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Utgåva 1

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 4: Isoleringskomponenter

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

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English Version

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

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 4: Constituants isolants

Auslegung und Herstellung standortgefertigter, stehender, zylindrischer Flachboden-Stahltanks für die Lagerung von tiefkalt verflüssigten Gasen bei einer Betriebstemperatur zwischen 0 °C und -165 °C - Teil 4: Dämmung

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.

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COMITÉ EUROPÉEN DE NORMALISATION
EUROPÄISCHES KOMITEE FÜR NORMUNG

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Contents

Foreword

This European Standard (EN 14620-4:2006) 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 the requirements for materials, design and installation of the insulation of refrigerated liquefied gas (RLG) storage tanks.

RLG storage tanks store liquefied gas with a low boiling point, i.e. below normal ambient temperature.

The concept of storing such products in liquid form and in non-pressurized tanks therefore depends on the combination of latent heat of vaporization and thermal insulation.

Consequently thermal insulation for RLG storage tanks is not an ancillary part of the containment system (as for most ambient atmospheric hydrocarbon tanks) but it is an essential component and the storage tank cannot operate without a properly designed, installed and maintained insulation system.

The main functions of the insulation in RLG storage tanks are:

— to maintain the boil off below the specific limits;

— to protect the non low temperature parts/materials of the tank (mainly the outer tank) by maintaining these parts at their required ambient temperature;

— to limit the cool-down of the foundations/soil underneath the tank to prevent damage by frost heave;

— to prevent/minimize condensation and icing on the outer surfaces of the tank.

A wide range of insulation materials is available. However the material properties differ greatly amongst the various generically different materials and also within the same generic group of materials.

Therefore within the scope of this European Standard, only general guidance on selection of materials is given.

NOTE For general guidance on selection of materials see Annex A.

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 826:1996, *Thermal insulating products for building applications — Determination of compression behaviour*

EN 1604, *Thermal insulating products for building applications — Determination of dimensional stability under specified temperature and humidity conditions*

EN 1606, *Thermal insulating products for building applications — Determination of compressive creep*

EN 1607, *Thermal insulating products for building applications — Determination of tensile strength perpendicular to faces*

EN 1608, *Thermal insulating products for building applications — Determination of tensile strength parallel to faces*

EN 1609, *Thermal insulating products for building applications — Determination of short term water absorption by partial immersion*

EN 12066, *Installations and equipment for liquefied natural gas — Testing of insulating linings for liquefied natural gas impounding areas*

EN 12086, *Thermal insulating products for building applications — Determination of water vapour transmission properties*

EN 12087, *Thermal insulating products for building applications — Determination of long term water absorption by immersion*

EN 12088, *Thermal insulating products for building applications — Determination of long term water absorption by diffusion*

EN 12090:1997, *Thermal insulating products for building applications — Determination of shear behaviour*

EN 12091, *Thermal insulating products for building applications — Determination of freeze-thaw resistance*

EN 12667, *Thermal performance of building materials and products — Determination of thermal resistance by means of guarded hot plate and heat flow meter methods — Products of high and medium thermal resistance*

EN 12939, *Thermal performance of building materials and products — Determination of thermal resistance by means of guarded hot plate and heat flow meter methods — Thick products of high and medium thermal resistance*

EN 13468, *Thermal insulating products for building equipment and industrial installations — Determination of trace quantities of water soluble chloride, fluoride, silicate, sodium ions and pH*

EN 13471, *Thermal insulating products for building equipment and industrial installations — Determination of the coefficient of thermal expansion*

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 62, *Plastics — Determination of water absorption (ISO 62:1999)*

EN ISO 3582, *Flexible cellular polymeric materials — Laboratory assessment of horizontal burning characteristics of small specimens subjected to a small flame (ISO 3582:2000)*

EN ISO 4590, *Rigid cellular plastics — Determination of the volume percentage of open cells and closed cells (ISO 4590:2002)*

EN ISO 4624, *Paints and varnishes — Pull-off test for adhesion (ISO 4624:2002)*

ISO 844, *Rigid cellular plastics — Determination of compression properties*

ISO 4897, *Cellular plastics — Determination of the coefficient of linear thermal expansion of rigid materials at sub-ambient temperatures*

ISO 8301, *Thermal insulation — Determination of steady-state thermal resistance and related properties — Heat flow meter apparatus*

ISO 8302, *Thermal insulation — Determination of steady-state thermal resistance and related properties — Guarded hot plate apparatus*

3 Terms and definitions

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

4 Design requirements, performance characteristics, testing and selection of insulating materials

4.1 General

The selection of the appropriate insulation system and materials shall be based on the following:

— analysis of design requirements (see 4.2).

— assessment of the performance characteristics of the materials (see 4.3).

For the insulation materials used, see Annex A.

4.2 Analysis of design requirements

4.2.1 General

The thermal insulation system as a whole and each component of it separately, shall be designed taking into account the following design requirements.

