SLOVENSKI STANDARD
oSIST prEN 13445-12:2019

01-maj-2019

Neogrevane (nekurjene) tlačne posode - 12. del: Dodatne zahteve za tlačne posode iz bakra in bakrovih zlitin

Unfired pressure vessels - Part 12: Additional requirements for pressure vessels of copper and copper alloys

Unbefeuerte Druckbehälter - Teil 12: Zusätzliche Anforderungen für Druckbehälter aus Kupfer und Kupferlegierungen

Récipients sous pression non soumis à la flamme - Partie 12 : Exigences complémentaires pour les récipients sous pression en cuivre et alliages de cuivre

Ta slovenski standard je istoveten z: **prEN 13445-12**

ICS:

23.020.32	Tlačne posode	Pressure vessels

oSIST prEN 13445-12:2019 **en,fr,de**

EUROPEAN STANDARD

NORME EUROPÉENNE

EUROPÄISCHE NORM

DRAFT
prEN 13445-12

May 2019

ICS 23.020.30

English Version

Unfired pressure vessels - Part 12: Additional requirements for pressure vessels of copper and copper alloys

Récipients sous pression non soumis à la flamme - Partie 12 : Exigences complémentaires pour les récipients sous pression en cuivre et alliages de cuivre

Unbefeuerte Druckbehälter - Teil 12: Zusätzliche Anforderungen für Druckbehälter aus Kupfer und Kupferlegierungen

This draft European Standard is submitted to CEN members for enquiry. It has been drawn up by the Technical Committee CEN/TC 54.

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, Former Yugoslav Republic of Macedonia, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey 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

This document (prEN 13445-12:2019) has been prepared by Technical Committee CEN/TC 54 “Unfired Pressure Vessels”, the secretariat of which is held by BSI.

This document is currently submitted to the CEN Enquiry.

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 EU Directive 2014/68/EU.

For relationship with EU Directive 2014/68/EU, see informative Annex ZA, which is an integral part of this document.

1 Scope

This Part 12 of EN 13445 series specifies requirements for unfired pressure vessels and their parts made of copper and copper alloys (see 5.2) in addition to the general requirements for unfired pressure vessels in EN 13445-1:2014 to EN 13445-5:2014.

NOTE 1 Cast materials are not included in this version. Details regarding cast materials will be subject to an amendment to or a revision of EN 13445 series.

NOTE 2 Soldered connections are presently not considered.

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.

EN 764-5:2014, *Pressure equipment — Part 5: Inspection documentation of metallic materials and compliance with the material specification*

EN 1653, *Copper and copper alloys — Plate, sheet and circles for boilers, pressure vessels and hot water storage units*

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

EN 13134:2000, *Brazing — Procedure approval*

EN 13445-1:2014, *Unfired pressure vessels — Part 1: General*

EN 13445-2:2014, *Unfired pressure vessels — Part 2: Materials*

EN 13445-3:2014, *Unfired pressure vessels — Part 3: Design*

EN 13445-4:2014, *Unfired pressure vessels — Part 4: Fabrication*

EN 13445-5:2014, *Unfired pressure vessels — Part 5: Inspection and testing*

EN 13445-8:2014, *Unfired pressure vessels — Part 8: Additional requirements for pressure vessels of aluminium and aluminium alloys*

FprEN 14276-1:2018, *Pressure equipment for refrigerating systems and heat pumps — Part 1: Vessels — General requirements*

EN ISO 3452 series, *Non-destructive testing — Penetrant testing (ISO 3452 series)*

EN ISO 9606-3, *Approval testing of welders — Fusion welding — Part 3: Copper and copper alloys (ISO 9606-3)*

EN ISO 10042, *Welding — Arc-welded joints in aluminium and its alloys — Quality levels for imperfections (ISO 10042)*

EN ISO 13585:2012, *Brazing — Qualification test of brazers and brazing operators (ISO 13585:2012)*

EN ISO 14732, *Welding personnel — Qualification testing of welding operators and weld setters for mechanized and automatic welding of metallic materials (ISO 14732)*

