SLOVENSKI STANDARD

SIST EN 13445-1:2002

01-november-2002

Neogrevane tlaļne posode - 1. del: Splošno

Unfired pressure vessels - Part 1: General

Unbefeuerte Druckbehälter - Teil 1: Allgemeines

Récipients sous pression non soumis a la flamme - Partie 1: Généralités

Ta slovenski standard je istoveten z: EN 13445-1:2002

ICS:

23.020.30

SIST EN 13445-1:2002 **en**

EUROPEAN STANDARD

NORME EUROPÉENNE

EUROPÄISCHE NORM

EN 13445-1

May 2002

ICS 23.020.30

English version

Unfired pressure vessels - Part 1: General

Récipients sous pression non soumis à la flamme - Partie 1: Généralités

Unbefeuerte Druckbehälter - Teil 1: Allgemeines

This European Standard was approved by CEN on 23 May 2002.

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 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 Management Centre has the same status as the official versions.

CEN members are the national standards bodies of Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Malta, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and United Kingdom.

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

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Ref. No. EN 13445-1:2002 E

Contents

Foreword

This document (EN 13445-1:2002) 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of an identical text or by endorsement, at the latest by November 2002, and conflicting national standards shall be withdrawn at the latest by November 2002.

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(s).

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

This European Standard concerning “Unfired pressure vessels” comprises the following Parts:

— *Part 1: General.*

— *Part 2: Materials.*

— *Part 3: Design.*

— *Part 4: Fabrication.*

— *Part 5: Inspection and testing.*

— *Part 6: Requirements for the design and fabrication of pressure vessels and pressure parts constructed from spheroidal graphite cast iron.*

CR 13445-7*, Unfired pressure vessels - Part 7: Guidance on the use of conformity assessment procedures.*

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.

NOTE If any matter of interpretation or doubt arises as to the meaning or effect of any normative part of this European Standard, or as to whether anything should be done or has been omitted to be done, in order that this European Standard should be complied with in full, the matter shall be referred to the CEN/TC54 Committee.

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

Introduction

EN 13445 specifies the requirements for design, construction, inspection and testing of unfired pressure vessels. It defines terms, definitions and symbols applicable to unfired pressure vessels.

NOTE In EN 13445 the term pressure vessel includes the welded attachments up to and including the nozzle flanges, screwed or welded connections, or the edge to be welded at the first circumferential weld at connecting piping or other elements. The term unfired excludes vessels that are subject to direct generated heat or flame impingement from a fired process. This does not exclude vessels subject to electrical heating or heated process streams.

In Parts 1 to 5 only pressure vessels manufactured from steels and steel castings as detailed in Part 2 of this standard are covered. Part 6 specifically deals with spheroidal graphite cast iron and special considerations apply.

Part 1

This Part outlines the basic principles underpinning the standard. The manufacturer is required to declare that the technical design specification and the supporting documentation are in compliance with the requirements of this standard.

Unforeseen factors may arise that require design modifications and/or manufacturing concessions. These need to be handled with the same rigour as the original design.

Part 2

This Part deals with the general philosophy on materials, material grouping and low temperature behaviour in relation to Room Temperature performance. It is limited to steel with sufficient ductility and excludes at present materials operating in the creep range. Part 2 provides the general requirements for establishing technical delivery conditions.

Furthermore Part 2 includes the requirements for marking. Four annexes give further details. The normative Annex A includes the material grouping system, which is in accordance with CR ISO 15608:2000. This system is used throughout the whole standard. Furthermore Annex A adds a list of all those material grades based upon European base material standards which are accepted to be used for unfired pressure vessels made to this standard The normative Annex B gives the necessary information on the requirements for the prevention of brittle fracture in the base material and the welds. Two methods based upon a code of practice developed from fracture mechanics are covered. The informative Annex C gives information on technical delivery conditions for clad products. Annex D gives an informative survey on European base material and component standards and their systematic nomenclature.

Part 3

This Part of this standard gives the rules to be used for design and calculation under internal and/or external pressure (as applicable) of pressure bearing components of Pressure Vessels, such as shells of various shapes, flat walls, flanges, heat exchanger tubesheets, including the calculation of reinforcement of openings. Rules are also given for components subject to local loads and to actions other than pressure.

For all these components the DBF (Design by Formulae) method is generally followed, i.e. appropriate formulae are given in order to find stresses which have to be limited to safe values. These formulae are generally intended for predominantly non-cyclic loads, which means for a number of full pressure cycles not exceeding 500.

However general prescriptions are also given for DBA (Design by Analysis) which can be used either to evaluate component designs or loading situations for which a DBF method is not provided, or, more generally, as an alternative to DBF.

Methods are also given where a fatigue evaluation is required, due to a number of load cycles being greater than 500. There are two alternative methods: a simplified method based on DBF (valid only in case of pressure variations) and a more sophisticated method based on a detailed determination of total stresses using, for example, FEM or experimental methods. This can be used also in the case of variable loads other than pressure.

