
Steklasti in keramični emajli – Projektiranje s steklastim emajlom zaščitenih jeklenih rezervoarjev za skladiščenje ali pripravo vode ali komunalnih ali industrijskih odplak

Vitreous and porcelain enamels - Design of bolted steel tanks for the storage or treatment of water or municipal or industrial effluents and sludges

Emails und Emaillierungen - Gestaltung von emailbeschichteten verschraubten Stahlbehältern für die Speicherung oder Behandlung von Wasser oder kommunalen und industriellen Abwässern

Emaux vitrifiés - Conception de réservoirs en acier, boulonnés et revetus d'émail vitrifié pour le stockage ou le traitement des eaux ou des effluents d'eaux usées principales

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English Version

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 Abwasserschlämme

This European Standard was approved by CEN on 3 February 2007.

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.

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Management Centre: rue de Stassart, 36 B-1050 Brussels

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Foreword

This document (EN 15282:2007) has been prepared by Technical Committee CEN/TC 262 “Metallic and other inorganic coatings”, 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of an identical text or by endorsement, at the latest by September 2007, and conflicting national standards shall be withdrawn at the latest by September 2007.

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.

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EN 15282:2007 (E)**1 Scope**

This European Standard establishes the requirement for the design and use of vitreous enamel coated bolted cylindrical steel tanks for the storage or treatment of water or municipal or industrial effluents and sludges.

This European Standard applies to the design of the tank and any associated roof and gives guidance on the requirements for the design of the foundation.

This European Standard applies where:

- a) the tank is cylindrical and symmetrical on plan and is mounted on a load-bearing base substantially at or above ground level;
- b) the multiple of the tank diameter in meters and the wall height in meters has a value within the range 5 to 500;
- c) the tank diameter does not exceed 100 m, and the total wall height does not exceed 50 m;
- d) the stored material has the characteristics of a liquid exerting negligible friction force in the tank wall; the stored material may be undergoing treatment as part of a municipal or industrial effluent treatment process;
- e) the internal pressure above the liquid does not exceed 50 kPa and the internal partial vacuum above the liquid does not exceed 10 kPa;
- f) the walls of the tank are vertical;
- g) the floor of the tank is substantially flat at its intersection with the wall; the floor of the tank may have a rise or fall built in to allow complete emptying of the tank contents. The slope should not exceed 1:100;
- h) there is negligible inertial and impact load due to tank filling;
- i) the minimum thickness of the tank shell is 1,5 mm;
- j) the material used for the manufacture of the steel sheets is carbon steel; (tanks constructed of sheets made from aluminium or stainless steel are outside the scope of this European Standard),
- k) the temperature of the tank wall during operation is within the range - 50 °C to + 100 °C under all operating conditions.

This European Standard also gives details of procedures to be followed during site installation and for inspection and maintenance of the installed tank.

It does not apply to chemical reaction vessels.

It does not apply to tanks fitted with floating roofs.

It does not cover resistance to fire.

2 Normative references

The following referenced documents are indispensable for the application 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 101, *Ceramic tiles — Determination of scratch hardness of surface according to Mohs*

- EN 1993-1-6, *Eurocode 3 — Design of steel structures — Part 1-6: Strength and Stability of Shell Structures*
- EN 1993-4-1, *Eurocode 3 — Design of steel structures — Part 4-1: Silos*
- EN 1993-4-2, *Eurocode 3 — Design of steel structures — Part 4-2: Tanks*
- EN 1998-4, *Eurocode 8: Design of structures for earthquake resistance — Part 4: Silos, tanks and pipelines*
- EN 10209:1996, *Cold rolled low carbon steel flat products for vitreous enamelling — Technical delivery conditions*
- EN 14430:2004, *Vitreous and porcelain enamels — High voltage test*
- EN 14483-1:2004, *Vitreous and porcelain enamels — Determination of resistance to chemical corrosion — Part 1: Determination of resistance to chemical corrosion by acids at room temperature*
- EN 14483-2:2004, *Vitreous and porcelain enamels — Determination of resistance to chemical corrosion — Part 2: Determination of resistance to chemical corrosion by boiling acids, neutral liquids and/or their vapours*
- EN 14483-3:2004, *Vitreous and porcelain enamels — Determination of resistance to chemical corrosion — Part 3: Determination of resistance to chemical corrosion by alkaline liquids using a hexagonal vessel*
- EN 14483-4:2004, *Vitreous and porcelain enamels — Determination of resistance to chemical corrosion — Part 4: Determination of resistance to chemical corrosion by alkaline liquids using a cylindrical vessel*
- EN ISO 2178, *Non-magnetic coatings on magnetic substrates — Measurement of coating thickness — Magnetic method (ISO 2178:1982)*
- EN ISO 8289:2001, *Vitreous and porcelain enamels — Low voltage test for detecting and locating defects (ISO 8289:2000)*
- ISO 2747, *Vitreous and porcelain enamels — Enamelled cooking utensils — Determination of resistance to thermal shock*
- ISO 2859-1, *Sampling procedures for inspection by attributes — Part 1: Sampling schemes indexed by acceptance quality limit (AQL) for lot-by-lot inspection*
- ISO 4532, *Vitreous and porcelain enamels — Determination of the resistance of enamelled articles to impact — Pistol test*
- ISO 6370-2, *Vitreous and porcelain enamels — Determination of resistance to abrasion — Part 2: Loss in mass after sub-surface abrasion*
- ISO 15686-1, *Building and constructed assets — Service life planning — Part 1: General principles*
- ANSI/AWWA D103-97, *Factory-Coated Bolted Steel Tanks for Water Storage*

