 12284:2003, *Refrigerating systems and heat pumps — Valves — Requirements, testing and marking*

EN 12517-1:2006, *Non-destructive examination of welds — Part 1: Evaluation of welded joints in steel, nickel, titanium and their alloys by radiography — Acceptance levels*

prEN 12517-2:2006, *Non destructive testing of welds — Part 2: Evaluation of welded joints in aluminium and its alloys by radiography — Acceptance levels*

prEN 12693:2006, *Refrigerating systems and heat pumps — Safety and environmental requirements — Positive displacement refrigerant compressors*

EN 12735-1:2001, *Copper and copper alloys — Seamless, round copper tubes for air conditioning and refrigeration — Part 1: Tubes for piping systems*

EN 12735-2:2001, *Copper and copper alloys — Seamless, round copper tubes for air conditioning and refrigeration — Part 2: Tubes for equipment*

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

EN 13136:2001, *Refrigerating systems and heat pumps — Pressure relief devices and their associated piping — Methods for calculation*

EN 13313:2001, *Refrigerating systems and heat pumps — Competence of personnel*

EN 13445-1:2002, *Unfired pressure vessels — Part 1: General*

EN 13445-2:2002, *Unfired pressure vessels — Part 2: Materials*

EN 13445-3:2002, *Unfired pressure vessels — Part 3: Design*

EN 13445-4:2002, *Unfired pressure vessels — Part 4: Fabrication*

EN 13445-5:2002, *Unfired pressure vessels — Part 5: Inspection and testing*

EN 13445-6:2002, *Unfired pressure vessels — Part 6: Requirements for the design and fabrication of pressure vessels and pressure parts constructed from spheroidal graphite cast iron*

EN 13445-8:2006, *Unfired pressure vessels — Part 8: Additional requirements for pressure vessels of aluminium and aluminium alloys*

EN 13480-1:2002, *Metallic industrial piping — Part 1: General*

EN 13480-2:2002, *Metallic industrial piping — Part 2: Materials*

EN 13480-3:2002, *Metallic industrial piping — Part 3: Design and calculation*

EN 13480-4:2002, *Metallic industrial piping — Part 4: Fabrication and installation*

EN 13480-5:2002, *Metallic industrial piping — Part 5: Inspection and testing*

EN 13480-6:2004, *Metallic industrial piping — Part 6: Additional requirements for buried piping*

EN 13480-8:2007, *Metallic industrial piping — Part 8: Additional requirements for aluminium and aluminium alloy piping*

EN 14276-1:2006, *Pressure equipment for refrigerating systems and heat pumps — Part 1: Vessels — General requirements*

EN 14276-2:2007, *Pressure equipment for refrigerating systems and heat pumps — Part 2: Piping — General requirements*

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

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EN 60335-1:2002, *Household and similar electrical appliances — Safety — Part 1: General requirements* (IEC 60335-1:2001, modified)

EN 60335-2-24:2003, *Household and similar electrical appliances — Part 2-24: Particular requirements for refrigerating appliances, ice-cream appliances and ice-makers* (IEC 60335-2-24:2002)

EN 60335-2-34:2002, *Household and similar electrical appliances — Safety — Part 2-34: Particular requirements for motor-compressors* (IEC 60335-2-34:2002)

EN 60335-2-40:2003, *Household and similar electrical appliances — Safety — Part 2-40: Particular requirements for electrical heatpumps, air-conditioners and dehumidifiers* (IEC 60335-2-40:2002, modified)

EN 60335-2-89:2002, *Household and similar electrical appliances — Safety — Part 2-89: Particular requirements for commercial refrigerating appliances with an incorporated or remote refrigerant condensing unit or compressor* (IEC 60335-2-89:2002)

EN 61000-6-1:2007, *Electromagnetic compatibility (EMC) — Part 6-1: Generic standards — Immunity for residential, commercial and light-industrial environments* (IEC 61000-6-1:2005)

EN 61000-6-2:2005, *Electromagnetic compatibility (EMC) — Part 6-2: Generic standards — Immunity for industrial environments* (IEC 61000-6-2:2005)

EN 61000-6-3:2007, *Electromagnetic compatibility (EMC) — Part 6-3: Generic standards — Emission standard for residential, commercial and light-industrial environments* (IEC 61000-6-3:2006)

EN 61000-6-4:2007, *Electromagnetic compatibility (EMC) — Part 6-4: Generic standards — Emission standard for industrial environments* (IEC 61000-6-4:2006)

