



**SLOVENSKI STANDARD**  
**SIST EN 1993-4-2:2007/oprA1:2016**  
**01-oktober-2016**

---

**Evrokod 3: Projektiranje jeklenih konstrukcij - 4-2. del: Rezervoarji**

Eurocode 3 - Design of steel structures - Part 4-2: Tanks

Eurocode 3: Bemessung und Konstruktion von Stahlbauten - Teil 4-2: Tankbauwerke

Eurocode 3 - Calcul des structures en acier - Partie 4-2: Réservoirs

**Ta slovenski standard je istoveten z: EN 1993-4-2:2007/prA1:2016**

<https://standards.iteh.ai/catalog/standards/sist/b329bc69-e44a-4e2f-80f9-e4ae113800a5/sist-en-1993-4-2-2007-a1-2017>

**ICS:**

23.020.10	Nepremične posode in rezervoarji	Stationary containers and tanks
91.010.30	Tehnični vidiki	Technical aspects
91.080.13	Jeklene konstrukcije	Steel structures

**SIST EN 1993-4-2:2007/oprA1:2016**      **en,fr,de**



EUROPEAN STANDARD  
NORME EUROPÉENNE  
EUROPÄISCHE NORM

**DRAFT**  
**EN 1993-4-2:2007**  
**prA1**

August 2016

ICS 23.020.10; 91.010.30; 91.080.10

English Version

## Eurocode 3 - Design of steel structures - Part 4-2: Tanks

Eurocode 3 - Calcul des structures en acier - Partie 4-2:  
Réservoirs

Eurocode 3: Bemessung und Konstruktion von  
Stahlbauten - Teil 4-2: Tankbauwerke

This draft amendment is submitted to CEN members for enquiry. It has been drawn up by the Technical Committee CEN/TC 250.

This draft amendment A1, if approved, will modify the European Standard EN 1993-4-2:2007. If this draft becomes an amendment, CEN members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for inclusion of this amendment into the relevant national standard without any alteration.

This draft amendment was established by CEN 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-CENELEC Management Centre has the same status as the official versions.

CEN members are the national standards bodies of Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, Former Yugoslav Republic of Macedonia, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and United Kingdom.

Recipients of this draft are invited to submit, with their comments, notification of any relevant patent rights of which they are aware and to provide supporting documentation.

**Warning** : This document is not a European Standard. It is distributed for review and comments. It is subject to change without notice and shall not be referred to as a European Standard.



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

**CEN-CENELEC Management Centre: Avenue Marnix 17, B-1000 Brussels**

## Contents

	Page
European foreword.....	3
1 Modification to the Foreword .....	4
2 Modifications to 1.1, Scope.....	4
3 Modifications to 1.2, Normative references.....	5
4 Modifications to 1.5, Terms and definitions .....	5
5 Deletion of 1.7.2, Conventions for global tank structure axis system for rectangular tanks .....	6
6 Modifications to 1.7.3 (new numbering 1.7.2), Conventions for structural element axes in both circular and rectangular tanks.....	6
7 Modifications to 1.7.4 (new numbering 1.7.3), Conventions for stress resultants for circular tanks and rectangular tanks.....	7
8 Modification to 2.2, Reliability differentiation .....	7
9 Modifications to 2.7, Modelling of the tank for determining action effects .....	9
10 Deletion of 2.10, Combinations of actions.....	9
11 Modification to 3.5.1, General.....	9
12 Modification to 3.5.2, Minimum design metal temperature .....	10
13 Modifications to 4.1.3, Effects of corrosion.....	10
14 Modification to 4.2.2.1, General .....	11
15 Deletion of 4.3, Analysis of the box structure of a rectangular tank.....	11
16 Modifications to 5.3, Resistance of the tank shell wall .....	11
17 Modification to 5.4.6.3, Design of shell man holes and shell nozzles of large size for LS1 .....	11
18 Modification to 5.4.7, Anchorage of the tank.....	11
19 Deletion of Clause 6, Design of conical hoppers.....	12
20 Modification to 7.1.2, Roof design .....	12
21 Modification to 7.3, Resistance of circular roofs.....	12
22 Modification to 7.4.3, Roof to shell junction (eaves junction).....	12
23 Deletion of Clause 8, Design of transition junctions at the bottom of the shell and supporting ring girders .....	12
24 Deletion of Clause 9, Design of rectangular and planar-sided tanks.....	12
25 Deletion of Clause 10, Requirements on fabrication, execution and erection with relation to design.....	12
26 Modification to Clause 11, Simplified design.....	12
27 Modification to 11.1, General .....	12
28 Modification to 11.2.1, Unstiffened roof shell butt welded or with double lap weld .....	12
29 Modifications to 11.3.2, Stiffening rings.....	13
30 Modification to A.1, General .....	13

## European foreword

This document (EN 1993-4-2:2007/prA1:2016) has been prepared by Technical Committee CEN/TC 250 “Structural Eurocodes”, the secretariat of which is held by BSI.

