

Cryogenic vessels - Large transportable non-vacuum insulated vessels - Part 2: Design, fabrication, inspection and testing
KONSOLIDEERITUD TEKST

Cryogenic vessels - Large transportable non-vacuum insulated vessels - Part 2: Design, fabrication, inspection and testing CONSOLIDATED TEXT

EESTI STANDARDI EESSÕNA

NATIONAL FOREWORD

<p>Käesolev Eesti standard EVS-EN 14398-2:2003+A2:2008 sisaldab Euroopa standardi EN 14398-2:2003+A2:2008 ingliskeelset teksti.</p> <p>Standard on kinnitatud Eesti Standardikeskuse 19.05.2008 käskkirjaga ja jõustub sellekohase teate avaldamisel EVS Teatajas.</p> <p>Euroopa standardimisorganisatsioonide poolt rahvuslikele liikmetele Euroopa standardi teksti kättesaadavaks tegemise kuupäev on 19.03.2008.</p> <p>Standard on kättesaadav Eesti standardiorganisatsioonist.</p>	<p>This Estonian standard EVS-EN 14398-2:2003+A2:2008 consists of the English text of the European standard EN 14398-2:2003+A2:2008.</p> <p>This standard is ratified with the order of Estonian Centre for Standardisation dated 19.05.2008 and is endorsed with the notification published in the official bulletin of the Estonian national standardisation organisation.</p> <p>Date of Availability of the European standard text 19.03.2008.</p> <p>The standard is available from Estonian standardisation organisation.</p>
--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------	-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------

ICS 23.020.40

Võtmesõnad: coolers, gas cylinders, nondestructive tests, pressure vessels, properties, quality assurance, safety requirements, sample surveys, specification (approval), specifications, surveillance (approval), symbols, temperature, testing, toughness, transport boxes, volumes

Standardite reprodutseerimis- ja levitamiseõigus kuulub Eesti Standardikeskusele

Andmete paljundamine, taastekitamine, kopeerimine, salvestamine elektroonilisse süsteemi või edastamine ükskõik millises vormis või millisel teel on keelatud ilma Eesti Standardikeskuse poolt antud kirjaliku loata.

Kui Teil on küsimusi standardite autorikaitse kohta, palun võtke ühendust Eesti Standardikeskusega:
Aru 10 Tallinn 10317 Eesti; www.evs.ee; Telefon: 605 5050; E-post: info@evs.ee

English Version

Cryogenic vessels - Large transportable non-vacuum insulated vessels - Part 2: Design, fabrication, inspection and testing

Réceptacles cryogéniques - Grands réceptacles transportables non isolés sous vide - Partie 2: Conception, fabrication, inspections et essais

Kryo-Behälter - Große ortsbewegliche, nicht vakuum-isolierte Behälter - Teil 2: Bemessung, Herstellung und Prüfung

This European Standard was approved by CEN on 10 July 2003 and includes Corrigendum 1 issued by CEN on 23 August 2006, Amendment 1 approved by CEN on 6 October 2006 and Amendment 2 approved by CEN on 7 February 2008.

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

Contents

page

Foreword.....	5
1 Scope	6
2 Normative references	6
3 Terms, definitions and symbols.....	7
3.1 Terms and definitions	7
3.2 Symbols	8
4 Design	9
4.1 Design options	9
4.1.1 General.....	9
4.1.2 Design by calculation.....	9
4.1.3 Design by calculation and pressure strengthening.....	9
4.1.4 Design by calculation supplemented with experimental methods.....	10
4.2 Common design requirements.....	10
4.2.1 General.....	10
4.2.2 Design specification.....	10
4.2.3 Design loads.....	11
4.2.4 Fatigue	13
4.2.5 Corrosion allowance	13
4.2.6 Inspection openings.....	13
4.2.7 Pressure relief.....	14
4.2.8 Valves.....	14
4.2.9 Insulation	14
4.2.10 Degree of filling.....	14
4.2.11 Electrical continuity.....	15
4.3 Design by calculation.....	15
4.3.1 General.....	15
4.3.2 Vessel.....	15
4.3.3 Attachments	16
4.3.4 Piping and accessories.....	16
4.3.5 Calculation formulae	17
4.3.6 Calculations for operating loads.....	25
5 Fabrication.....	53
5.1 General.....	53
5.2 Cutting	53
5.3 Cold forming.....	54
5.3.1 Austenitic stainless steel.....	54
5.3.2 Ferritic steel.....	54
5.4 Hot forming.....	55
5.4.1 General.....	55
5.4.2 Austenitic stainless steel.....	55
5.4.3 Ferritic steel.....	55
5.5 Manufacturing tolerances	55
5.5.1 Plate alignment	55
5.5.2 Thickness	57
5.5.3 Dished ends.....	57
5.5.4 Cylinders.....	57
5.6 Welding.....	60
5.6.1 General.....	60
5.6.2 Qualification	60
5.6.3 Temporary attachments	60
5.6.4 Welded joints.....	60
5.7 Non-welded joints	61

