EESTI STANDARD

EVS-EN 13831:2007

Integreeritud membraaniga (diafragmaga) suletud paisupaagid veesüsteemides kasutamiseks

Closed expansion vessels with built in diaphragm for installation in water systems

This document is a preview generated by EVS

EESTI STANDARDIKESKUS

EESTI STANDARDI EESSÕNA

Käesolev Eesti standard EVS-EN 13831:2007 sisaldab Euroopa standardi EN 13831:2007 ingliskeelset teksti. Käesolev dokument on jõustatud 30.10.2007 ja selle kohta on avaldatud teade Eesti standardiorganisatsiooni ametlikus väljaandes. Standard on kättesaadav Eesti standardiorganisatsioonist.	This Estonian standard EVS-EN 13831:2007 consists of the English text of the European standard EN 13831:2007. This document is endorsed on 30.10.2007 with the notification being published in the official publication of the Estonian national standardisation organisation. The standard is available from Estonian standardisation organisation.

NATIONAL FOREWORD

Käsitlusala: This European Standard specifies requirements for the design, manufacture and testing of closed expansion vessels with built in diaphragm, which will hereinafter be called "vessels", and a) whose diaphragm serves to separate water on the one hand and air / nitrogen on the other hand in heating/cooling systems or fresh water systems; b) which are manufactured singly or in series; c) which may consist partly or entirely of (cold) deep-drawn parts; d) whose parts may be joined by welding, clenching or flanges; e) whose size is not limited; f) whose maximum allowable pressure is greater than 0,5 bar, yet not exceeding 30 bar; g) whose upper wall thickness is limited to 12 mm for austenitic steels and 15 mm for ferritic steels; h) whose minimum operating temperature is not below –10 °C, whose maximum operating temperature is not above 70 °C.	**Scope:** This European Standard specifies requirements for the design, manufacture and testing of closed expansion vessels with built in diaphragm, which will hereinafter be called "vessels", and a) whose diaphragm serves to separate water on the one hand and air / nitrogen on the other hand in heating/cooling systems or fresh water systems; b) which are manufactured singly or in series; c) which may consist partly or entirely of (cold) deep-drawn parts; d) whose parts may be joined by welding, clenching or flanges; e) whose size is not limited; f) whose maximum allowable pressure is greater than 0,5 bar, yet not exceeding 30 bar; g) whose upper wall thickness is limited to 12 mm for austenitic steels and 15 mm for ferritic steels; h) whose minimum operating temperature is not below –10 °C, whose maximum operating temperature is not above 70 °C.

ICS 91.140.10

Võtmesõnad:

The document is a preview generated by EVS

Eesti Standardikeskusele kuulub standardite reprodutseerimis- ja levitamisõigus

EUROPEAN STANDARD

NORME EUROPÉENNE

EUROPÄISCHE NORM

EN 13831

August 2007

ICS 91.140.10

English Version

Closed expansion vessels with built in diaphragm for installation in water

Vases d'expansion fermés avec membrane incorporée pour installation dans des systèmes à eau

Ausdehnungsgefäße mit eingebauter Membrane für den Einbau in Wassersystemen

This European Standard was approved by CEN on 26 July 2007.

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 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 Management Centre has the same status as the official versions.

CEN members are the national standards bodies of Austria, Belgium, Bulgaria, 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.

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

Management Centre: rue de Stassart, 36 B-1050 Brussels

© 2007 CEN All rights of exploitation in any form and by any means reserved worldwide for CEN national Members.

