

Konstruktion och tillverkning av stationära, vertikala, cylindriska stålcisterner med plan botten, för lagring av kylda, kondenserade gaser med arbetstemperaturer mellan 0 °C och -165 °C – Del 2: Metalliska komponenter

Design and manufacture of site built, vertical, cylindrical, flat-bottomed steel tanks for the storage of refrigerated, liquefied gases with operating temperatures between 0 °C and -165 °C – Part 2: Metallic components

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Design and manufacture of site built, vertical, cylindrical, flat-bottomed steel tanks for the storage of refrigerated, liquefied gases with operating temperatures between 0 °C and -165 °C - Part 2: Metallic components

Conception et fabrication de réservoirs en acier à fond plat, verticaux, cylindriques, construits sur site, destinés au stockage des gaz réfrigérés, liquéfiés, dont les températures de service sont comprises entre 0 °C et -165 °C - Partie 2 : Constituants métalliques

Auslegung und Herstellung standortgefertigter, stehender, zylindrischer Flachboden-Stahltanks für die Lagerung von tiefkalt verflüssigten Gasen bei Betriebstemperaturen zwischen 0 °C und -165 °C - Teil 2: Metallische Bauteile

This European Standard was approved by CEN on 20 February 2006.

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EN 14620-2:2006 (E)**Foreword**

This European Standard (EN 14620-2:2006) has been prepared by Technical Committee CEN/TC 265 "Site built metallic tanks for the storage of liquids", 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of an identical text or by endorsement, at the latest by March 2007, and conflicting national standards shall be withdrawn at the latest by March 2007.

EN 14620 *Design and manufacture of site built, vertical, cylindrical, flat-bottomed steel tanks for the storage of refrigerated, liquefied gases with operating temperatures between 0 °C and -165 °C* consists of the following parts:

- Part 1: General;
- Part 2: Metallic components;
- Part 3: Concrete components;
- Part 4: Insulation components;
- Part 5: Testing, drying, purging and cool-down.

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, 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 general requirements for the materials, design, construction and installation of the metallic components of refrigerated liquefied gas storage tanks.

This European Standard deals with the design and manufacture of site built, vertical, cylindrical, flat-bottomed steel tanks for the storage of refrigerated, liquefied gases with operating temperatures between 0 °C and –165 °C.

2 Normative references

The following referenced documents are indispensable for the application of this European Standard. 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, *Qualification test of welders — Fusion welding — Part 1: Steels*

EN 462-1, *Non-destructive testing — Image quality of radiographs — Part 1: Image quality indicators (wire type) — Determination of image quality value*

EN 462-2, *Non-destructive testing — Image quality of radiographs — Part 2: Image quality indicators (step/hole type) — Determination of image quality value*

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

EN 571-1, *Non-destructive testing — Penetrant testing — Part 1: General principles*

EN 584-1, *Non-destructive testing — Industrial radiographic film — Part 1: Classification of film systems for industrial radiography*

EN 584-2, *Non-destructive testing — Industrial radiographic film — Part 2: Control of film processing by means of reference values*

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

EN 970, *Non-destructive examination of fusion welds — Visual examination*

EN 1011-2, *Welding — Recommendations for welding of metallic materials — Part 2: Arc welding of ferritic steels*

EN 1092-1:2001, *Flanges and their joints — Circular flanges for pipes, valves, fittings and accessories, PN designated — Part 1: Steel flanges*

EN 1290, *Non-destructive testing of welds — Magnetic particle testing of welds*

EN 1418, *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 1515-1:1999, *Flanges and their joints — Bolting — Part 1: Selection of bolting*

EN 1593, *Non-destructive testing — Leak testing — Bubble emission techniques*

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EN 1712:1997, *Non-destructive testing of welds — Ultrasonic testing of welded joints — Acceptance levels*

EN 1714:1997, *Non-destructive testing of welds — Ultrasonic testing of welded joints*

