SLOVENSKI STANDARD
SIST EN 14276-1:2020/oprA1:2023

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Tlačna oprema za hladilne sisteme in toplotne črpalke - 1. del: Posode - Splošne zahteve - Dopolnilo A1

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

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

Équipements sous pression pour systèmes de réfrigération et pompes à chaleur - Partie 1 : Récipients - Exigences générales

Ta slovenski standard je istoveten z: **EN 14276-1:2020/prA1**

ICS:

23.020.32	Tlačne posode	Pressure vessels
27.080	Toplotne črpalke	Heat pumps
27.200	Hladilna tehnologija	Refrigerating technology

SIST EN 14276-1:2020/oprA1:2023 **en,fr,de**

EUROPEAN STANDARD
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ICS

English Version

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

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

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

This draft amendment A1, if approved, will modify the European Standard EN 14276-1:2020. If this draft becomes an amendment, CEN members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for inclusion of this amendment into the relevant national standard without any alteration.

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

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Contents

European foreword

This document (EN 14276-1:2020/prA1:2023) 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 is currently submitted to the CEN Enquiry.

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

For relationship with EU Directive(s) / Regulation(s), see informative Annex ZA, which is an integral part of this document.

1 Modification to Clause 1

Add the following sentence at the end of the second paragraph:

The term “copper” used in this document includes copper and copper alloys.

Update the following references throughout the clause:

— EN 378-1:2016+A1:2020;

— EN 13445-3:2021;

— EN 13445-2:2021.

2 Modification to Clause 2

Update the following references:

— EN 378-1:2016+A1:2020;

— EN 378-3:2016+A1:2020;

— EN 378-4:2016+A1:2019;

— EN 12735-1:2020;

— EN 12797:2000[1];

— EN 13445-1:2021;

— EN 13445-2:2021;

— EN 13445-3:2021;

— EN 13445-4:2021;

— EN 13445-5:2021;

— EN 13445-6:2021;

— EN 13445-8:2021;

— EN ISO 2553:2019;

— EN ISO 6892-1:2019;

— EN ISO 7438:2020;

— EN ISO 15607:2019;

— EN ISO 15609-1:2019;

[1] Document impacted by A1:2003.

— EN ISO 15609-2:2019;

— EN ISO 15614-1:2017[2];

— ISO 817:2014.[3]

Add the following references:

— 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)*

— EN ISO 18279:2003, *Brazing - Imperfections in brazed joints (ISO 18279:2003)*

3 Modification to Clause 3

Update the following reference:

— EN 378-1:2016+A1:2020

Add the following definition:

3.1.13
brazing
joining process using filler metal with a liquidus temperature above 450 °C and lower than that of the metals to be joined and wetting the parent metals

Replace definitions 3.1.13 to 3.1.18 with definitions 3.1.14 to 3.1.19:

3.1.14
manual brazing
brazing where the required brazing conditions are maintained by hand

3.1.15
semi-automatic brazing
brazing with equipment which controls only the brazing filler metal feed

Note 1 to entry: The advance of the brazing is manually controlled.

3.1.16
machine brazing
brazing where the required brazing conditions are maintained by mechanical or electronic means but may be manually varied during the process

3.1.17
automatic brazing
brazing in which all operations are performed without brazing operator intervention during the process

3.1.18
brazer
person who holds and manipulates the device for heating the brazing area by hand

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[2] Document impacted by A1:2019.

[3] Document impacted by A1:2017 and A2:2021.

3.1.19
brazing operator
person who controls or adjusts brazing parameters for mechanized brazing or sets up brazing parameters for automatic brazing

Add the following definitions:

3.1.20
brazing procedure specification
BPS
document that has been qualified and provides the required variables of the brazing procedure to ensure repeatability during production brazing

3.1.21
preliminary brazing procedure specification
pBPS
document containing the required variables of the brazing procedure which is not yet qualified

3.2.22
furnace brazing
brazing in which the workpiece, complete with preplaced filler metal, is raised to brazing temperature in a furnace which may contain a protective atmosphere

3.2.23
induction brazing
brazing in which heat is obtained by inducing medium- or high-frequency electric current within the metal in the neighbourhood of the joint