4.2.2 Thermal resistance

4.2.2.1 Normal operation of the tank

All factors contributing to heat in-leak through the insulation system shall be considered, such as:

— product temperature;

— external temperature and other climatic conditions (solar radiation, wind, humidity etc.);

— thermal conductivity;

NOTE A safety margin to be built in for influences of degradation through ageing.

— thermal convection;

— heat in-leak through radiation;

— heat in-leak through cold bridges (from insulation system or tank design).

4.2.2.2 Accidental conditions

In addition, accidental conditions shall be considered. These shall include:

— required thermal resistance, specified for each component of the insulation and the designed duration of the accidental condition;

— thermal resistance offered by the insulation under these conditions.

4.2.3 Structural requirements

The insulation system shall be designed for the following structural requirements:

— static and dynamic actions in all directions;

— liquid tightness (if required).

4.2.4 Specific design requirements

In addition to the above thermal and structural requirements, the tank insulation design shall fulfil all the specific design requirements that are inherent with the selected specific insulation system, material, installation method and type of containment. These shall be specified on a case-by-case basis.

4.3 Assessment of the performance characteristics

4.3.1 General

Based on the design requirements, the required performance characteristics of the insulation materials in the operating temperature range shall be determined. As a minimum the subjects described in 4.3.2 to 4.3.8 shall be considered.

4.3.2 Thermal resistance

The following shall be considered:

— thermal conductivity:

  1) over the required temperature range;

  2) in the intended environment, external and internal (product vapour space, purged space, contact with liquid product);

  3) taking into account ageing effects over the tank design lifetime;

— possible heat in-leak through radiation;

— possible heat in-leak through convection (permeability of the insulation material and of the complete insulation system);

— heat in-leak through cold bridges.

For testing of thermal resistance, see Table B.1.

4.3.3 Mechanical properties

The following shall be considered:

— compressive properties both at short- and at long-term (creep);

— tensile and shear properties for insulation on which lateral forces may act (e.g. earthquake).

NOTE Tensile properties may also be required for assessment of thermo-mechanical loads and thermal stresses.

— adhesive strength for insulation systems, which are installed by adhesion.

For testing of mechanical properties, see Table B.2.

4.3.4 Temperature resistance

The insulation shall withstand the temperatures (maximum and minimum service temperatures) and temperature variations to which it may be exposed. Therefore, shrinkage, expansion and possible cracking effects shall be determined, taking into account:

— coefficient of thermal expansion, contraction;

— tensile strength, tensile modulus in the designed temperature ranges.

For testing of temperature resistance, see Table B.3.

4.3.5 Resistance to water and water vapour

To assess the possible negative effects of water and water vapour on the insulation, the following characteristics shall be considered:

— closed cell content;

— permeability for water vapour;

— water absorption.

In addition, the consequential effects of water and water vapour penetration shall be assessed:

— reduction of thermal resistance;

— possible structural damage to the insulation by liquid water or by the process of freezing (possibly freeze/thaw cycles).

For testing permeability of water and water vapour, see Table B.4.

4.3.6 Influences of stored product

The following characteristics shall be assessed:

— closed cell content (as indication of open/closed cellular structure);

— absorption of product vapours and effect on other material properties (thermal conductivity, mechanical properties, fire resistance);

— absorption of/and permeability for liquid product;

— effects of long term liquid absorption on other material properties;

— desorption behaviour: time/percentage.

NOTE The influence of the stored product on an internal insulation system is critical, as it is often continuously in contact with product vapours and it can come in direct contact with the liquid product in case of an accidental leakage.

For testing of material behaviour in presence of product, see Table B.5.

4.3.7 Chemical properties

An assessment shall be made of the compatibility between and/or possible chemical reactions of:

— insulation system, including all its constituents:

  1) insulation materials;

  2) ancillary products (paints, adhesives, mastics, sealants, coatings etc.);

  3) its protective layer (cladding and fastening);

— its environment:

  1) for external insulation: ambient conditions, water, water vapour, contaminants in air and water;

  2) for internal insulation: the product vapours and liquid, inerting/purging gas;

— tank material and/or its coating in contact with the insulation system.

Typical chemical characteristics to be assessed shall be:

— for external insulation:

  1) resistance to corrosion of the insulation system itself (or parts of it) in conditions representative for the site location, e.g.: marine atmosphere, atmosphere polluted by chemical industries;

  2) corrosion protective or corrosion activating properties of the insulation, e.g.: possibility of dissolving or leaching out corrosive products from the insulation, corrosion protection in case of waterproof insulation system;

— for internal insulation:

  1) chemical resistance of the insulation system against the product vapours/liquids in the tank;

  2) insulation to be inert for the products stored in the tank (absence of contaminants, chemical reagents).

For methods of assessing the chemical properties, see Table B.6