Ref. No. EN 13831:2007: E

This document is a preview generated by EVS

Contents

Page

Foreword 4

Introduction 5

1 Scope 6

2 Normative references 6

3 Terms and conditions 7

4 Symbols and units 9

5 Materials 10
5.1 General 10
5.2 Materials proven by experience and current use 10
5.3 Fasteners 11
5.4 Non-pressurised parts 11

6 Design and calculation 11
6.1 Design 11
6.1.1 Requirements pertaining to the diaphragm 11
6.1.2 Requirements pertaining to fresh water application 11
6.1.3 Outside finish 11
6.1.4 Inspection openings 11
6.1.5 Connections 12
6.1.6 Clenched joints 12
6.1.7 Volume tolerance of vessels 12
6.1.8 Fatigue 12
6.1.9 Loadings 13
6.2 Experimental design method 13
6.2.1 General 13
6.2.2 Preparations 13
6.2.3 Vessels with $PS \times V \leq$ 1 000 bar $\times L$ 13
6.2.4 Vessels with 1 000 bar $\times L < PS \times V <$ 6 000 bar $\times L$ 13
6.2.5 Vessel parts and components 13
6.3 Calculation method 14
6.3.1 General 14
6.3.2 Symbols 14
6.3.3 Cylindrical and spherical shells under internal pressure 15
6.3.4 Dished ends under internal pressure 15
6.3.5 Openings in cylindrical shells, spherical shells and dished ends 18
6.3.6 Bolted circular flat ends under internal pressure 25
6.3.7 Flanges and boltings 31

7 Manufacturing and welding 39
7.1 Introduction 39
7.2 General 39
7.3 Manufacturing tolerances 39
7.3.1 General 39
7.3.2 Middle line and surface alignment 39
7.3.3 Tolerances for vessels 40
7.4 Weld details 41
7.4.1 Recommended weld details 41
7.4.2 Vessels made in more courses 42
7.4.3 Joggle joints 42
7.5 Welding 42
7.5.1 General 42

This document is a preview generated by EVS

7.5.2 Welding procedure specification (WPS) ... 42
7.5.3 Qualification of WPS ... 42
7.5.4 Qualification of welders and welding operators ... 42
7.5.5 Preparation of edges to be welded ... 43
7.5.6 Execution of welded joints ... 43
7.5.7 Attachments, supports and stiffeners ... 43
7.6 NDE personnel ... 43
7.7 Manufacture and testing of permanent joints ... 43
7.7.1 Welded joints ... 43
7.7.2 Clenched joints ... 46
7.8 Forming of parts subject to pressure ... 46
7.8.1 Ratio of deformation ... 46
7.8.2 Forming conditions ... 48
7.8.3 Heat treatment ... 48
7.8.4 Visual examination and control of dimensions ... 49
7.8.5 Test certificate ... 49
7.9 Repairs ... 49
7.9.1 Surface defects ... 49
7.9.2 Repairs, elimination of defects ... 49
7.10 Finishing operations ... 49

8 Diaphragm ... 50
8.1 General ... 50
8.2 Materials ... 50
8.3 Hygienic demands ... 50
8.4 Test concept ... 50
8.5 Testing ... 50
8.5.1 General ... 50
8.5.2 Tests on diaphragms ... 50
8.5.3 Cyclic stressing on vessels ... 51
8.5.4 Diaphragm permeability test ... 53
8.5.5 Repetition of tests ... 53
8.5.6 Test report ... 53
8.6 Tests by the diaphragm manufacturer ... 54
8.7 Marking of diaphragms ... 54

9 Testing and inspection ... 54
9.1 General ... 54
9.2 Technical documentation ... 54
9.3 Inspections during manufacturing ... 55
9.4 Pressure test ... 55
9.5 Marking ... 55
9.6 Documentation ... 56

Annex A (informative) **Standards for testing diaphragms** ... 57

Annex B (informative) **Proven diaphragm materials** ... 58

Annex ZA (informative) **Relationship between this European Standard and the Essential requirements of EU Directive 97/23/EC** ... 59

Bibliography ... 60

This document is a preview generated by EVS

Foreword

This document (EN 13831:2007) 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 2008, and conflicting national standards shall be withdrawn at the latest by February 2008.

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.

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Bulgaria, 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 the United Kingdom.

This document is a preview generated by EVS

Introduction

Closed expansion vessels with built in diaphragm made their commercial début in the early 1950s. They were employed in heating systems, or for fresh water supply systems.

