SLOVENSKI STANDARD

SIST EN 14276-1:2007

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Tlaļ na oprema za hladilne sisteme in toplotne ļ rpalke - 1. del: Posode - Sploġne zahteve

Pressure equipment for refrigerating systems and heat pumps - Part 1: Vessels - General requirements

Druckgeräte für Kälteanlagen und Wärmepumpen - Teil 1: Behälter - Allgemeine Anforderungen

Equipements sous pression pour systemes de réfrigération et pompes a chaleur - Partie 1: Récipients - Exigences générales

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English Version

Pressure equipment for refrigerating systems and heat pumps - Part 1: Vessels - General requirements

Appareils à pression pour systèmes de réfrigération et de pompes à chaleur - Partie 1: Récipients - Prescriptions générales

Druckgeräte für Kälteanlagen und Wärmepumpen - Teil 1: Behälter - Allgemeine Anforderungen

This European Standard was approved by CEN on 24 May 2006.

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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 Central Secretariat has the same status as the official versions.

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Contents

Foreword

This document (EN 14276-1:2006) 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of an identical text or by endorsement, at the latest by January 2007, and conflicting national standards shall be withdrawn at the latest by January 2007.

This document has been prepared under a mandate given to CEN by the European Commission and the European Free Trade Association to support Essential Requirements of EU Directive 97/23/EC concerning Pressure Equipment.

For relationship with EU directive 97/23/EC see informative Annex ZA, which is an integral part of this document.

This document consists of the following parts under the general title "*Pressure equipment for refrigerating systems and heat pumps*":

Part 1: Vessels – General requirements

Part 2: Piping – General requirements

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

Introduction

This standard recognises the unique nature of vessels for refrigerating systems or heat pumps and is intended to address the specific needs of the refrigeration and heat pump industry. This standard should be read in conjunction with the various parts of EN 13445.

When the text of this standard modifies or supplements a clause within EN 13445, then this standard should prevail. Where this standard does not modify or supplement the requirements of a clause, the requirements of EN 13445 should prevail.

The unique nature of a refrigerating system is defined as follows:

a) the purpose of the refrigerating system is to extract and reject heat (this involves both cooling and heating);

b) to operate the refrigerating system a pressure-imposing element (e.g. a compressor or an energy source) is necessary;

c) the refrigerating system has a defined refrigerant charge in a closed circuit;

d) the refrigerant has a chemical composition and purity defined in the relevant standards;

e) the pressure of the refrigerant decreases when the temperature decreases (see typical curve in Annex A of this standard);

f) due to the maximum temperature limit of 200 °C and the maximum pressure limit of 64 bar, the time dependant creep and fatigue due to pressure variation or vibrations are not significant design factors except for some materials such as aluminium, copper and titanium where the fatigue shall be taken into account;

g) the risk of overpressure is due to:

- the pressure imposing element;
- an external heat source (e.g. fire or hot water);
- improper operation.

h) the refrigerating system is designed to minimise refrigerant emissions and the ingress of contaminants.

Only hermetic compressors are covered by this standard.

1 Scope

This European Standard specifies the requirements for material, design, manufacturing, testing and documentation for stationary pressure vessels intended for use in refrigerating systems and heat pumps. These systems are referenced in this standard as refrigerating systems as defined in EN 378-1.

This European Standard applies to vessels including welded or brazed attachments up to and including the nozzle flanges, screwed, welded or brazed connectors or to the edge to be welded or brazed at the first circumferential joint connecting piping or other elements.

This European Standard applies to pressure vessels with an internal pressure down to – 1 bar, to account for the evacuation of the vessel prior to charging with refrigerant.

This European Standard applies to both the mechanical loading conditions and thermal conditions as defined in EN 13445-3 associated with refrigerating systems. It applies to pressure vessels subject to the maximum allowable temperatures for which nominal design stresses for materials are derived using EN 13445-2 and EN 13445-3 or as specified in this standard. In addition vessels designed to this standard should have a maximum design temperature not exceeding 200 °C and a maximum design pressure not exceeding 64 bars. Outside of these limits, it is important that EN 13445 be used for the design, construction and inspection of the vessel. Under these circumstances it is important that the unique nature of refrigerating plant, as indicated in the introduction to this standard, also be taken into account.

It is important that pressure vessels used in refrigerating systems and heat pumps of category less than II as defined in Annex H comply with other relevant clauses of EN 378-2 for vessels.

This European Standard applies to pressure vessels where the main pressure bearing parts are manufactured from metallic ductile materials as defined in Clause 4 and Annex I of this standard.