This document is currently submitted to the CEN Enquiry.

This document has been prepared under a mandate given to CEN by the European Commission and the European Free Trade Association.

iTeh STANDARD PREVIEW  
(standards.iteh.ai)

SIST EN 1993-4-2:2007/A1:2017

<https://standards.iteh.ai/catalog/standards/sist/b329bc69-e44a-4e2f-80f9-e4ae113800a5/sist-en-1993-4-2-2007-a1-2017>

## EN 1993-4-2:2007/prA1:2016 (E)

**1 Modification to the Foreword**

In the Foreword, in the section "National Annex for EN 1993-4-2", in the 2<sup>nd</sup> paragraph, replace the whole list with the following one:

- "
- 2.2 (1)
  - 2.2 (3)
  - 2.9.2 (3)P
  - 2.9.3 (2)
  - 3.3 (3)
  - 4.1.4 (3)".

**2 Modifications to 1.1, Scope**

Replace Paragraph (1) with the following one (including the present Footnote 1)):

"(1) Part 4-2 of Eurocode 3 provides principles and application rules for the structural design of vertical cylindrical, conical and pedestal above ground steel tanks for the storage of liquid products with the following characteristics:

- a) tanks with capacity greater than 100 m<sup>3</sup> (100 000 litres);
- b) tanks that have significant fabrication or assembly on site;
- c) shop-fabricated tanks with conical bottoms, supported on skirts or columns;
- d) tanks with characteristic internal pressures above the liquid surface not more negative than -0,1 bar and not greater than 0,5 bar<sup>1)</sup>;
- e) design metal temperatures limited to the ranges:
  - 1) tanks constructed using structural steel grades,  $-50^{\circ}\text{C} < T < +300^{\circ}\text{C}$ ;
  - 2) tanks constructed using austenitic stainless steels,  $-165^{\circ}\text{C} < T < +300^{\circ}\text{C}$ ;
  - 3) tanks constructed with special steel grades that have defined yield strengths up to higher temperatures,  $-165^{\circ}\text{C} < T < \text{the maximum defined temperature for the grade}$ ;
  - 4) tanks susceptible to failure by fatigue,  $T < 150^{\circ}\text{C}$ ;
- f) in cylindrical ground-supported tanks, the maximum design liquid level not higher than the top of the cylindrical shell."

Replace Paragraph (8) with the following one:

"(8) This Part 4-2 does not cover:

- tanks of rectangular planform;
- tanks with capacity below 100 m<sup>3</sup>;
- tanks exposed to fire (refer to EN 1993-1-2);

<sup>1)</sup>All pressures are in bar gauge unless otherwise specified.

- tanks with dished ends and diameter less than 5 m;
- cylindrical tanks with an aspect ratio of height to diameter greater than 3."

### 3 Modifications to 1.2, Normative references

Replace "EN 1990" with "EN 1990:2002".

In the list of the parts of EN 1993, replace "Part 1.6:" with "Part 1.6:2007:".

In the list of the parts of EN 1993, replace "Part 1.10:" with "Part 1.10:2005:".

In the list of the parts of EN 1993, replace "Part 4.1:" with "Part 4.1:2007:".

### 4 Modifications to 1.5, Terms and definitions

In 1.5.1, replace the last sentence with the following one: "In the tank construction industry, this term is also taken to have the special meaning of the vertical wall of a cylindrical tank, see 1.5.9."

Delete Entry 1.5.3 and renumber the following numbered entries accordingly.

In 1.5.5 (new numbering 1.5.4), delete in the last sentence: "irrespective of whether the tank is circular or rectangular in plan".

Replace the content of Entry 1.5.6 (new numbering 1.5.5) with "This term is used to refer to the stress-free middle surface when a shell is subject to pure bending in any direction."

In 1.5.8, (new numbering 1.5.7) replace the second sentence with: "In this standard it is assumed to be circular in plan."

