SLOVENSKI STANDARD
oSIST prEN 14620-4:2023

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Konstruiranje in proizvodnja na mestu postavitve grajenih pokončnih, valjastih posod z ravnim dnom za shranjevanje hlajenih utekočinjenih plinov z delovnimi temperaturami med 0 °C in –196 °C - 4. del: Izolacijski deli

Design and manufacture of site built, vertical, cylindrical, flat-bottomed tank systems for the storage of refrigerated, liquefied gases with operating temperatures between 0 °C and -196 °C - Part 4: Insulation components

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

Conception et fabrication de réservoirs 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 -196 °C - Partie 4: Constituants isolants

Ta slovenski standard je istoveten z: **prEN 14620-4**

ICS:

23.020.10	Nepremične posode in rezervoarji	Stationary containers and tanks

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This draft European Standard is submitted to CEN members for enquiry. It has been drawn up by the Technical Committee CEN/TC 265.

If this draft becomes a European Standard, 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.

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

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European foreword

This document (prEN 14620-4:2023) 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 document will supersede EN 14620-4:2006.

In comparison with EN 14620-4:2006, the following changes have been made:

— General editorial update;

— Normative reference updated;

— Recent insulating materials European standards introduced and Annex B updated;

— Aspects related to insulating materials fire behaviour developed and clarified;

— Brittle material compressive behaviour clarified with the use of interleaving material;

— Requirements for Insulation for penetrations and internal piping introduced;

— New annex added about the recommendations for qualification compressive strength testing of tank insulation system made of brittle material;

— New annex for non-metallic TPS added;

— Annex about limit state theory for tank bottom insulation removed.

EN 14620 *Design and manufacture of site built, vertical, cylindrical, flat-bottomed tank system for the storage of refrigerated, liquefied gases with operating temperatures between 0 °C and -196 °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;*

— *Part 6: Specific requirements for the design and construction of tank systems for the storage of liquefied oxygen (LOX), liquefied nitrogen (LIN) and liquefied argon (LAR);*

— *Part 7: Specific requirements for the design and construction of tank systems for the storage of liquefied anhydrous ammonia.*

1 Scope

This document specifies the requirements for materials, design and installation of the insulation of refrigerated liquefied gas (RLG) storage tank systems.

RLG storage tank systems 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 tank systems 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 system cannot operate without a properly designed, installed and maintained insulation system.

The main functions of the insulation in RLG storage tank systems are:

— to maintain the boil off at or below the specified limits;

— to protect the outer tank components by maintaining them at or above their minimum design temperature;

— to prevent damage by frost heave of the foundation/soil beneath the tank base slab (in combination with the slab heating system for tanks resting at grade);

— to 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 document, only general guidance on selection of materials is given.

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

This document deals with the design and manufacture of site built, vertical, cylindrical, flat-bottomed tank systems for the storage of refrigerated, liquefied gases with operating temperatures between 0 °C and -196 °C.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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 1363-1, *Fire resistance tests - Part 1: general requirements*

EN 1363-2, *Fire resistance tests - Part 2: Alternative and additional procedures*

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

EN 1993-1-2, *Eurocode 3 - Design of steel structures - Part 1-2: General rules - Structural fire design*

EN 13501-1, *Fire classification of construction products and building elements - Part 1: classification using data from reaction to fire tests*

EN 13501-2, *Fire classification of construction products and building elements - Part 2: Classification using data from fire resistance tests, excluding ventilation services*

EN 13381-4, *Test methods for determining the contribution to the fire resistance of structural members - Part 4: Applied passive protection to steel members*

EN 14303, *Thermal insulation products for building equipment and industrial installations - Factory made mineral wool (MW) products - Specification*

EN 14305:2015, *Thermal insulation products for building equipment and industrial installations - Factory made cellular glass (CG) products - Specification*

EN 14307, *Thermal insulation products for building equipment and industrial installations - Factory made extruded polystyrene foam (XPS) products - Specification*

EN 14308, *Thermal insulation products for building equipment and industrial installations - Factory made rigid polyurethane foam (PUR) and polyisocyanurate foam (PIR) products - Specification*

EN 14309, *Thermal insulation products for building equipment and industrial installations - Factory made products of expanded polystyrene (EPS) - Specification*