EN ISO 15614-6, *Specification and qualification of welding procedures for metallic materials — Welding procedure test — Part 6: Arc and gas welding of copper and its alloys (ISO 15614-6)*

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

EN ISO 17635, *Non-destructive testing of welds — General rules for metallic materials (ISO 17635)*

EN ISO 17636 series, Non-destructive testing of welds — Radiographic testing *(ISO 17636 series)*

EN ISO 17637, *Non-destructive testing of welds — Visual testing of fusion-welded joints (ISO 17637)*

CEN ISO/TR 15608:2013, *Welding — Guidelines for a metallic materials grouping system (ISO/TR 15608:2013)*

3 Terms, definitions, symbols and units

For the purposes of this document, the terms and definitions given in EN 13445-1:2014, EN 13445-2:2014, EN 13445-3:2014, EN 13445-4:2014, EN 13445-5:2014 and the following apply.

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

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

3.1
copper alloys
alloys which contain mainly copper and are classified in alloy groups 31 to 38 according to CEN ISO/TR 15608:2013

4 General requirements

The general requirements of EN 13445-1 shall apply.

5 Materials

5.1 General

The general requirements of EN 13445-2:2014 shall apply with the following additions/exclusions in 5.2 to 5.6.

The base materials listed in this European standard, additionally specified with the extra requirements given in this European standard, are suitable for and may be employed in the manufacture of pressure vessels conforming to prEN 13445-12.

NOTE Materials listed in this European standard can be used without European Approval of Materials (EAM) or Particular Material Appraisal (PMA).

5.2 Technical delivery conditions

5.2.1 General

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.

The use of these materials with > 70 % by mass of copper is not permitted in the presence of acetylene.

5.2.2 Materials in accordance with EN standards

The materials given in Annex B, Table B.1 can be used within the temperature limits for sheets, plates, seamless tubes, rods and forgings. The limits for the various product forms are given in Table B.1.

The data in Annexes C to E apply for the material conditions, mechanical properties and long-term elevated temperature strength properties.

NOTE For CuZn38Sn1As, the 1 % creep strain limit values are estimations on the basis of some orientation values.

The materials shall be supplied in accordance with the technical delivery conditions laid down in the respective material standards listed in Annex B, Table B.1. The materials shall be tested as specified in these material standards. Testing shall comprise at least chemical analysis and tensile testing (tensile strength, yield strength, elongation after fracture).

5.2.3 Particular Material Appraisals

Products made of other copper alloys and wrought copper alloys may be used after they have undergone a Particular Material Appraisal (PMA). Information shall be given on application limits, requirements, test conditions, marking and further processing (forming, heat treatment, welding, soldering). The materials shall meet the following requirements:

Only material having a minimum elongation after fracture A of not less than 10 % in its final fabricated state shall be used for the construction of pressure vessels.

Alternatively, the elongation at fracture A for materials subject to heat treatment shall display the values characterizing the materials, but for sheets, strips, plates and rods shall be at least 14 % regardless of the direction of the test specimen. If a test is only possible in the longitudinal direction, the elongation at fracture A shall be at least 16 %.

However, lower elongation values may also be applied provided that appropriate measures are taken to compensate for these lower values and the specific requirements are verifiable.

NOTE Examples for compensation:

— application of higher safety factors in design or of lower material strength values;

— performance of burst tests to demonstrate ductile material behaviour.

5.3 Material grouping system

Annex A of EN 13445-2:2014 is not applicable to pressure vessels of copper and copper alloys and is replaced by the Annexes A to G of this prEN 13445-12:2019.

The grouping system for copper and its alloys is shown in Table A.1.

5.4 Material documentation and material marking

Materials for pressure bearing parts compliant with the requirements of this European Standard shall be accompanied by inspection documentation in accordance with EN 10204:2004.

The type of inspection document shall be in accordance with EN 764-5:2014 and include a declaration of compliance to the material specification.