EN 1759-1:2004, *Flanges and their joint — Circular flanges for pipes, valves, fittings and accessories, Class designated — Part 1: Steel flanges, NPS 1/2 to 24*

EN 1993-1-1, *Eurocode 3: Design of steel structures — Part 1-1: General rules and rules for buildings*

ENV 1993-1-6, *Eurocode 3: Design of steel structures — Part 1-6: General rules — Supplementary rules for the strength and stability of shell structures*

ENV 1993-4-2:1999, *Eurocode 3: Design of steel structures — Part 4-2: Silos, tanks and pipelines — Tanks*

EN 1994-1-1, *Eurocode 4: Design of composite steel and concrete structures — Part 1-1: General rules and rules for buildings*

EN 10025:2004 (all parts), *Hot rolled products of non-alloy structural steels*

EN 10029:1991, *Hot rolled steel plates 3 mm thick or above — Tolerances on dimensions, shape and mass*

EN 10045-1, *Metallic materials — Charpy impact test — Part 1: Test method*

EN 10160:1999, *Ultrasonic testing of steel flat product of thickness equal or greater than 6 mm (reflection method)*

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

EN 10216-1, *Seamless steel tubes for pressure purposes — Technical delivery conditions — Part 1: Non-alloy steel tubes with specified room temperature properties*

EN 10216-2, *Seamless steel tubes for pressure purposes — Technical delivery conditions — Part 2: Non-alloy and alloy steel tubes with specified elevated temperature properties*

EN 10216-3, *Seamless steel tubes for pressure purposes — Technical delivery conditions — Part 3: Alloy fine grain steel tubes*

EN 10216-4, *Seamless steel tubes for pressure purposes — Technical delivery conditions — Part 4: Non-alloy and alloy steel tubes with specified low temperature properties*

EN 10217-1, *Welded steel tubes for pressure purposes — Technical delivery conditions — Part 1: Non-alloy steel tubes with specified room temperature properties*

EN 10217-2, *Welded steel tubes for pressure purposes — Technical delivery conditions — Part 2: Electric welded non-alloy and alloy steel tubes with specified elevated temperature properties*

EN 10217-3, *Welded steel tubes for pressure purposes — Technical delivery conditions — Part 3: Alloy fine grain steel tubes*

EN 10217-4, *Welded steel tubes for pressure purposes — Technical delivery conditions — Part 4: Electric welded non-alloy steel tubes with specified low temperature properties*

EN 10217-5, *Welded steel tubes for pressure purposes — Technical delivery conditions — Part 5: Submerged arc welded non-alloy and alloy steel tubes with specified elevated temperature properties*

EN 10217-6, *Welded steel tubes for pressure purposes — Technical delivery conditions — Part 6: Submerged arc welded non-alloy steel tubes with specified low temperature properties*

EN 10220, *Seamless and welded steel tubes — Dimensions and masses per unit length*

EN 12062:1997, *Non-destructive examination of welds — General rules for metallic materials*

EN 14015:2004, *Specification for the design and manufacture of site built, vertical, cylindrical, flat-bottomed, above ground, welded, steel tanks for the storage of liquids at ambient temperature and above*

EN 14620-1:2006, *Design and manufacture of site built, vertical, cylindrical, flat-bottomed steel tanks for the storage of refrigerated, liquefied gases with operating temperatures between 0°C and -165 °C — Part 1: General*

EN ISO 5817:2003, *Welding — Fusion-welded joints in steel, nickel, titanium and their alloys (beam welding excluded) — Quality levels for imperfections (ISO 5817:2003)*

EN ISO 15607:2003, *Specification and qualification of welding procedures for metallic materials — Part 1: General rules (ISO 15607:2003)*

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 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 261, *ISO general purpose metric screw threads — General plan*

ISO 965-2:1998, *ISO general purpose metric screw threads — Tolerances — Part 2: Limits of sizes for general purpose external and internal screw threads — Medium quality*

API 620:2004, *Design and construction of large, welded, low-pressure storage tanks*

3 Terms and definitions

For the purposes of this European Standard, the terms and definitions given in EN 14620-1:2006 and the following apply.

3.1

amplitude of strain

one half of the range of strains

3.2

progressive deformation

phenomenon in which the deformations in each part of the membrane increase progressively under the cyclic loads

3.3

range of strain

difference between the maximum and minimum values in the cyclic strain curves

3.4

ratcheting

progressive incremental inelastic deformation or strain, which can occur in a component that is subject to variation of mechanical stress

EN 14620-2:2006 (E)**3.5****unstable collapse**

phenomenon in which the assessment of the process of deformation under static load becomes ambiguous

4 Materials**4.1 General**

The temperature to which the steel may be exposed under all conditions is important, and shall be determined.

4.2 Temperatures**4.2.1 Minimum design temperature**

The minimum design temperature shall be used as the design metal temperature for material selection of the primary and secondary liquid container.

4.2.2 Lodmat

The purchaser shall specify the lodmat.

4.2.3 Design metal temperature

When a steel component is protected from the low liquid or vapour temperature by thermal insulation, the design metal temperature shall be calculated based on the most pessimistic assumption under that loading (accidental actions included).

4.3 Primary and secondary liquid container**4.3.1 Steel selection****4.3.1.1 General**

The material requirements for the primary and secondary liquid container given in 4.3.1.2 have been selected primarily for their high level of toughness at the design metal temperature. For each product to be stored, specific material requirements are specified.

4.3.1.2 Material requirements**4.3.1.2.1 Steel classification**

Plate materials shall be classified as follows:

- type I steel: low temperature carbon-manganese steel;
- type II steel: special low temperature carbon-manganese steel;
- type III steel: low nickel steel;
- type IV steel: improved 9 % nickel steel;
- type V steel: austenitic stainless steel.

For each product to be stored, the steel types shall be in accordance with Table 1.

Table 1 — Product and steel class

Product	Single containment tank	Double, or full containment tank	Membrane tank	Typical product storage temperature
Butane	Type II	Type I		- 10 °C
Ammonia	Type II	Type II		- 35 °C
Propane/ Propylene	Type III	Type II	Type V	- 50 °C
Ethane/Ethylene	Type IV	Type IV	Type V	- 105 °C
LNG	Type IV	Type IV	Type V	- 165 °C

NOTE Service related effects, such as stress corrosion cracking, should be considered during material selection.

4.3.1.2.2 General requirements

The following general requirements shall apply:

a) Type I steel:

A Type I steel is a fine-grained, low carbon steel, which shall be specified for pressure purposes at temperatures down to - 35 °C. The steel shall meet the following requirements:

- 1) The steel shall be specified to meet the requirements of an established European Standard (e.g. EN 10028-3). Steels with a minimum yield strength greater than 355 N/mm² shall not be used.
- 2) The steel shall be in the normalized condition or produced by a thermo mechanical rolled process.
- 3) The carbon content shall be less than 0,20 %. The carbon equivalent C_{eq} shall be equal to or less than 0,43 with

$$C_{eq}=C + \frac{Mn}{6} + \frac{(Cr + Mo + V)}{5} + \frac{(Ni + Cu)}{15}$$

b) Type II steel:

A Type II steel is a fine-grained low carbon steel, which shall be specified for pressure purposes at temperatures down to - 50 °C. The steel shall meet the following requirements:

- 1) The steel shall be specified to meet the requirements of an established European Standard (e.g. EN 10028-3). Steels with a minimum yield strength greater than 355 N/mm² shall not be used.
- 2) The steel shall be in the normalized condition or produced by a thermo mechanical rolled process.
- 3) The carbon content shall be less than 0,20 %. The carbon equivalent C_{eq} shall be equal to or less than 0,43 with