For certain components (such as flanges and tubesheets) also an alternative DBF method (based on limit analysis) has been provided; the choice of which method has to be used in each particular case is left to the Designer.

For the time being, the scope of Part 3 is limited to steel components working at temperatures lower than the creep range of the specific material concerned.

Part 4

The philosophy in Part 4 is based on existing good practice in current European Standards, manufacturing and sub-contracting, material traceability, tolerances, welding procedures and qualification, production testing, forming, post weld heat treatment and repairs for steel constructions. Part 4 is not applicable for Part 6 which has separate and different requirements regarding manufacturing.

Part 5

This Part covers all those inspection and testing activities associated with the verification of the pressure vessel for compliance with the standard.

Inspection activities include design review by the manufacturer and supporting technical documentation. . Numerous inspection activities, in addition to the Non Destructive Testing (NDT) are described including document control, material traceability, joint preparation and welding.

The requirements for testing are predominantly related to individually designed single vessels. However, Annex A provides a procedure for serially produced pressure vessels.

The level of testing is driven by the selection of the vessel testing group. Basically, the testing group determines the level of NDT and the joint coefficient used in the design. There are four testing groups which are designed to give the same safety by a combination of several factors. Testing groups take into consideration manufacturing difficulties associated with different groups of steels, maximum permitted thickness, welding processes, service temperature range and the thickness by means of the joint coefficient of the governing joint. (i.e. the full penetration butt joint that, as a result of the weld joint coefficient, governs the thickness of the component).

The testing groups are numbered from 1 to 4 in decreasing levels of NDT. However, it was necessary to subdivide testing groups 1, 2 and 3 into subgroups 1a, 1b, 2a, 2b, 3a, and 3b in order to reflect the better behaviour to crack sensitivity of easy to weld steels of groups 1.1, 1.2 and 8.1.

A single testing group is normally applied to the entire vessel. However, provided specific requirements are met, a combination of testing groups is permitted.

In terms of NDT, the overall philosophy has been the general adoption of ISO/DIS 5817:2000 quality level 'C' for predominantly non-cyclic loaded vessels and level 'B' for vessels subject to cyclic loadings.

Part 6

This Part specifies that the manufacturer shall select a testing factor of 0,8 (visual inspection only) or 0,9 (NDT inspection) when a cast pressure vessel or cast part is designed for pressure up to 50 bar and a maximum temperature of 300 °C. For component the DBF method is generally followed. Appropriate formulae are given in order that the stresses be limited to safe values. These formulae are generally intended for predominantly static loads, which means for a number of load cycles not exceeding 200 000 in the case of spheroidal graphite cast iron. Calculation of minimum wall thickness is dealt with by Part 3 except for design stresses which are given in Part 6. A method for design by experiment up to 6 000 bar·l without calculation is given. Material requirements are as in Part 2 except for the tables in Part 6. Inspection and testing requirements are as in Part 5 except requirements for castings and test pressure. Interaction between good design and good workmanship is so important for cast vessels that special requirements are laid down in this Part. Annex A is informative for the determination of burst pressure and wall thickness minimum requirements.

1 Scope

1.1 General

This Part of this European Standard defines the terms, definitions, symbols and units that are used throughout the EN 13445.

This Part of EN 13445 also gives guidelines on the principles on which each part of the standard has been based. This information is aimed to aid the user of the EN 13445. This European Standard applies to unfired pressure vessels subject to a maximum allowable pressure greater than 0,5 bar gauge but may be used for vessels operating at lower pressures, including vacuum.

This European Standard applies to maximum allowable temperatures for which creep effects need not be considered, i.e. for maximum allowable temperatures for which the corresponding maximum calculation temperature renders a relevant proof strength smaller than the 100 000 h creep rupture strength. For ferritic steels the temperature limit corresponds to calculation temperatures below approximately 380 °C

In EN13445-3:2002 two methods of Design by Analysis (DBA) are given in Annex B and Annex C respectively. Both of these are normative. However Parts 2, 4 and 5 of this edition of the standard do not include provision within their respective areas of responsibility for vessels designed using Design by Analysis – Direct Route (DBA) of EN13445-3:2002, Annex B

NOTE The selection, application and installation of safety related accessories intended to protect pressure vessels during operation are covered in prEN 764-7.

1.2 Exclusions

This European Standard is not applicable to pressure equipment of the following types:

a) transportable pressure equipment;

b) items specifically designed for nuclear use, the failure of which may cause a release of radioactivity;

c) pressure equipment intended for the generation of steam or superheated water at temperatures higher than 110 °C;

d) vessels of riveted construction;

e) vessels of lamellar cast iron or any other materials not included in EN 13445-2 or EN 13445-6;

f) multilayered, autofrettaged or pre-stressed vessels;

g) pipelines and industrial piping.