



BSI Standards Publication

Unfired pressure vessels

Part 2: Materials

This is a preview of BS EN 13445-2:2021+A1:2023. Click here to purchase the full version from the ANSI store.

National foreword

This British Standard is the UK implementation of EN 13445-2:2021+A1:2023. It supersedes BS EN 13445-2:2021, which is withdrawn.

The start and finish of text introduced or altered by amendment is indicated in the text by tags. Tags indicating changes to CEN text carry the number of the CEN amendment. For example, text altered by CEN amendment A1 is indicated by **A1** **A1**.

The UK participation in its preparation was entrusted to Technical Committee PVE/1, Pressure Vessels.

A list of organizations represented on this committee can be obtained on request to its committee manager.

Contractual and legal considerations

This publication has been prepared in good faith, however no representation, warranty, assurance or undertaking (express or implied) is or will be made, and no responsibility or liability is or will be accepted by BSI in relation to the adequacy, accuracy, completeness or reasonableness of this publication. All and any such responsibility and liability is expressly disclaimed to the full extent permitted by the law.

This publication is provided as is, and is to be used at the recipient's own risk.

The recipient is advised to consider seeking professional guidance with respect to its use of this publication.

This publication is not intended to constitute a contract. Users are responsible for its correct application.

This publication has been prepared under a mandate given to the European Standards Organizations by the European Commission and the European Free Trade Association. It is intended to support requirements of the EU legislation detailed in the European Foreword. A European Annex, usually Annex ZA or ZZ, describes how this publication relates to that EU legislation.

For the Great Britain market (England, Scotland and Wales), if UK Government has designated this publication for conformity with UKCA marking (or similar) legislation, it may contain an additional National Annex. Where such a National Annex exists, it shows the correlation between this publication and the relevant UK legislation. If there is no National Annex of this kind, the relevant Annex ZA or ZZ in the body of the European text will indicate the relationship to UK regulation applicable in Great Britain. References to EU legislation may need to be read in accordance with the UK designation and the applicable UK law. Further information on designated standards can be found at www.bsigroup.com/standardsandregulation.

For the Northern Ireland market, UK law will continue to implement relevant EU law subject to periodic confirmation. Therefore Annex ZA/ZZ in the European text, and references to EU legislation, are still valid for this market.

UK Government is responsible for legislation. For information on legislation and policies relating to that legislation, consult the relevant pages of www.gov.uk.

This is a preview of BS EN 13445-2:2021+A1:2023. [Click here to purchase the full version from the ANSI store.](#)

© The British Standards Institution 2023
Published by BSI Standards Limited 2023

ISBN 978 0 539 28115 6

ICS 23.020; 23.020.20; 23.020.30; 23.020.32

Compliance with a British Standard cannot confer immunity from legal obligations.

This British Standard was published under the authority of the Standards Policy and Strategy Committee on 31 May 2021.

Amendments/corrigenda issued since publication

Date	Text affected
31 May 2023	Implementation of CEN amendment A1:2023
30 September 2023	Corrections to CEN cover page and European foreword

EUROPÄISCHE NORM

August 2023

ICS 23.020.30

English Version

Unfired pressure vessels - Part 2: Materials

Récipients sous pression non soumis à la flamme -
Partie 2: Matériaux

Unbefeuerte Druckbehälter - Teil 2: Werkstoffe

This European Standard was approved by CEN on 24 February 2021 and includes Amendment 1 approved by CEN on 21 February 2023 and Amendment 1 approved by CEN on 13 June 2023.

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. Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the CEN-CENELEC Management Centre or to any CEN member.

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-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.



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
1 Scope.....	4
2 Normative references.....	6
3 Terms, definitions, symbols and units	8
3.1 Terms and définitions	8
3.2 Symbols and units	10
4 Requirements for materials to be used for pressure-bearing parts	12
4.1 General.....	12
4.2 Special provisions	15
4.2.1 Special properties	15
4.2.2 Design temperature above 20 °C	15
4.2.3 Prevention of brittle fracture	15
4.2.4 Design properties in the creep range	16
4.2.5 Specific requirements for steels for fasteners.....	16
4.3 Technical delivery conditions	17
4.3.1 European Standards.....	17
4.3.2 European Approval for Materials.....	17
4.3.3 Particular material appraisals	17
4.3.4 Clad products.....	17
4.3.5 Welding consumables.....	17
4.4 Marking.....	17
5 Requirements for materials to be used for non-pressure parts	18
Annex A (normative) Grouping system for steels for pressure equipment	19
Annex B (normative) Requirements for prevention of brittle fracture at low temperatures.....	21
B.1 General.....	21
B.2 Material selection and impact energy requirements.....	22
B.2.1 Introduction	22
B.2.2 Method 1.....	22
B.2.3 Method 2.....	32
B.2.4 Method 3 — Fracture mechanics analysis.....	44
B.3 General test requirements.....	45
B.3.1 General.....	45
B.3.2 Sub-sized specimens	46
B.4 Welds	47
B.4.1 General.....	47
B.4.2 Welding procedure qualification	47
B.4.3 Production test plates	47
B.5 Materials for use at elevated temperatures	47
B.5.1 General.....	47
B.5.2 Materials.....	48
B.5.3 Welding procedure qualification and production test plates.....	48
B.5.4 Start up and shut down procedure	48
B.5.5 Pressure test	48