All products shall be marked or labelled as specified in the respective material standard. Marking or labelling shall contain at least:

— the manufacturer's symbol,

— the material symbol or material number,

— the production batch number

NOTE A production batch is defined as the volume of the semi-finished product of an order made from a material of identical delivery condition, identical dimensions and, where applicable, of the same melt that has been made continuously in the same production sequence and with the same production equipment.

5.5 Prevention of brittle fracture

EN 13445-2:2014, Annex B, is not applicable.

The lowest temperatures specified in Table B.1 of this document apply to unwelded parts.

Filler materials for permanent joints shall be selected to be suitable for the design temperature.

5.6 Lamellar tearing

Failure by lamellar tearing is not normally applicable to copper and copper alloys.

6 Design

6.1 General

All the design methods included in EN 13445-3:2014 shall apply, with the following amendments, given in 6.2 to 6.4.

Mechanical properties of copper and copper alloys are given in the Annexes B to G of this standard.

EN 13445-3:2014, Annex A and B, shall not be applied.

NOTE This could be subject to a future revision of or an amendment to this prEN 13445-12.

6.2 Design values

6.2.1 Tables F.1 to F.3 contain the permitted stress f.

The permitted stresses at room temperature apply up to 50 °C. For other temperatures, linear interpolation shall be carried out between the values given.

Table 6.2.1-1 — Nominal design stress for copper products except for seamless pipes from copper groups 31 and 34

Copper designation	Normal operating load cases	Testing and exceptional load cases
Copper group 31–32–33–34–35 (except Cu-DHP, R200 and R220) Elongation < 25 %	min (0,2 % proof stress/1,5 and 1 % creep strain limit/1,0)	Rp/Ttest/1,05
Copper group 31–32–33–34–35 (except Cu-DHP, R200 and R220) Elongation ≥ 25 %[a]	min (max (0,2 % proof stress/1,5 or 1,0 % proof stress/1,5), 1 % creep strain limit/1,0)	Rp/Ttest/1,05
Cu-DHP, R200 and R220	$R_{m/T}/3,5$	$R_{m/Ttest}/2,22$

[a] The 1,0 % proof stress may be used instead of the 0,2 % proof stress if the ratio of the 0,2 % proof stress to the tensile strength is ≤ 0,5 and the elongation at fracture in the transverse direction is at least 25 %, or at least 27 % in the longitudinal direction.

Table 6.2.1-2 — Nominal design stress for seamless pipes from copper groups 31 and 34

Material	Supplied temper	Design temper	Normal operating load cases	Testing and exceptional load cases
Cu-DHP	Y040, Y080	R220	$R_{m/T}/3$	$R_{m/T}/2,22$
	R200, R220, R250, R290, R360	R200	$R_{m/T}/3$	$R_{m/T}/2,22$
CuNi10Fe1Mn	R290, R310, R480	R290	$R_{p1,0/T}/1,3$	$R_{p1,0/T}/1,05$
CuNi30Mn1Fe	R370, R480	R370	$R_{p1,0/T}/1,3$	$R_{p1,0/T}/1,05$
CuFe2P	R370, R420	R300	$R_{m/T}/3$	$R_{m/T}/2,22$
CuFe2P	R300	R300[a]	$R_{m/T}/3$	$R_{m/T}/2,22$
		R300[b]	$R_{p1,0/T}/1,3$	$R_{p1,0/T}/1,05$

[a] Material according to EN 12735-1:2016.

[b] Material with enhanced strength properties according to FprEN 14276-1:2018, Table F.3.

6.2.2 For welded, brazed or heat-treated components, the basis for the calculation shall be the characteristic values of the material condition with the lowest characteristic values.

6.2.3 Table G.1 contains data on the modulus of elasticity. The scatter is ± 5 %.

6.3 Fixed tubesheets not uniformly perforated

This clause concerns flat tubesheets of shell and tube vessel types where the tubesheet is not uniformly perforated in a circular area or where the unperforated diametral rows exceed four times the tube pitch.

To supplement EN 13445-3:2014, Clause 13 for tubesheets which are not uniformly perforated, the design rules given in FprEN 14276-1:2018 may be applied.