This European Standard does not apply to vessels of the following types:

- vessels of riveted construction;
- multilayered, autofrettaged or prestressed vessels;
- vessels directly heated by a flame;
- « roll bond » heat exchangers.

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 287-1:2004, *Qualification test of welders — Fusion welding — Part 1: Steels*

EN 378-1:2000, *Refrigerating systems and heat pumps — Safety and environmental requirements — Part 1: Basic requirements, definitions, classification and selection criteria*

EN 378-2:2000, *Refrigerating systems and heat pumps — Safety and environmental requirements — Part 2: Design, construction, testing, marking and documentation*

EN 378-4:2000, *Refrigerating systems and heat pumps — Safety and environmental requirements — Part 4: Operation, maintenance, repair and recovery*

EN 764-1:2004, *Pressure equipment - Part 1: Terminology - Pressure, temperature, volume, nominal size*

EN 764-2:2002, *Pressure equipment — Part 2: Quantities, symbols and units*

EN 764-3:2002, *Pressure equipment — Part 3: Definition of parties involved*

EN 764-4:2002, *Pressure equipment — Part 4: Establishment of technical delivery conditions for metallic materials*

EN 764-5:2002, *Pressure equipment — Part 5: Compliance and inspection documentation of materials*

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

EN 910:1996, *Destructive tests on welds in metallic materials — Bend tests*

EN 1005-2:2003, *Safety of machinery — Human physical performance — Part 2: Manual handling of machinery and component parts of machinery*

EN 1044:1999, *Brazing - Filler metals*

EN 1045:1997, *Brazing — Fluxes for brazing — Classification and technical delivery conditions*

EN 1173:1995, *Copper and copper alloys — Material condition or temper designation*

EN 1418:1997, *Welding personnel — Approval testing of welding operators for fusion welding and resistance weld setters for fully mechanized and automatic welding of metallic materials*

EN 10002-1:2001, *Metallic materials — Tensile testing — Part 1: Method of test at ambient temperature*

EN 10111:1998, *Continuously hot-rolled low carbon steel sheet and strip for cold forming — Technical delivery conditions*

EN 10130:1991 + A1:1998 , *Cold-rolled low carbon steel flat products for cold forming — Technical delivery conditions*

EN 10160:1999, *Ultrasonic testing of steel flat product of thickness equal or greater than 6 mm (reflection method)*

EN 10164:2004, *Steel products with improved deformation properties perpendicular to the surface of the product — Technical delivery conditions*

EN 10204:2004, *Metallic products — Types of inspection documents*

EN 12517:1998 + A1:2002 + AC :2003, *Non-destructive examination of welds — Radiographic examination of welded joints — Acceptance levels*

EN 12797:2000 + A1:2003, *Brazing — Destructive tests of brazed joints*

EN 12799:2000 + A1:2003, *Brazing — Non-destructive examination of brazed joints*

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 + A2:2005, *Unfired pressure vessels — Part 5: Inspection and testing*

EN 13445-6:2002 + A1:2004, *Unfired pressure vessels — Part 6: Requirements for the design and fabrication of pressure vessels and pressure vessel parts constructed from spheroidal graphite cast iron*

prEN 13445-8:2003, *Unfired pressure vessels – Part 8: Additional requirements for pressure vessels of aluminium and aluminium alloys*

EN 22553:1994, *Welded, brazed and soldered joints — Symbolic representation on drawings (ISO 2553:1992)*

EN ISO 3677:1995, *Filler metal for soft soldering, brazing and braze welding — Designation (ISO 3677:1992)*

EN ISO 4063:2000, *Welding and allied processes — Nomenclature of processes and reference numbers (ISO 4063:1998)*

EN ISO 7438:2005, *Metallic materials - Bend test (ISO 7438:2005)*

EN ISO 10012:2003, *Measurement management systems — Requirements for measurement processes and measuring equipment (ISO 10012:2003)*

EN ISO 15607:2003, *Specification and qualification of welding procedures for metallic materials — General rules (ISO 15607:2003)*

EN ISO 15609-1:2004, *Specification and qualification of welding procedures for metallic materials — Welding procedure specification — Part 1: Arc welding (ISO 15609-1:2004)*

EN ISO 15611:2003, *Specification and qualification of welding procedures for metallic materials — Qualification based on previous welding experience (ISO 15611:2003)*

EN ISO 15612:2004, *Specification and qualification of welding procedures for metallic materials — Qualification by adoption of a standard welding procedure (ISO 15612:2004)*