3.2.24
resistance brazing
brazing in which heat is obtained by:

— the passage of an electric current between the parts to be joined, as in resistance welding or

— the passage of an electric current through two electrodes of metals with high resistance and high melting point, e.g. carbon, molybdenum, tungsten, and the parts to be joined; the greater part of the brazing heat is generated in the electrodes and conducted to the joint

3.2.25
vacuum brazing
brazing in which the workpiece, complete with preplaced filler metal, is raised to brazing temperature in a vacuum chamber

3.2.26
braze welding
brazing in which a joint of the open type is obtained step by step, using a technique similar to fusion welding with a filler metal, the melting temperature of which is lower than that of the parent metal but higher than 450 °C, but neither using capillary action as in brazing nor intentionally melting the parent metal

3.1.33
filler metal(s)
added metal required for brazed joints

3.1.34
flux
non-metallic material which, when molten, promotes wetting by removing existing oxide or other detrimental films from the surfaces to be joined and prevents their re-formation during the joining operation

3.1.35
governing weld joint
main full penetration butt joint, the design of which, as a result of membrane stresses, governs the thickness of the component

Renumber the remaining definitions accordingly (3.1.19 to 3.1.24 are renumbered 3.1.36 to 3.1.41).

In Table 1, add a new column for units:

Table 1 — Symbols, descriptions and units

Symbol	Description	Unit
A	Elongation after fracture	%
A_t	Strengthened area tube side	mm²
A_V	Strengthened area in a tubesheet pattern	mm²
A_W	Effective area of expanded joint	mm²
BPAR	Brazing Procedure Approval Record	—
BPS	Brazing Procedure Specification	—
c	Corrosion allowance	mm
C	Joint clearance	—
D	Diameter	mm
DBA	Design by analysis	—
DBF	Design by formula	—
D_e	External diameter of shell or tube	mm
d_e	External diameter of branch/nozzle	mm
D_i	Internal diameter of shell or tube	mm
d_i	Internal diameter of branch/nozzle	mm
DN	Nominal diameter	—
D_s	Internal shell diameter, only applicable in shell and tube heat exchangers	mm
d_{tube}	Nominal outside diameter of tubes, only applicable in tubesheets (in the formulae, d_{tube} can be replaced by d_t)	mm
e	Thickness	mm
e_{act}	Actual thickness	mm
e_b	Brazing joint size of tube in the tubesheet	mm
e_{min}	Minimum material thickness given by a standard or any other technical document	mm

Symbol	Description	Unit
e_n	Nominal thickness	mm
EPAR	Expansion Procedure Approval Record	—
EPS	Expansion Procedure Specification	—
E_{tube}	Elasticity modulus for tube material at design temperature	MPa
EV	Essential Variables	—
e_W	Welding joint size of tube in the tubesheet	mm
f	Nominal design stress at design temperature	MPa
FB	Furnace brazing	—
F_s	Tube force generated by shell side	N
f_{ttest}	Nominal design stress at test temperature t °C	MPa
f_{tube}	Nominal design stress of tube material at design temperature t °C	MPa
F_{tube}	Tube force generated by tube side	N
H	Depth	mm
IB	Induction brazing	—
K	Safety factor	—
l	Actual lap length	—
L_0	Gauge length for tensile test	mm
L_k	Unsupported tube length	mm
l_{tx}	Expanded length on tube inside tubesheet	mm
min t_0	Stress case	—
NDT	Non Destructive Testing	—
NEV	Non-Essential Variables	—
N_{tube}	Number of tube for a tubular heat exchanger	—
p	Tube pitch for tubesheet	mm
$P_{(max)}$	Maximum design pressure	MPa or bar [a]
P_c	Calculation pressure (in the formulae, P_c can be replaced by P)	MPa or bar [a]
P_d	Design pressure	MPa or bar [a]
PED	Pressure Equipment Directive n° 2014/68/EU	—
PS	Maximum allowable pressure	MPa or bar [a]
P_{test}	Test pressure	MPa or bar [a]
P_{tube}	Tube side calculation pressure	MPa or bar [a]
P_v	Shell side calculation pressure	MPa or bar [a]
PWHT	Post Weld Heat Treatments	—
Q	Ratio of load	—