EN ISO 3744:1995, *Acoustics — Determination of sound power levels of noise sources using sound pressure — Engineering method in an essentially free field over a reflecting plane* (ISO 3744:1994)

EN ISO 3746:1995, *Acoustics — Determination of sound power levels of noise sources using sound pressure — Survey method using an enveloping measurement surface over a reflecting plane* (ISO 3746:1995)

EN ISO 4126-1:2004, *Safety devices for protection against excessive pressure — Part 1: Safety valves* (ISO 4126-1:2003)

EN ISO 4126-2:2003, *Safety devices for protection against excessive pressure — Part 2: Bursting disc safety devices* (ISO 4126-2:2003)

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

EN ISO 11202:1995, *Acoustics — Noise emitted by machinery and equipment — Measurement of emission sound pressure levels at a work station and at other specified positions — Survey method in situ* (ISO 11202:1995)

EN ISO 11688-1:1998, *Acoustics — Recommended practice for the design of low-noise machinery and equipment — Part 1: Planning* (ISO TR 11688-1:1995)

EN ISO 12100-1:2003, *Safety of machinery — Basic concepts, general principles for design — Part 1: Basic terminology, methodology* (ISO 12100-1:2003)

EN ISO 12100-2:2003, *Safety of machinery — Basic concepts, general principles for design — Part 2: Technical principles* (ISO 12100-2:2003)

EN ISO 13732-1:2006, *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 13849-1:2006, *Safety of machinery — Safety-related parts of control systems — Part 1: General principles for design (ISO/DIS 13849-1:2006)*

EN ISO 13850:2006, *Safety of machinery — Emergency stop — Principles for design (ISO 13850:2006)*

ISO 817:2005, *Refrigerants — Designation system*

ASTM D 4728:2006, *Standard Test Method for Random Vibration Testing of Shipping Containers*

3 Terms, definitions, designations, classification and abbreviations

3.1 Terms and definitions

For the purposes of this document, the terms and definitions given in EN 378-1:2008 apply.

3.2 Designations and classification

Designation and classification of the refrigerant such as:

- refrigerant number, e.g. R 717 and
- safety groups A1, A2, A3, B1, B2, B3

are specified in EN 378-1:2008, Annex E.

3.3 Abbreviations

DN	Nominal size (see EN 378-1:2008, 3.5.17)
PS	Maximum allowable pressure in bar (1 bar = 0,1 MPa) (see EN 378-1:2008, 3.3.2)
LFL	Lower flammability limit in kg/m ³

4 Significant hazards

The list of significant hazards related to the Machinery Directive is given in Annex D.

5 Safety requirements and/or measures

5.1 General safety and/or environmental requirements

5.1.1 General

Safety and environmental requirements are specified in 5.2 and Clause 6.

Refrigerating appliances complying with the product standards such as

- EN 60335-2-40 for electrical heat pumps, air-conditioners and dehumidifiers,
- EN 60335-2-24 for refrigerating appliances, ice-cream appliances and ice-makers and
- EN 60335-2-89 for commercial refrigerating appliances with an incorporated or remote refrigerant condensing unit or compressor

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are in compliance with this European Standard up to and including category I as determined in Annex B. For refrigerating appliances of category II and higher, as determined in Annex B, the relevant requirements for pressure safety in 5.2 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 B.5 are indicated in 5.3.

Where the product standards for components or piping are not harmonised for the EC provisions in relation to pressure or if the essential requirements of such provisions are not covered then, if relevant, compliance of such components or piping shall be proved and by risk assessment assure that the relevant requirements for pressure are met.

If the relevant standards for those components listed in Table 1 does not cover requirements for electrical safety, than the electrical parts/ systems of these components shall fulfil the requirements for electrical safety as defined in EN 60335-2-40, EN 60335-2-24, EN 60335-2-89 or EN 60204-1 as relevant.