3 Terms and definitions

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

3.1 brief

working document which specifies at any point in time the relevant needs and aims of the project, resources to be provided by the client, the details of the project and any applicable design requirements within which all subsequent briefing (when needed) and designing can take place

EN 15282:2007 (E)**3.2****client**

person or organisation that requires a tank to be provided, altered or extended and is responsible for initiating and approving the brief

3.3**defect**

break in the surface of the vitreous enamel

3.4**designer**

person or organisation responsible for stating the form and specification of the component to be designed

3.5**design life**

service life intended by the designer

3.6**discontinuity**

defect area or spot that allows an electric current to pass when tested with the low voltage or high voltage test apparatus used in accordance with 10.3.2.2

3.7**enamel supplier**

person or organisation supplying materials for use by the vitreous enameller in the enamelling process

3.8**freeboard**

distance between the top of the cylindrical tank vertical shell wall and the surface of the contained liquid at the specified operating level

3.9**headspace pressure**

pressure within a roofed tank above the stored liquid

3.10**inspection area**

area inside a boundary 25 mm from any panel edge or hole, and outside a boundary 25 mm from any opening or hole within the body of the panel

3.11**liquid**

bulk substance that exerts substantially the same vertical and horizontal pressures and has no fixed form

3.12**maintenance**

combination of all technical and associated administrative actions during the service life to retain a tank or its parts in a state in which it can perform its required function

3.13**manufacturer**

person or organisation that manufactures the tank or parts of the tank

3.14**purchaser**

person or organisation purchasing the tank from the supplier

NOTE The purchaser can also be the client.

3.15**rectification**

return of a tank or its parts to an acceptable condition by the renewal, replacement or mending of worn, damaged or degraded parts

3.16**supplier**

person or organisation that supplies the tank or parts of the tank

3.17**service life**

period of time after installation during which the tank or its parts meets or exceeds the performance requirements

3.18**tank**

cylindrical, vertical shell for containing liquid, with or without a roof, which is constructed from vitreous enamelled curved steel panels bolted together on the construction site and mounted on a base which may also form the floor of the container

3.19**vitreous enameller**

person undertaking and controlling the process of preparing the steel sheets and applying the vitreous enamel coating to the surfaces of the steel sheet

NOTE The vitreous enameller will normally be the manufacturer.

3.20**vitreous enamel**

substantially vitreous, or glassy inorganic silica coating bonded to steel by fusion at a temperature above 750 °C

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NOTE 1 This coating is applied for protective purposes to the internal liquid contact surface of the steel and for functional and decorative purposes to the external surface of the steel.

NOTE 2 This coating is produced by the proprietary formulation of silica glass, minerals and clays to produce a sprayable medium, dry or suspended in water on to the surface of curved steel sheets and its subsequent fusion bonding.

4 Symbols and abbreviated terms

For the purposes of this document, the following symbols and abbreviations apply.