Symbol	Description	Unit
Q_{tube}	Tube force due to tube side (in the formulae, Q_{tube} can be replaced by Q_t)	N
Q_V	Tube force due to tubesheet	N
RB	Resistance brazing	—
R_{eH}	Upper yield strength	MPa
R_m	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
$R_{m\ min}$	Minimum tensile strength	MPa
$R_{m,tube}$	Tensile strength of tube	—
$R_{m/t}$	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	mm²
TB	Flame brazing	—
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
VB	Vacuum brazing	—
z	Joint coefficient for welds	—
α	Thermal expansion	—
δ_e	Negative wall thickness tolerance	mm
ν	Poisson's ratio	—
$\tau_{b,max}$	Maximum permissible shear strength of the brazing filler material	100 MPa
μ	Basic ligament efficiency of the tube sheet	—
[a] 1 bar = 100 000 Pa = 0,1 MPa = 0,1 N/mm².		

4 Modification to Clause 4

Update the following references throughout the clause:

— EN 13445-2:2021;

— EN 13445-6:2021;

In subclause 4.3.1.1, replace "Copper group: 31 to 35" with "Copper group: 31 to 38" and update the following reference:

Delete subclause 4.3.1.2 and renumber current subclause 4.3.1.3 accordingly.

Insert the following new clauses:

4.3.1.3 The minimum values for the elongation after fracture (A) specified for gauge length $L_0 = 5,65\sqrt{S_0}$ are:

— Steel for transverse direction: 14 %;

— Steel for longitudinal direction: 16 %;

— Aluminium and aluminium alloys: 14 %;

— Copper and copper alloys in wrought condition: 14 %;

— Copper alloys in cast condition: 12 %;

— Titanium: 14 %.

In case of tubular copper and copper alloy material where the elongation values fall below the values given above, their use shall be restricted to use within the following limits:

— $PS \times DN \leq 50\,000$ bar A > 5 %;

— $PS \times DN \leq 10\,000$ bar 3 % ≤ A ≤ 5 %.

4.3.1.4 When the gauge length is different from $L_0 = 5,65\sqrt{S_0}$ and for a non-proportional gauge length, the requirements of EN ISO 6892-1:2019 shall apply to determine the minimum value of elongation after fracture.

4.3.1.5 For steel, mechanical strength is given in EN 13445-2:2021. For other materials (e.g. aluminium, copper, copper alloys, titanium) mechanical strength is given in material standards or in Annex F.

The values specified at room temperature may be used for temperature equal to or less than 50 °C.

4.3.1.6 In Annex F, the following values are given in the table:

Table F.1 — Elastic Modulus: E x 10^{-3} MPa and Poisson's ratio

Table F.2 — Thermal expansion α (average value between 20 °C and Td)

4.3.1.7 The chemical composition shall be in accordance with the material specification.

4.3.2 Steel and Cast iron

4.3.2.1 Deep drawing

For deep drawing, the following steels are particularly suitable:

— EN 10130:2006, all grades excluding DC 01;

— EN 10111:2008: grade DD12, DD13, DD14.

After forming and possible heat treatment, the material selected shall have a minimum elongation of 14 % when measured as defined in 4.3.1.3, and the test sample is taken close to the edge of the end cap.

Other materials can be considered, provided they conform to this requirement.

4.3.2.2 Cladding

The base metal of clad materials shall be selected from steel groups listed in 4.3.1.1. The cladding materials may be selected from other material groups.

The requirements of EN 13445-2:2021, Annex D shall apply when the strength of the cladding material is included in the design calculation.

4.3.2.3 Lamellar tearing

With steel grades, where the vessel manufacturer perceives that there is a risk of lamellar tearing due to joint design and loading, one of the following solutions shall be employed:

— testing in accordance with EN 10164:2018 with a minimum value of Z15;

— ultrasonic inspection of the area where the joint is made. The minimum area to be inspected is a band of material equivalent to five times the weld joint width. The inspection shall be carried out to EN 10160:1999 with class S3 or E4 acceptance levels. The examination shall be conducted after manufacturing processes to the part in question are complete.