6	Inspection and testing	61
6.1	Quality plan	61
6.1.1	Inspection stages during manufacture of a vessel	61
6.1.2	Additional inspection stages during manufacture of a large transportable cryogenic vessel ...	62
6.2	Production control test plates	62
6.2.1	Requirements	62
6.2.2	Extent of testing	62
6.3	Non-destructive testing	63
6.3.1	General	63
6.3.2	Extent of examination for surface imperfections	63
6.3.3	Extent of examination for volumetric imperfections	63
6.3.4	Acceptance levels	64
6.4	Rectification	65
6.5	Pressure testing	66
Annex A	(informative) Elastic stress analysis	67
A.1	General	67
A.2	Terminology	67
A.2.1	Stress intensity	67
A.2.2	Gross structural discontinuity	68
A.2.3	Local structural discontinuity	68
A.2.4	Normal stress	68
A.2.5	Shear stress	68
A.2.6	Membrane stress	68
A.2.7	Primary stress	69
A.2.8	Primary local membrane stress	69
A.2.9	Secondary stress	69
A.2.10	Peak stress	69
A.3	Limit for longitudinal compressive general membrane stress	69
A.4	Stress categories and stress limits for general application	70
A.4.1	General	70
A.4.2	General primary membrane stress category	70
A.4.3	Local primary membrane stress category	70
A.4.4	General or local primary membrane plus primary bending stress category	70
A.4.5	Primary plus secondary stress category	70
A.4.6	Thermal stress	70
A.5	Specific criteria, stress categories and stress limits for limited application	71
A.5.1	General	71
A.5.2	Attachments and supports	71
A.5.3	Nozzles and openings	71
A.5.4	Additional stress limits	72
Annex B	(normative) Additional requirements for 9 % Ni steel	76
B.1	Introduction	76
B.2	Specific requirements	76
Annex C	(normative) Pressure strengthening of vessels from austenitic stainless steels	78
C.1	Introduction	78
C.2	Scope	78
C.3	Definitions and units of measurement	78
C.4	Materials	79
C.5	Design	80
C.5.1	General	80
C.5.2	Design for internal pressure	80
C.6	Manufacturing and inspection	83
C.6.1	Strengthening procedure	83
C.6.2	Procedure record	83
C.6.3	Welding	83
C.6.4	Pressure vessel drawing	84
C.6.5	Data plate	84
C.7	Comments	84
C.7.1	Strengthening theory	84
C.7.2	Work-hardened material	86

C.7.3	Derivation of formulae	86
C.7.4	Deformations at strengthening	87
Annex D	(informative) Specific weld details	90
D.1	Field of application	90
D.2	Weld detail	90
D.2.1	Joggle joint	90
D.2.2	Intermediate ends	90
D.2.3	Backing strip	91
D.2.4	End plate closure	91
D.2.5	Non full penetration nozzle weld	91
D.2.6	Non continuous fillet weld on attachments	91
D.3	Oxygen service requirements	91
Annex E	(normative) Increased material property for austenitic stainless steel	95
Bibliography	96

Document is a preview generated by EVS

Foreword

This document (EN 14398-2:2003+A2:2008) has been prepared by Technical Committee CEN/TC 268 "Cryogenic vessels", the secretariat of which is held by AFNOR.

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 September 2008 and conflicting national standards shall be withdrawn at the latest by September 2008.

This document includes Amendment 1, approved by CEN on 2006-10-06, Amendment 2, approved by CEN on 2008-02-07 and Corrigendum 1 issued by CEN on 2006-08-23.

This document supersedes EN 14398-2:2003.

The start and finish of text introduced or altered by amendment is indicated in the text by tags $\boxed{A_1}$ $\triangleleft A_1$ and $\boxed{A_2}$ $\triangleleft A_2$.

The modifications of the related CEN Corrigendum have been implemented at the appropriate places in the text and are indicated by the tags \boxed{AC} $\triangleleft AC$.

This document has been prepared under a mandate given to CEN by the European Commission and the European Free Trade Association, and supports the objectives of the framework Directives on Transport of Dangerous Goods.

The standard has been submitted for reference into the RID and/or in the technical annexes of the ADR. $\boxed{A_2}$ *deleted text* $\triangleleft A_2$

EN 14398 consists of the following parts under the general title, *Cryogenic vessels – Large transportable non-vacuum insulated vessels*:

- *Part 1: Fundamental requirements*
- *Part 2: Design, fabrication, inspection and testing*
- *Part 3: Operational requirements*

$\boxed{A_2}$ Annexes B, C and E are normative. Annexes A and D are normative. $\triangleleft A_2$

This document includes a Bibliography.