When used in heating systems they take up the increase of the water volume due to the heating up. The gas pressure (on the other side of the diaphragm) pushes the water back into the system when due to cooling down the water volume in the heating system is decreasing. Expansions vessels with built in diaphragm are an undisputed standard in European heating engineering. When used in fresh water circuits, vessels with built in diaphragm serve to accommodate the extra volume caused by water heaters warming up,, thus saving valuable drinking water from flowing down the drain. The other main application is to store water under pressure in connection with booster systems allowing an energy efficient pump operation.

Though the development of the closed expansion vessel with built in diaphragm constituted a real revolution in the domains of heating and drinking water, industry in general took only limited note of it. Nevertheless this has not prevented the manufacturers from refining the product and the manufacturing technique over the last 40 years, often charting entirely new paths. As a consequence, the production of closed expansion vessels can differ considerably from conventional pressure vessel production. This is especially true in respect to the highly developed deep drawing technology.

This document is a preview generated by EVS

1 Scope

This European Standard specifies requirements for the design, manufacture and testing of closed expansion vessels with built in diaphragm, which will hereinafter be called "vessels", and

a) whose diaphragm serves to separate water on the one hand and air / nitrogen on the other hand in heating/cooling systems or fresh water systems;

b) which are manufactured singly or in series;

c) which may consist partly or entirely of (cold) deep-drawn parts;

d) whose parts may be joined by welding, clenching or flanges;

e) whose size is not limited;

f) whose maximum allowable pressure is greater than 0,5 bar, yet not exceeding 30 bar;

g) whose upper wall thickness is limited to 12 mm for austenitic steels and 15 mm for ferritic steels;

h) whose minimum operating temperature is not below –10 °C and whose maximum operating temperature is not above 70 °C.

NOTE The maximum operating temperature of 70 °C is determined by the characteristics of the diaphragm materials. It may be higher, if suitability of diaphragm material is proven.

Whatever the temperature in the heating system, for the vessel operation the decisive factor is the maximum operating temperature of the diaphragm. It is the system designer's responsibility to prescribe measures to protect the diaphragm from unsuitable temperatures (e.g. connection to the coldest part of the system in a heating system, to the warmest in a refrigeration circuit; thermostatic monitoring of connection to vessel or intermediate vessel).

For cases where operating temperatures above 70 °C cannot be avoided the suitability of the diaphragm material is to be proven (see Clause 8).

When reference is made in this European Standard to EN 13445-1, EN 13445-2, EN 13445-3, EN 13445-4 and EN 13445-5 respectively, all relevant provisions in the concerned clauses of these standards need to apply.

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 473:2000, *Non destructive testing — Qualification and certification of NDT personnel — General principles*

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

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

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

EN 895:1995, *Destructive tests on welds in metallic materials — Transverse tensile test*

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

This document is a preview generated by EVS

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 1435:1997, *Non-destructive examination of welds — Radiographic examination of welded joints*

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

EN 10269:1999, *Steels and nickel alloys for fasteners with specified elevated and/or low temperature properties*

EN 13445-1:2002, *Unfired pressure vessels — Part 1: General*

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

EN ISO 898-1:1999, *Mechanical properties of fasteners made of carbon steel and alloy steel — Part 1: Bolts, screws and studs (ISO 898-1:1999)*

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 15613:2004, *Specification and qualification of welding procedures for metallic materials — Qualification based on pre-production welding test (ISO 15613:2004)*

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)*

ISO 898-2:1998, *Mechanical properties of fasteners — Part 2: Nuts with specified proof load values — Coarse thread*

3 Terms and conditions

For the purposes of this document, the terms and definitions given in EN 764-1:2004, EN 764-2:2002, EN 764-3:2002 and the following apply.

3.1
automatic welding
welding in which all the parameters are automatically controlled, some of these parameters may be adjusted to a limited amount (manually or automatically by mechanical or electronic devices) during welding to maintain the specified welding conditions

3.2
clench joints
separate metal ring holding together two vessel parts or a rolled joint holding together two vessel parts in a permanent way. Its design is always done according to the experimental design method

3.3
expansion vessel
vessel to take up the volume variations of a liquid due to changes of temperature. The expansion vessel is called "closed", if the liquid contained is not in contact with any gaseous or liquid medium

This document is a preview generated by EVS