4.3.2.4 Prevention of brittle fracture

For pressure vessel made with steel material the allowed stress at the minimum allowable temperature is applied as per EN 13445-2:2021, Annex B, or Annex A of this document.

Annex A takes into account that due to the physical conditions during the phase change in refrigerating systems, the pressure in the refrigerant containing part of the vessel drops when the refrigerant temperature decreases. Thus at lower temperatures the stresses due to refrigerant pressure are always lower than the stresses at the design pressure according to the relevant table of EN 378-2:2016 (vapour pressure curve of a common refrigerant, see Figure A.1).

In the case of fluids without phase change, e.g. brine, the pressure does not change at low temperatures, therefore in Annex A, the permissible stress of the component parts is determined by higher safety factors (see Table A.1).

For steel materials listed in 4.3.1.1, the test temperature and the minimum value of the impact test energy measured on an ISO V notch bending test specimen are determined in accordance with EN 13445-2:20211, Annex B, or Annex A of this document.

For spheroidal cast iron, refer to EN 13445-6:20211 requirements.

The brittle fracture should be determined only when the material thickness can permit to make a test piece according to EN ISO 148-1 with a minimum section size 5 mm × 10 mm.

4.3.3 Aluminium and aluminium alloy

The aluminium, aluminium alloys are not susceptible to brittle fracture due to low temperature and no special provisions are necessary for their use to a minimum allowable temperature of – 196 °C.

4.3.4 Copper and copper alloy

4.3.4.1 The material specification shall specify the composition limits for all constituents, heat treatment and the appropriate mechanical properties for acceptance and other purposes.

The product forms in their delivery conditions shall be kept free from internal stresses that may lead to stress corrosion cracking.

When using copper-zinc alloys, for example, care shall be taken to ensure that they are adequately resistant to the media in question and that no hazardous chemical reactions take place.

When annealed in an atmosphere containing hydrogen (or, for example, when welding or brazing using a naked flame), product forms made of Cu-DHP shall not show any signs of hydrogen embrittlement.

4.3.4.2 Copper and copper alloys shall be ordered in material condition R or Y as defined in the material standard in accordance with the designation system given in EN 1173:2008.

4.3.4.3 The material resistance given in Table F.3 of Annex F can be used within the temperature limit of 200 °C.

4.3.4.4 Failure by lamellar tearing is not applicable to copper and copper alloys

4.3.4.5 The copper, copper alloys with the exception of alloy groups 32.2 and 35 are not susceptible to brittle fracture due to low temperature and no special provisions are necessary for their use to a minimum allowable temperature of –196 °C.

For these two groups, material properties shall be checked in material standards.

4.3.5 Titanium

Titanium is not susceptible to brittle fracture due to low temperature and no special provisions are necessary for their use to a minimum allowable temperature of –196 °C.

Renumber 4.5 as 4.4, and 4.4 as 4.5

5 Modification to Clause 5

In Table 2, replace the line for flammable gas with the following:

Table 2 — Dangerous fluids

Hazard class	Hazard statement
Flammable gases, category 1A, 1B and 2 Including unstable gases and Pyrophoric gas	H220, H221 H230, H231 H232

In note of Table 2, update the following reference:

— EN 378-1:2016+A1:2020.

6 Modification to Clause 6

Update the following reference throughout the clause:

— EN 13445-3:2021;

— EN 12735-1:2020;

— EN 13445-5:2021;

— EN 378-3:2016+A1:2020;

— EN 378-4:2016+A1:2019.

Add a new paragraph in 6.1:

Whenever the word “corrosion” is used in this standard it shall be taken to mean corrosion, oxidation, scaling, abrasion, erosion and all other forms of wastage.

A corrosion allowance is not required when corrosion can be excluded, either because the materials, including the welds, used for the pressure vessel walls are corrosion resistant relative to the contents and the loading or are reliably protected.

No corrosion allowance is required for heat exchanger tubes and other parts in similar heat exchanger duty, unless a specific corrosive environment requires one.

Replace 6.2.2 with the following:

6.2.2 Internal corrosion

For suitable material in contact with refrigerants internal corrosion is negligible and the minimum corrosion allowance shall be taken to be 0 mm if the refrigerant has the maximum allowable levels of contaminants according to Table 3.