EN ISO 15614-1:2004, *Specification and qualification of welding procedures for metallic materials — Welding procedure test — Part 1: Arc and gas welding of steels and arc welding of nickel and nickel alloys (ISO 15614-1:2004)*

EN ISO 15614-8:2002, *Specification and qualification of welding procedures for metallic materials — Welding procedure test — Part 8: Welding of tubes to tube-plate joints (ISO 15614-8:2002)*

ISO 817:2005, *Refrigerants – Designation system*

ISO 857-1:1998, *Welding and allied processes — Vocabulary — Part 1: Metal welding processes*

ISO 5187:1985, *Welding and allied processes — Assemblies made with soft solders and brazing filler metals — Mechanical test methods*

3 Terms and definitions

For the purposes of this document, the terms and definitions listed in EN 378-1:2000, EN 764-1:2004, EN 764-2:2002, EN 764-3:2002, EN 764-4:2002 EN 764-5:2002, ISO 857-1:1998 and the following apply.

3.1 Definitions

3.1.1 Temperatures stress cases

3.1.1.1
min $t_{0\ 100}$
lowest temperature at which pressurised parts are allowed to be used at a stress of up to 100 % of the design stress at 20 °C (standard design stress)

3.1.1.2
min $t_{0\ 75}$
lowest temperature at which pressurised parts are allowed to be used when their stress is a maximum of 75 % of the design stress at 20 °C (reduced stress)

3.1.1.3
min $t_{0\ 50}$
lowest temperature at which pressurised parts are allowed to be used when their stress is a maximum of 50 % of the design stress at 20 °C (medium stress)

3.1.1.4
min $t_{0\ 25}$
lowest temperature at which pressurised parts are allowed to be used when their stress is a maximum of 25 % of the design stress at 20 °C (low stress)

3.1.2
corrosion
all forms of material wastage (e.g. oxidation, erosion, wear and abrasion)

3.1.3
material safety data sheet
document which gives all necessary information for prevention, safety, storage, transportation, labelling, use and disposal of substances and preparations which have a risk for health, safety or environment

3.1.4
maximum design temperature
highest temperature that can occur during operation or standstill of the refrigerating system or during testing under test conditions

NOTE This temperature is equivalent to the maximum allowable temperature as defined in article 1.2.4 of the PED.

3.1.5
minimum design temperature
lowest temperature that can occur during operation or standstill of the refrigerating system or during testing under test conditions

NOTE This temperature is equivalent to the minimum allowable temperature as defined in article 1.2.4 of the PED.

3.1.6
main pressure bearing part
components of the vessel retaining the pressure and contributing to the vessel strength such as shell, tubesheet, end plate, dished ends, connection or fitting

3.1.7
volume
internal volume of a compartment ready for operation, including the volume of nozzles to the first connection (flange, coupling, weld, braze) and excluding the volume of permanent internal part

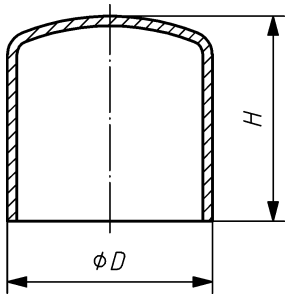
3.1.8
« roll bond » heat exchanger
heat exchanger consisting of two plates which are weld-bonded together with the exception of the printed circuit forming the refrigerant passage which is obtained by inflation under pressure

3.1.9
maximum operating pressure
maximum pressure which the vessel can withstand without the operation of any safety accessory with a continuous operation of the pressure generator (compressor, heat source...)

NOTE This pressure determines the maximum operating conditions for equipment users.

3.1.10
maximum standstill pressure
maximum pressure which the vessel can withstand without operation of any safety accessory when the pressure generator is not in operation. This pressure occurs during transportation, storage or shut down of the pressure generator

3.1.11
deep drawing
process of forming by stamping when the ratio of depth (H) by diameter (D) is greater than or equal to 0,45, see Figure 1



Key
H depth
D diameter

Figure 1 — Deep drawing

3.1.12
manual brazing
brazing operation performed and controlled by hand

3.1.13
semi-automatic brazing
brazing with equipment which controls only the brazing filler metal feed.