This is a preview of BS EN 13445-2:2021+A1:2023. [Click here to purchase the full version from the ANSI store.](#)

Annex C (informative) Procedure for determination of the weld creep strength reduction factor (WCSRF)	56
Annex D (informative) Technical delivery conditions for clad products for pressure purposes	57
D.1 Introductory note	57
D.2 Requirements for the material	57
D.3 Requirements for the deposited material	57
D.4 Qualification of the cladding procedure.....	58
D.5 Production tests	59
Annex E (informative) European steels for pressure purposes.....	61
E.1 European Standards for steels and steel components for pressure purposes.....	61
E.2 European standardised steels grouped according to product forms	62
Annex F (normative) Special provisions for materials and components	85
F.1 General	85
F.2 Mechanical properties and technical delivery conditions for fasteners in accordance with EN ISO 3506.....	85
F.2.1 Mechanical properties for austenitic bolts in accordance with EN ISO 3506-1	85
F.2.2 Delivery conditions for austenitic fasteners.....	86
Annex Y (informative) History of EN 13445-2	87
Y.1 Differences between EN 13445-2:2014 and EN 13445-2:2021.....	87
Annex ZA (informative) Relationship between this European Standard and the essential requirements of Directive 2014/68/EU aimed to be covered	88
Bibliography	89

This is a preview of BS EN 13445-2:2021+A1:2023. Click here to purchase the full version from the ANSI store.

European foreword

This document (EN 13445-2:2021+A1:2023) has been prepared by Technical Committee CEN/TC 54 “Unfired pressure vessels”, the secretariat of which is held by BSI.

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 February 2024, and conflicting national standards shall be withdrawn at the latest by February 2024.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN shall not be held responsible for identifying any or all such patent rights.

This document supersedes A1 EN 13445-2:2021 A1.

This document includes Amendment 1 approved by CEN on 21 February 2023.

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

This document has been prepared under a standardisation request addressed to [the relevant ESO] by the European Commission. The Standing Committee of the EFTA States subsequently approves these requests for its Member States.

For the relationship with EU Legislation, see informative Annex ZA, which is an integral part of this document.

The list of all parts in the EN 13445 series can be found on the CEN website.

Although these Parts may be obtained separately, it should be recognised that the Parts are inter-dependant. As such the manufacture of unfired pressure vessels requires the application of all the relevant Parts in order for the requirements of the Standard to be satisfactorily fulfilled.

Corrections to the standard interpretations where several options seem possible are conducted through the Migration Help Desk (MHD). Information related to the Help Desk can be found at <http://www.unm.fr/en13445@unm.fr>. A form for submitting questions can be downloaded from the link to the MHD website. After subject experts have agreed an answer, the answer will be communicated to the questioner. Corrected pages will be given specific issue number and issued by CEN according to CEN Rules. Interpretation sheets will be posted on the website of the MHD.

This document supersedes EN 13445-2:2014. This new edition incorporates the Amendments which have been approved previously by CEN members, and the corrected pages up to Issue 5 without any further technical change. Annex Y provides details of significant technical changes between this European Standard and the previous edition.

Amendments to this new edition may be issued from time to time and then used immediately as alternatives to rules contained herein. It is intended to deliver a new Issue of EN 13445:2021 each year, starting with the precedent as Issue 1, consolidating these Amendments and including other identified corrections.

Any feedback and questions on this document should be directed to the users’ national standards body. A complete listing of these bodies can be found on the CEN website.

This is a preview of BS EN 13445-2:2021+A1:2023. [Click here to purchase the full version from the ANSI store.](#)

According to the CEN-CENELEC Internal Regulations, the national standards organisations of the following countries are bound to implement this European Standard: 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, Turkey and the United Kingdom.

1 Scope

This document specifies the requirements for steel products used for unfired pressure vessels.

For some metallic materials other than steel, such as spheroidal graphite cast iron, aluminium, nickel, copper, titanium, requirements are or will be formulated in separate parts of this document.

For metallic materials which are not covered by a harmonized material standard and are not likely to be in near future, specific rules are given in this part or the above cited parts of this document.

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 764-1:2015+A1:2016, *Pressure equipment — Terminology — Part 1: Pressure, temperature, volume, nominal size*

EN 764-2:2012, *Pressure equipment — Part 2: Quantities, symbols and units*

 Deleted reference 

EN 764-4:2014, *Pressure equipment — Part 4: Establishment of technical delivery conditions for metallic materials*

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

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

 EN 10028-2:2017 , *Flat products made of steels for pressure purposes — Part 2: Non-alloy and alloy steels with specified elevated temperature properties*

 EN 10028-3:2017 , *Flat products made of steels for pressure purposes — Part 3: Weldable fine grain steels, normalized*

 EN 10028-4:2017 , *Flat products made of steels for pressure purposes — Part 4: Nickel alloy steels with specified low temperature properties*

 EN 10028-5:2017 , *Flat products made of steels for pressure purposes — Part 5: Weldable fine grain steels, thermomechanically rolled*

 EN 10028-6:2017 , *Flat products made of steels for pressure purposes — Part 6: Weldable fine grain steels, quenched and tempered*

 EN 10028-7:2016 , *Flat products made of steels for pressure purposes — Part 7: Stainless steels*

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