D	Tank diameter
E	Young's modulus of elasticity
F_H	Static hoop force
g	Acceleration due to gravity
H	Depth of liquid at point under consideration measured from the liquid surface at the maximum possible filling level
H_0	Total vertical wall height
l	Length of shell between intermediate stiffeners
I_z	Second moment of area of a stiffener
p_n	Static liquid pressure at a specified depth
p_h	Headspace pressure

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r	Tank radius
$q_{r,cr}$	Critical external buckling pressure
$q_{w,max}$	Maximum stagnation pressure due to wind
w	Proportion of dissolved solids in sludge
t	Shell plate thickness
ν	Poisson's ratio
γ	Partial load factor
ρ	Relative density of a liquid
σ	Stress
$\sigma_{z,cr}$	Critical axial buckling resistance
cr	(subscript) Critical
ds	(subscript) Dissolved solids
h	(subscript) Headspace
max	(subscript) Maximum value
n	(subscript) Normal to the tank wall
s	(subscript) Sludge
w	(subscript) Wind
z	(subscript) Coincident with the central axis of a shell of revolution
φ	(subscript) Coincident with the radial axis of a shell of revolution

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5 Units

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The use of one of the following sets of consistent units is recommended:

— dimensions:	m, mm
— unit weight:	kN/m ³ , N/mm ³
— forces and loads:	kN, N
— line forces and line loads:	kN/m, N/mm
— pressures and area distributed actions:	kPa, MPa
— unit mass:	kg/m ³ , kg/mm ³
— acceleration:	km/s ² , m/s ²
— membrane stress resultants:	kN/m, N/mm
— bending stress resultants:	kNm/m, Nmm/mm
— stresses and elastic moduli:	kPa, MPa (1 MPa = 1 N/mm ²)

6 Information and requirements to be agreed and documented

6.1 General

For the safe design and manufacture of the tank and associated parts, the specification shall be agreed by the contracting parties.

6.2 Information to be provided by the purchaser

The purchaser shall provide specification data to the supplier that shall include, but is not limited to the following.

- a) Specification of the stored liquid that shall include, but not be limited to:
 - 1) name and/or description;
 - 2) relative density;
 - 3) any relevant properties or characteristics particular to the liquid to be stored;
 - 4) operating temperature range.
- b) Environmental conditions that shall include, but not be limited to:
 - 1) wind; iTeh STANDARD PREVIEW
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 - 2) seismic; [SIST EN 15282:2007](https://standards.iteh.ai/catalog/standards/sist/d21408f8-630b-4183-85f6-03302bf887ae/sist-en-15282-2007)
 - 3) snow; <https://standards.iteh.ai/catalog/standards/sist/d21408f8-630b-4183-85f6-03302bf887ae/sist-en-15282-2007>
 - 4) ice; [SIST EN 15282:2007](https://standards.iteh.ai/catalog/standards/sist/d21408f8-630b-4183-85f6-03302bf887ae/sist-en-15282-2007)
 - 5) temperature range.
- c) The usage and planned dimensions of the tank that shall include, but not be limited to:
 - 1) the rate of fill and discharge;
 - 2) a summary describing the function and method of the process;
 - 3) the net effects of the process on the tank or any of its components.
- d) The planned location of all openings into the tank shell and roof.
- e) Attached equipment:
 - 1) method of attachment;
 - 2) dead and live loads;
 - 3) connections.
- f) Proximity of other tanks and buildings.

EN 15282:2007 (E)**6.3 Information to be provided by the designer**

The designer shall provide essential data concerning the design limitations of the tank that shall include, but not be limited to the following:

- a) the name and description of the stored liquid or liquids;
- b) the range of values of relative density of the stored liquid or liquids;
- c) the limits of the environmental criteria used in the design including, where relevant, the design wind speed, the design operating temperature range, the design snow load and the seismic zone and seismic coefficients;
- d) the maximum access and superimposed loads used in the design;
- e) a maintenance plan conforming to the requirements of ISO 15686-1;
- f) guidance concerning change of use;
- g) all relevant data assumed by the designer used in the design process.

7 Applicable standards

All activities specified in this European Standard shall be carried out under an appropriate quality management system. A quality management system conforming to EN ISO 9001 [1] will be deemed to satisfy the requirements.

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The designer and client shall agree through consultation upon the applicable standards to be used for design. Where provision is not made within this European Standard, other European Standards or national standards may be specified.

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The applicable standards agreed upon shall include, but not be limited to, standards providing details of parameters for the following design procedures:

- a) hydrostatic loads;
- b) wind loads;
- c) seismic loads;
- d) access loads;
- e) snow loads;
- f) rain loads;
- g) load factors;
- h) sheet strength calculations;
- i) bolt strength calculations;
- j) stability calculations;
- k) foundation design.