NOTE The advance of the brazing is manually controlled

3.1.14
machine brazing
brazing with equipment which performs the brazing operation under the constant control of a brazing operator

3.1.15
automatic brazing
brazing with equipment which performs the brazing operation without constant observation and adjustment by a brazing operator

3.1.16
brazer
person who performs a manual or semiautomatic brazing operation

3.1.17
brazing operator
person who operates a machine or automatic brazing equipment

3.1.18
semiautomatic expansion
expansion with equipment which controls the operation and where the operator manually introduces the equipment to the inside of the tube

3.1.19
machine expansion
expansion with equipment which performs the expansion operation under the constant control of operator

3.1.20
automatic expansion
expansion with equipment which performs the expansion operation without constant observation and adjustment by an expansion operator

3.1.21
expansion operator
person who makes an expansion joint

3.1.22
rolling
plastic cold forming of tubes by means of a tool which have several rolls turning during the operation

3.2 Symbols, quantities and units

Symbols, quantities and units used in this standard are listed in Table 1.

Table 1 — Symbols, quantities and units

Symbol	Quantity	Unit
A	elongation after fracture	%
A_t	strengthened area tube side	mm²
A_V	strengthened	mm²
A_W	effective area of expanded joint	mm²
c	corrosion allowance	mm
d_{tube}	nominal outside diameter of tubes	mm
d_e	external diameter of tube	mm
d_i	internal diameter of tube	mm
D_s	internal shell diameter	mm
DN	Nominal diameter	—
e	thickness	mm
e_{act}	actual thickness	mm
e_b	brazing joint size of tube in the tubesheet	mm
e_W	welding joint size of tube in the tubesheet	mm
e_n	nominal thickness	mm
E_{tube}	Elasticity modulus for tube material at design temperature	MPa
f	nominal design stress at design temperature	MPa
f_{tube}	nominal design stress of tube material at design temperature t °C	MPa
f_{ttest}	nominal design stress at test temperature t °C	MPa
F_s	tube force generated by shell side	N
F_{tube}	tube force generated by tube side	N
l_{tx}	expanded length on tube inside tubesheet	mm
l_k	unsupported tube length	mm
L_0	gauge length for tensile test	mm
N_{tube}	Number of tube for a tubular heat exchanger	—
p	tube pitch for tubesheet	mm
P_c	calculation pressure (in formula, P_c can be replaced by P)	MPa or bar[a]
P_d	design pressure	MPa or bar[a]
$P_{(max)}$	maximum design pressure	MPa or bar[a]
PS	maximum allowable pressure	MPa or bar[a]
P_{test}	test pressure	MPa or bar[a]
P_v	shell side calculation pressure	MPa or bar[a]
P_{tube}	tube side calculation pressure	MPa or bar[a]
PED	Pressure Equipment Directive n° 97/23/EC	—
Q_{tube}	tube force due to tube side	N
Q_V	tube force due to tubesheet	N

Table 1 *(continued)*

Symbol	Quantity	Unit
R_{eH}	upper yield strength	MPa
R_m	tensile strength	MPa
$R_{m\ min}$	minimum tensile strength	MPa
$R_{m\ avg}$	average value of tensile strength of several test specimens	MPa
$R_{m\ max}$	maximum tensile strength specified in the standard	MPa
$R_{m/t}$	tensile strength at temperature t °C	MPa
$R_{m/ttest}$	tensile strength at test temperature t °C	MPa
$R_{p\ avg}$	average value of proof strength of several test specimens	MPa
$R_{p0,2}$	0,2 % proof strength	MPa
$R_{p0,2/t}$	0,2 % proof strength at temperature t °C	MPa
$R_{p0,2/ttest}$	0,2 % proof strength at test temperature t °C	MPa
$R_{p1,0}$	1,0 % proof strength	MPa
$R_{p1,0/t}$	1,0 % proof strength at temperature t °C	MPa
$R_{p1,0/ttest}$	1,0 % proof strength at test temperature t °C	MPa
S_0	original cross section area	mm^2
S_F	safety factor	—
t_c	calculation temperature	°C
t_d	design temperature	°C
t_{ha}	temperature of heat absorbing fluid	°C
t_{he}	temperature of heat emitting fluid	°C
z	joint coefficient	—
α	thermal expansion	—
δ_e	negative wall thickness tolerance	mm
ν	Poisson's ratio	—
μ	basic ligament efficiency of the tubesheet	—

[a] 1 bar = 100 000 Pa = 0,1 MPa = 0,1 N/mm^2

4 Materials

4.1 General

The requirements for materials referenced in this standard shall conform to EN 13445-2, unless modified by the clauses of this section. This standard or reference to other relevant standards shall cover materials not included in EN 13445-2.

It is permitted to use non-metallic materials (e.g. gaskets, coatings, insulating materials, sightglasses) provided they are compatible with the other materials, refrigerants and lubricants present.