EN 14314, *Thermal insulation products for building equipment and industrial installations - Factory made phenolic foam (PF) products - Specification*

prEN 14620-1:2022, *Design and manufacture of site built, vertical, cylindrical, flat-bottomed tank systems for the storage of refrigerated, liquefied gases with operating temperatures between 0°C and - 196 °C - Part 1: General*

EN 15599-1, *Thermal insulation products for building equipment and industrial installations - In-situ thermal insulation formed from expanded perlite (EP) products - Part 1: Specification for bonded and loose-fill products before installation*

EN ISO 1182, *Reaction to fire tests for products - Non-combustibility test (ISO 1182)*

EN ISO 1716, *Reaction to fire tests for products - Determination of the gross heat of combustion (calorific value) (ISO 1716)*

EN ISO 12624, *Thermal insulating products for building equipment and industrial installations - Determination of trace quantities of water-soluble chloride, fluoride, silicate, sodium ions and pH (ISO 12624)*

EN ISO 16535, *Thermal insulating products for building applications - Determination of long-term water absorption by immersion (ISO 16535)*

EN ISO 29469:2022, *Thermal insulating products for building applications - Determination of compression behaviour (ISO 29469:2022)*

ISO 3951-1, *Sampling procedures for inspection by variables - Part 1: Specification for single sampling plans indexed by acceptance quality limit (AQL) for lot-by-lot inspection for a single quality characteristic and a single AQL*

ASTM E84, *Standard Test Method for Surface Burning Characteristics of Building Materials*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in prEN 14620-1:2022 apply.

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

— IEC Electropedia: available at https://www.electropedia.org/

— ISO Online browsing platform: available at https://www.iso.org/obp

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).

Information on common material selection may be found in Annex A.

Selected material shall comply with the relevant European Standards as follows (non exhaustive list):

— Expanded Perlite: EN 15599-1;

— Mineral Wool: EN 14303;

— Cellular Glass: EN 14305:2015;

— Extruded Polystyrene: EN 14307;

— Rigid Polyurethane (PUR) and Polyisocyanurate (PIR) foam: EN 14308;

— Expanded Polystyrene: EN 14309;

— Phenolic foam: EN 14314.

Other insulating materials can be used providing they meet design requirements and performance characteristics specified in this document.

For the specific application of this document, refer also to 4.3 and Annex B for the assessment of performance characteristics.

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 ambient temperature and other climatic conditions (solar radiation, wind velocity, humidity, etc.);

— thermal conductivity, including effects of ageing and exposure;

— thermal convection;

— heat in-leak through radiation;

— heat in-leak through cold bridges (including but not limited to nozzles, TPS, anchors, deck rods, etc).

4.2.2.2 Accidental conditions

Each insulation component shall provide appropriate thermal resistance for all specified accidental conditions. The thermal performance shall be retained for the duration of and following the accidental condition.

4.2.3 Structural and tightness requirements

The insulation system shall be designed to resist all applicable static and dynamic actions for both normal and accidental conditions, unless the insulation is not intended to provide the structural resistance.

The insulation system shall provide liquid tightness and vapour tightness, if specified.

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.

4.2.5 Ageing and deterioration

The insulation shall be resistant to deterioration from environmental conditions, ageing and product exposure:

— There shall be no reduction in insulation thermal or mechanical performance due to ageing and no deterioration from the exposure to substances insulation may be in contact during its lifetime.

— Ageing and deterioration shall not affect performance of the insulation support and attachment systems.

— If such deterioration is possible, it shall be accounted in the insulation design.

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:

a) 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;

b) possible heat in-leak through radiation;

c) possible heat in-leak through convection (permeability of the insulation material and of the complete insulation system). Where insulation of a tank wall consists solely of glass fibre or mineral wool insulation, thermal design shall account for enhancement of convective heat transfer due to the air gas permeability of the insulation;

d) heat in-leak through cold bridges.

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 can also be required for assessment of thermo-mechanical loads and thermal stresses.

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

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.

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).

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.1.

4.3.7 Chemical properties

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

a) 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);

b) 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;

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

Typical chemical characteristics to be assessed shall be:

d) 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;

e) 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.2.