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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 or EN 13445 if applicable combined with 5.2.2 of this standard
Plate heat exchangers	EN 14276-1 or EN 13445 if applicable combined with 5.2.2 of this standard
Headers and coils with air as secondary fluid	EN 14276-2 combined with 5.2.2.2 of this standard
Receiver/accumulator/economiser	EN 14276-1 or EN 13445 if applicable combined with 5.2.2 of this standard
Oil separator	EN 14276-1 or EN 13445 if applicable combined with 5.2.2 of this standard
Drier	EN 14276-1 or EN 13445 if applicable combined with 5.2.2 of this standard
Filter	EN 14276-1 or EN 13445 if applicable combined with 5.2.2 of this standard
Muffler	EN 14276-1 or EN 13445 if applicable combined with 5.2.2 of this standard
Hermetic positive displacement compressor	EN 60335-2-34 or prEN 12693
Semi hermetic positive displacement compressor	EN 60335-2-34 or prEN 12693
Open positive displacement compressor	prEN 12693
Non positive displacement compressor	EN 14276-1 or EN 13445 if applicable combined with EN 60204-1
Pump General requirements	EN 809 combined with EN 60204-1, and combined with 5.2.2.2 and 5.2.2.5 of this standard Annex A
Additional requirements for pumps in refrigerating systems and heat pumps with R717	
Piping	EN 14276-2 or EN 13480-1
piping joints	EN 14276-2
permanent joints	5.2.2.2 and 5.2.2.3 of this standard
detachable joints	
Flexible piping	EN 1736
Valves	EN 12284
safety valve	EN 13136 and EN ISO 4126-1 combined with 5.2.2 of this standard
safety switching devices for limiting the pressure	EN 12263 combined with 5.2.2.2 of this standard
isolating valves	EN 12284
hand operated valves	EN 12284
valves with seal cap	EN 12284
Bursting disc	EN ISO 4126-2 and EN 13136 combined with 5.2.2.2 of this standard
Fusible plug	EN 13136 combined with 5.2.2.2 and 5.2.2.4 of this standard
Liquid level indicators	EN 12178 combined with 5.2.2.2 of this standard
Gauges	EN 837-1, EN 837-2 and EN 837-3 combined with 5.2.2.2 of this standard
Brazing and soldering materials	5.3.1.3 e), f) of this standard
Welding materials	EN 14276-2

If the component contains electrical components, and if the component standard does not cover electrical safety, then the component shall fulfil the electrical requirements of EN 60335-2-40, EN 60335-2-24, EN 60335-2-89 or EN 60204-1 as relevant.

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NOTE Components that are declared to comply with the relevant directives using a method alternative to the above standards also comply with the requirements of this standard.

5.2.2 Specific requirements**5.2.2.1 General**

In addition to the requirements of 5.2.1, following requirements are applicable for incorporation of specific components and piping into the refrigerating system.

5.2.2.2 Tightness

If no test procedure is specified in the component standard, the tightness shall be assured by testing using a test method appropriate for the component and refrigerant, for details see 6.3.4.

When required, some or all tests may be executed on the assembly (refer to 6.3).

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

NOTE For guidance refer also to EN 1779:1999.

5.2.2.3 Piping joints

Joints shall be designed so that they will not be damaged due to the 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 Fusible plugs

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The nominal melting temperature and work pressure of the fusible material shall be stamped on the non-fusible portion of the plug.

5.2.2.5 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) design pressure or 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 in combination with refrigerating systems and heat pumps as specified by the manufacturer of the refrigerant systems and heat pumps. The relevant standards have to be considered.

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

NOTE For example as required in 76/769/EC ("dangerous substances") and 2002/95/EC (RoHS).

5.3.1.2 Ferrous materials

The material of the component shall be suitable for the specified temperature and pressure range and combination with the refrigerants applicable for that part.

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 standard.

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

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

b) Steel, cast steel, carbon steel and low alloy steel

Steel, cast steel, carbon steel and low alloy steel may be used for all parts carrying refrigerant and also for heat transfer medium circuits. Where there is a combination of low temperatures and high pressure and/or where corrosion risks and/or thermal stresses are present, steel with adequate impact strength shall be used paying regard to thickness, the lowest operating temperature and its welding properties.

c) High alloy steel

High alloy steel may be required where there is a combination of low temperatures and high pressure and/or where corrosion risks and/or thermal stresses are present. The impact strength shall be adequate for the particular duty and the material suitable for welding, if required.

d) 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, e.g. sodium chloride (NaCl), sulphuric acid (H₂SO₄).

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

The material of the component shall be suitable for the specified temperature and pressure range and combination with the refrigerants applicable for that part.

a) Copper and copper alloys

Copper in contact with refrigerants shall be oxygen-free or de-oxidized (refer to EN 12735-1 and EN 12735-2).

Copper and alloys with a high percentage of copper shall not be used for parts carrying R717 unless their compatibility has been proved by test or experience.