6.4 Brazed lapped and T-joints

The design of brazed lapped and T-joints shall be in accordance with FprEN 14276-1:2018, Annex B.

6.5 Fatigue design

Fatigue design for over 500 full equivalent pressure cycles is not covered by this Part 12 for copper and copper alloy pressure vessels. For the determination of 500 full equivalent pressure cycles see EN 13445-3:2014, 5.4.2

NOTE This will be subject to a future revision of or an amendment to this Part 12.

7 Manufacture

7.1 General

EN 13445-4:2014 shall apply, with the following amendments, given in 7.2 to 7.11.

NOTE Not all welding processes are suitable for all copper alloys.

Welding consumables may be selected from EN ISO 17777 and EN ISO 24373.

7.2 Permanent joints

7.2.1 General

Permanent joints in the context of this Clause 7.2 are composed of the following:

— welded and brazed joints which contribute to the pressure resistance of the vessel;

— expansion joints which are mainly used for the junction of tubes into the tubesheet.

7.2.2 Permanent joint and operator qualification

The permanent joint procedure and operator shall be qualified as defined below.

7.2.3 Permanent joint operations and traceability

No production of permanent joints shall be commenced until the permanent joint process and operators have been qualified. The manufacturer shall have a procedure that allows the identification of the operators who produce the joints.

7.2.4 Qualification of welding procedures, welders and welding operators

For welding procedures the requirements of EN 13445-4:2014, 7.3, shall apply with the following modifications:

a) WPAR shall be in accordance with EN ISO 15614-6 and/or EN ISO 15614-8.

b) Annex B of EN 13445-2:2014 shall not apply.

For welders and welding operators the requirements in EN 13445-4:2014, 7.4, shall apply with the following modification:

Replace reference to EN ISO 9606-1 with EN ISO 9606-3.

7.2.5 Qualification of brazing procedures and brazers

For hand brazing and manual mechanical brazing, brazing procedures and brazer approvals shall be conducted in accordance with EN 13134:2000 and EN ISO 13585:2012.

The rules for fully automated furnace brazing shall be in accordance with FprEN 14276-1:2018.

Old approvals valid under the Directive 2014/68/EU or 97/23/EC already before publication of this standard retain their validity.

Note Brazing procedures qualified according to the rules described in FprEN 14276-1 are acceptable to be used under EN 13445 series.

7.2.6 Mechanical roller expansion

Mechanical roller expansion procedures and expansion operator approvals shall be conducted in accordance with FprEN 14276-1:2018, Annex K.

7.3 Preheat

Preheating may be required when welding some alloys above a certain thickness due to the high heat conductivity of the material. As the heat conductivity varies significantly with the composition, any preheat shall be specified.

Heating to 75 °C may be applied to remove condensation.

7.4 Production test, reference criteria

The requirements in EN 13445-4:2014, 8.2, are applicable with the following modifications:

a) Under d) in EN 13445-4:2014, 8.2: Replace reference to material groups 1.1, 1.2 and 8.1 with reference to all copper materials permitted by Clause 5 of this document.

b) Paragraphs a), c) and e) in EN 13445-4:2014, 8.2, are not applicable.

7.5 Extent of testing

The requirements of EN 13445-4:2014, 8.3, shall apply with the following modifications:

Table 8.3-1 shall be replaced by Table 7.5-1 below:

Table 7.5-1 — Testing of production test plates

Material Group	Thickness of test plate e[a] mm	Test specimens[b]
All	$e \leq 12$	1 FB, 1 RB, 1 TT, 1 Ma, 1 Mi
	$e > 12$	2 SB[c], 1 TT, 1Ma, 1Mi
[a] Thinner plate thickness. [b] The symbols for Table 7.5–1 are given in EN 13445-4:2014, Table 8.3–2. [c] SB = side bends		

7.6 Performance of test and acceptance criteria

The requirements in 8.4.1, 8.4.2, 8.4.5, 8.4.6, 8.4.7, 8.4.9 and 8.4.10 of EN 13445-4:2014 shall apply.

7.7 Forming of pressure parts

The following requirements shall apply:

— Cold forming: