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Naļ rtovanje in proizvodnja na mestu postavitve grajenih navpiļ nih, valjastih jeklenih posod z ravnim dnom za shranjevanje hlajenih utekoļ injenih plinov z delovnimi temperaturami med 0 ŃC in ï 165 ŃC - 1. del: Sploġno

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

Auslegung und Herstellung standortgefertigter, stehender, zylindrischer Flachboden-Stahltanks für die Lagerung von tiefkalt verflüssigten Gasen bei Betriebstemperaturen zwischen 0 C und -165 C - Teil 1: Allgemeines

Conception et fabrication de réservoirs en acier a fond plat, verticaux, cylindriques, construits sur site, destinés au stockage de gaz réfrigérés, liquéfiés, dont les températures de service sont comprises entre 0° C et –165° C - Partie 1: Généralités

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23.020.10	Nepremiļ ne posode in rezervoarji	Stationary containers and tanks

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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 1: General

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

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 Central Secretariat 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 Central Secretariat has the same status as the official versions.

CEN members are the national standards bodies of 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.

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Contents

Foreword

This European Standard (EN 14620-1:2006) 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 is a specification for vertical, cylindrical tanks, built on site, above ground and of which the primary liquid container is made of steel. The secondary container, if applicable, may be of steel or of concrete or a combination of both. An inner tank made only of pre-stressed concrete is excluded from the scope of this European Standard.

This European Standard specifies principles and application rules for the structural design of the "containment" during construction, testing, commissioning, operation (accidental included), and decommissioning. It does not address the requirements for ancillary equipment such as pumps, pumpwells, valves, piping, instrumentation, staircases etc. unless they can affect the structural design of the tank.

This European Standard applies to storage tanks designed to store products, having an atmospheric boiling point below ambient temperature, in a dual phase, i.e. liquid and vapour. The equilibrium between liquid and vapour phases being maintained by cooling down the product to a temperature equal to, or just below, its atmospheric boiling point in combination with a slight overpressure in the storage tank.

The maximum design pressure of the tanks covered by this European Standard is limited to 500 mbar. For higher pressures, reference can be made to EN 13445, Parts 1 to 5.

The operating range of the gasses to be stored is between 0 °C and –165 °C. The tanks for the storage of liquefied oxygen, nitrogen and argon are excluded.

The tanks are used to store large volumes of hydrocarbon products and ammonia with low temperature boiling points, generally called "Refrigerated Liquefied Gases" (RLG's). Typical products stored in the tanks are: methane, ethane, propane, butane, ethylene, propylene, butadiene (this range includes the LNG's and LPG's).

NOTE Properties of the gases are given in Annex A.

The requirements of this European Standard cannot cover all details of design and construction because of the variety of sizes and configurations that may be employed. Where complete requirements for a specific design are not provided, the intention is for the designer, subject to approval of the purchaser's authorized representative, to provide design and details that are as safe as those laid out in this European Standard.

This European Standard specifies general requirements for the tank concept, selection and general design considerations.

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 1991-1-4, *Eurocode 1: Actions on structures — Part 1-4: Wind actions*

EN 1991-1-6, *Eurocode 1: Actions on structures — Part 1-6: General actions — Actions during execution*

EN 1992-1-1:2004, *Eurocode 2: Design of concrete structures — Part 1-1: General rules and rules for buildings*

EN 1997-1:2004, *Eurocode 7: Geotechnical design — Part 1: General rules*

EN 1998-1:2004, *Eurocode 8: Design of structures for earthquake resistance — Part 1: General rules, seismic actions and rules for buildings*

ENV 1998-4:1998, *Eurocode 8: Design provisions for earthquake resistance of structures — Part 4: Silos, tanks and pipelines*

EN 14620-2:, *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*

EN 14620-3:2006, *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 3: Concrete components*

EN 14620-4, *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 4: Insulation components*

EN 14620-5, *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 5: Testing, drying, purging and cool-down*

3 Terms and definitions

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

3.1
action
a) set of forces (loads) applied to the structure (direct action)

b) set of imposed deformation or accelerations caused for example, by temperature changes, moisture variation, uneven settlement or earthquakes (indirect action)

3.2
annular space
space between the inner shell and outer shell or wall of self-supporting tanks

3.3
base slab
continuous concrete base supporting the tank (either on the ground or elevated)

3.4
boil-off
process of vaporization of refrigerated liquid by heat conducted through the insulation surrounding the storage tank

3.5
bund wall
low construction of earth or concrete surrounding the storage tank at a considerable distance to contain spilled liquid

3.6
polymeric vapour barrier
reinforced or un-reinforced polymeric layer applied to the concrete to function as a product vapour, water vapour and in some cases as liquid barrier

3.7
contractor
company with which the purchaser agrees a proposal for the design, construction, testing and commissioning of a tank

3.8
design pressure
maximum permissible pressure

3.9
design negative pressure
maximum permissible negative pressure (vacuum)

3.10
design metal temperature
minimum temperature for which the metal component is designed

NOTE It may be the minimum design temperature (in the case of the primary container) or a higher calculated temperature.

3.11
double containment tank
see 4.1.2

3.12
foundations
elements of the construction that comprise the base slab, ring-wall or pile system required to support the tank and contents

3.13
full containment tank
see 4.1.3.

NOTE The secondary container contains the vapour in normal operation and ensures controlled venting in the case of a primary container leakage.

3.14
hazard
event having the potential to cause harm, including ill health and injury, damage to property, products or the environment, production losses or increased liabilities

3.15
inner tank
metallic self-supporting cylindrical primary container

3.16
insulation space
volume containing insulation material in the tank annular space, and between the tank bottoms or roofs

3.17
liner
metallic plate installed against the inside of the concrete outer tank, impervious to product vapour and water vapour

3.18
load bearing insulation
thermal insulation with special properties capable of transferring loads to the appropriate load bearing structures

3.19
lodmat
lowest one-day average ambient temperature.

Note The average temperature is half the sum of the maximum and minimum temperature

3.20
maximum design liquid level
maximum liquid level that will be maintained during operation of the tank used for the static shell thickness determination

3.21
maximum normal operating level
Maximum liquid level that will be maintained during normal operation of the tank. Normally the level at which the first high level alarm is set

3.22
membrane
thin metallic primary container of a membrane tank

3.23
membrane tank
containment whereby a membrane (primary container) together with load bearing thermal insulation and a concrete tank are forming jointly an integrated, composite tank structure

3.24
minimum design temperature
assumed temperature of the product, specified by the purchaser, for which the tank is designed

NOTE This temperature may be lower than the actual product temperature.

3.25
Operating Basis Earthquake (OBE)
maximum earthquake event for which no damage is sustained and restart and safe operation can continue

NOTE This event would result in no loss to the operational integrity and public safety is assured.

3.26
outer tank
self-supporting cylindrical secondary container made of steel or concrete

3.27
purchaser
company who gives an order to the contractor for the design, construction and testing of a tank

3.28
primary liquid container
part of a single, double, full containment or membrane tank that contains the liquid during normal operation

3.29
product vapour barrier
polymeric vapour barrier or a liner to prevent escape of product vapours from the tank

3.30
ringbeam
circular support under the shell of the tank

3.31
roll-over
uncontrolled mass movement of stored liquid, correcting an unstable state of stratified liquids of different densities and resulting in a significant evolution of product vapour

3.32
roof
structure on top of a shell or wall containing the vapour pressure and sealing off the contents from the atmosphere

3.33
Safe Shutdown Earthquake (SSE)
maximum earthquake event for which the essential fail-safe functions and mechanisms are designed to be preserved

NOTE Permanent damage can be accepted, but without the loss of overall integrity and containment. The tank would not remain in operation without a detailed examination and structural assessment.

3.34
secondary liquid container
part of the outer container of a double, full containment or membrane tank that contains the liquid

3.35
self supporting tank
container designed to carry the hydrostatic forces of the stored liquid and the vapour pressure loads, if applicable

3.36
set pressure
pressure at which the pressure relief device first opens

3.37
shell
metallic vertical cylinder

3.38
single containment tank
see 4.1.1

NOTE The product vapour is contained by the primary container or by means of a metallic outer tank.

3.39
suspended roof
structure for supporting the internal insulation of the roof

3.40
test pressure
air pressure in the tank during testing

3.41
Thermal Protection System (TPS)
thermally insulating and liquid tight structure in order to protect the outer tank against low temperatures

NOTE Examples include bottom and bottom corner (see also 7.1.11).

3.42
vapour container
part of a single, double, full containment or membrane tank that contains the vapour during normal operation

3.43
wall
concrete vertical cylinder

3.44
vapour barrier
barrier to prevent entry of water vapour and other atmospheric gases into the insulation or into the outer tank

4 Concept selection

4.1 Types of tank

4.1.1 Single containment

A single containment tank shall consist of only one container to store the liquid product (primary liquid container). This primary liquid container shall be a self-supporting, steel, cylindrical tank.

The product vapours shall be contained by:

— either the steel dome roof of the container;

— or, when the primary liquid container is an open top cup, by a gas-tight metallic outer tank encompassing the primary liquid container, but being only designed to contain the product vapours and to hold and protect the thermal insulation.

NOTE 1 Depending on the options taken for vapour containment and thermal insulation; several types of single containment tanks exist.

A single containment tank shall be surrounded by a bund wall to contain possible product leakage.

NOTE 2 For examples of single containment tanks, see Figure 1.

4.1.2 Double containment

A double containment tank shall consist of a liquid and vapour tight primary container, which itself is a single containment tank, built inside a liquid-tight secondary container.

The secondary container shall be designed to hold all the liquid contents of the primary container in case it leaks. The annular space, between the primary and secondary containers, shall not be more than 6,0 m.

NOTE 1 The secondary container is open at the top and therefore cannot prevent the escape of product vapours. The space between primary and secondary container can be covered by a “rain shield” to prevent the entry of rain, snow, dirt etc.

NOTE 2 For examples of double containment tanks, see Figure 2.

4.1.3 Full containment

A full containment tank shall consist of a primary container and a secondary container, which together form an integrated storage tank. The primary container shall be a self-standing steel, single shell tank, holding the liquid product.

The primary container shall:

— either be open at the top, in which case it does not contain the product vapours

— or equipped with a dome roof so that the product vapours are contained.

The secondary container shall be a self-supporting steel or concrete tank equipped with a dome roof and designed to combine the following functions:

— in normal tank service: to provide the primary vapour containment of the tank (this in case of open top primary container) and to hold the thermal insulation of the primary container;

— in case of leakage of the primary container: to contain all liquid product and to remain structurally vapour tight. Venting release is acceptable but shall be controlled (pressure relief system).

The annular space between the primary and secondary containers shall not be more than 2,0 m.

NOTE 1 Full containment tanks with thermal insulation placed external to the secondary container are also covered by these requirements.

NOTE 2 For examples of full containment tanks, see Figure 3.

4.1.4 Membrane containment

A membrane tank shall consist of a thin steel primary container (membrane) together with thermal insulation and a concrete tank jointly forming an integrated, composite structure. This composite structure shall provide the liquid containment.

All hydrostatic loads and other loadings on the membrane shall be transferred via the load-bearing insulation onto the concrete tank.

The vapours shall be contained by the tank roof, which can be either a similar composite structure or with a gas-tight dome roof and insulation on a suspended roof.

NOTE For an example of a membrane tank, see Figure 4.

In case of leakage of the membrane, the concrete tank, in combination with the insulation system, shall be designed such that it can contain the liquid.