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 United Kingdom.

1 Scope

This European Standard specifies requirements for the design, fabrication, inspection and testing of large transportable non vacuum insulated cryogenic vessels of more than 1000 l volume, which are permanently (fixed tanks) or not permanently (demountable tanks) attached to a vehicle, for carriage by road. However, it can be used for other mode of transport providing the specific regulations/requirements are complied with.

This European Standard applies to large transportable non vacuum insulated cryogenic vessels for fluids specified in EN 14398-1 and does not apply to vessels designed for toxic fluids.

This European Standard does not include the general vehicle requirements e.g. running gear, brakes, lighting etc. that shall be in accordance with the relevant standards/regulations.

2 Normative references

This European Standard incorporates by dated or undated reference, provisions from other publications. These normative references are cited at the appropriate places in the text, and the publications are listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to this European Standard only when incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to applies (including amendments).

EN 287-1, *Approval testing of welders - Fusion welding - Part 1: Steels.*

 deleted text 

EN 473, *Non destructive testing - Qualification and certification of NDT personnel - General principles.*

EN 875, *Destructive tests on welds in metallic materials - Impact tests - Test specimen location, notch orientation and examination.*

EN 895, *Destructive tests on welds in metallic materials - Transverse tensile test.*

EN 910, *Destructive tests on welds in metallic materials – Bend tests.*

EN 1252-1:1998, *Cryogenic vessels - Materials - Part 1: Toughness requirements for temperatures below - 80 °C.*

EN 1252-2, *Cryogenic vessels - Materials - Part 2: Toughness requirements for temperatures between – 80 °C and –20 °C.*

EN 1418, *Welding personnel – Approval testing of welding operators for fusion welding and resistance weld setters for fully mechanised and automatic welding of metallic materials.*

EN 1435, *Non-destructive examination of welds – Radiographic examination of welded joints.*

EN 1626, *Cryogenic vessels - Valves for cryogenic service.*

EN 1797, *Cryogenic vessels - Gas/material compatibility.*

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

EN 10028-7:2000, *Flat products made of steels for pressure purposes - Part 7: Stainless steels.*

EN 13068-3, *Non-destructive testing – Radioscopic testing – Part 3: General principles of radioscopic testing of metallic materials by X – and gamma rays.*

EN 13445-3, *Unfired pressure vessels – Part 3: Design.*

EN 13648-3, *Cryogenic vessels - Safety devices for protection against excessive pressure - Part 3: Determination of required discharge - Capacity and sizing.*

EN 14398-1:2003, *Cryogenic vessels - Large transportable non-vacuum insulated vessels - Part 1: Fundamental requirements.*

EN 14398-3, *Cryogenic vessels – Large Transportable non-vacuum insulated vessels – Part 3: Operational requirements.*

EN ISO 6520-1, *Welding and allied processes - Classification of geometric imperfections in metallic materials - Part 1: Fusion welding* ^(A1) (ISO 6520-1:2007) ^(A1).

^(A2) EN ISO 9606-2, *Qualification test of welders - Fusion welding - Part 2: Aluminium and aluminium alloys* (ISO 9606-2:2004).

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

EN ISO 15614-1, *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).

EN ISO 15614-2, *Specification and qualification of welding procedures for metallic materials - Welding procedure test - Part 2: Arc welding of aluminium and its alloys* (ISO 15614-2:2005). ^(A2)

ISO 1106-1, *Recommended practice for radiographic examination of fusion welded joints - Part 1: Fusion welded butt joints in steel plates up to 50 mm thick.*

3 Terms, definitions and symbols

For the purposes of this European Standard, the following terms, definitions and symbols apply.

3.1 Terms and definitions

For the purposes of this European Standard, the terms and definitions given in EN 14398-1:2003 and the following apply.

3.1.1

large transportable non vacuum insulated vessel

vessel of more than 1000 l volume intended for one or more cryogenic fluids, consisting of an inner vessel, an insulation, all of the valves and accessories and additional framework

3.1.2

fixed tank (tank vehicle)

large transportable vessel permanently attached to a vehicle or to units of running gear used in its stead

3.1.3

demountable tank

large transportable vessel non permanently attached to a vehicle. When attached to the carrier vehicle, the demountable tank meets the requirements prescribed for a fixed tank. It is designed to be lifted only when empty

3.1.4

inner vessel

pressure vessel proper intended to contain the cryogenic fluid

3.1.5

insulation

to protect the vessel against heat transfer from the outside atmospheric temperature