Replace the content of Entry 1.5.9 (new numbering 1.5.8) with: "The term shell is often used in the tank industry to refer to the vertical wall of a cylindrical tank. This usage is slightly confusing when compared with the general definition (see EN 1993-1-6) given in 1.5.1, it is quite widely used, so it is also used in this standard where appropriate. Where any confusion may arise, the term cylindrical wall is used instead."

In 1.5.13 (new numbering 1.5.12), in the 1<sup>st</sup> sentence, delete "or flat plate elements".

In 1.5.13 (new numbering 1.5.12), in the 2<sup>nd</sup> sentence, delete "or box".

In 1.5.15 (new numbering 1.5.14), replace: "The shell-roof junction is the junction between the vertical wall and the roof. It is sometimes referred to as the eaves junction, though this usage is more common for solids storages." with: "The shell-roof junction, alternatively known as the top angle or eaves junction, is the junction between the vertical wall and the roof."

In 1.5.17 (new numbering 1.5.16), in the first sentence, delete "or flat plate" and "or a vertical stiffener on a box".

In 1.5.18 (new numbering 1.5.17), delete the last sentence: "In a shell of revolution it is circular, but in rectangular structures it takes the rectangular form of the plan section."

In 1.5.20 (new numbering 1.5.19), replace the first sentence with: "A ring girder or ring beam is a circumferential stiffener which has bending stiffness and strength in the plane of the circular section of a shell and also normal to that plane."

In 1.5.20 (new numbering 1.5.19), delete in the second sentence: "or box structure".

## EN 1993-4-2:2007/prA1:2016 (E)

In 1.5.23 (new numbering 1.5.22), replace: "An external tank structure to contain fluid that may escape by leakage or accident from the primary tank. This type of structure is used where the primary tank contains toxic or dangerous fluids." with: "An external tank structure to contain fluid that may escape by leakage or accident from the primary tank. This type of structure is usually used where the primary tank contains toxic or dangerous fluids. A catch basin also effectively reduces the requirement for an extensive area of fluid containment around the tank."

## 5 Deletion of 1.7.2, Conventions for global tank structure axis system for rectangular tanks

Delete the whole Subclause 1.7.2, including Figure 1.2, and renumber Subclauses 1.7.3 and 1.7.4 as 1.7.2 and 1.7.3.

## 6 Modifications to 1.7.3 (new numbering 1.7.2), Conventions for structural element axes in both circular and rectangular tanks

Replace the title of this subclause "Conventions for structural element axes in both circular and rectangular tanks" with "Conventions for structural element axes in circular tanks".

In Paragraph (1) replace "(see figures 1.3 and 1.4)" with "(see Figure 1.2)".

In Paragraph (2) replace "(see figure 1.3a)" with "(see Figure 1.2a)" and delete "(for both a shell and a box)".

Replace Figure 1.3 with the following new Figure 1.2:

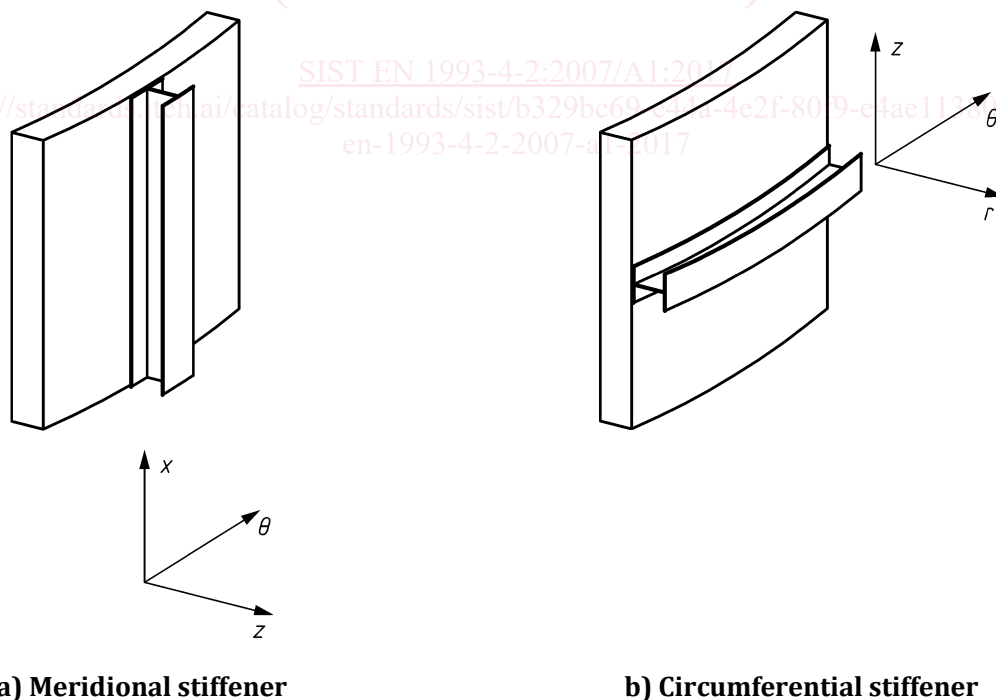


Figure 1.2 — Local coordinate systems for meridional and circumferential stiffeners".

Delete Figure 1.4.

In Paragraph (3) replace "(see figure 1.4a)" with "(see Figure 1.2b)".

Delete Paragraph (4).



## 7 Modifications to 1.7.4 (new numbering 1.7.3), Conventions for stress resultants for circular tanks and rectangular tanks

Replace the title "Conventions for stress resultants for circular tanks and rectangular tanks" with "Conventions for stress resultants for circular tanks".

In Paragraph (1) replace the two references to Figure 1.5 with "Figure 1.3" and delete:

" $n_y$  circumferential membrane stress resultant in rectangular boxes"

and

" $\sigma_{my}$  circumferential membrane stress in rectangular boxes".

In Paragraph (2) replace the two references to Figure 1.5 with "Figure 1.3" and delete:

" $m_y$  circumferential bending stress resultant in rectangular boxes"

and

" $\sigma_{by}$  circumferential bending stress in rectangular boxes"

and

" $\sigma_{siy}$ ,  $\sigma_{soy}$  circumferential inner, outer surface stress in rectangular boxes

" $\tau_{sixy}$ ,  $\tau_{soxy}$  inner, outer surface shear stress in rectangular boxes".

Renumber Figure 1.5 as Figure 1.3.

## 8 Modification to 2.2, Reliability differentiation

Replace Paragraphs (1) to (4)P with:

"(1) For reliability differentiation, see EN 1990.

NOTE The National Annex may define the Consequence Classes for tanks as a function of the location, type of stored fluid and loading, the structural form, size and operational aspects.

(2) Different levels of rigour should be used in the design of tank structures, depending on the Consequence Class chosen, the structural arrangement and the susceptibility to different failure modes.

(3) For this standard, three Consequence Classes are used, with requirements which produce designs with essentially equal risk in the design assessment and considering the expense and procedures necessary to reduce the risk of failure for different structures: Consequence Classes 1, 2 and 3.

NOTE The National Annex may choose appropriate values for the boundaries between the classes. Table 2.1 gives recommended values for the classification based on the size, structural form and stored contents into Consequence Classes when all other parameters result in medium consequences, see EN 1990:2002, B.3.1.

(4) The classification of flat-bottomed tanks that rest on the ground is based on the dimension  $U$ , which is related to the potential energy of the stored fluid.

$$U = \sqrt{DH} \quad (2.1)$$

where  $D$  is the tank diameter and  $H$  is the maximum depth of stored fluid (see Figure 2.1a)).

**Table 2.1 a) — Recommended Consequence Class definitions depending on contents, size and structural form**

Consequence Class	Design Situations
Consequence Class 3	<p>a) Tanks storing liquids or liquefied gases with toxic or explosive potential;</p> <p>b) All flat-bottomed tanks used to store fluids at or near the top of a building;</p> <p>c) All pedestal tanks with centroidal height <math>H_g \geq H_{ga}</math> (see Fig. 2.1b);</p> <p>d) Ground-supported water tanks with parameter <math>U</math> in the range <math>U &gt; U_{3a}</math>;</p> <p>e) Ground-supported tanks storing water-polluting liquids with parameter <math>U</math> in the range <math>U &gt; U_{3b}</math>;</p> <p>f) Ground-supported tanks storing flammable liquids with parameter <math>U</math> in the range <math>U &gt; U_{3c}</math>.</p> <p>Emergency loadings should be taken into account for these structures where necessary, see A.2.14.</p>
Consequence Class 2	<p>a) All pedestal tanks not in Consequence Class 3;</p> <p>b) Ground-supported water tanks with parameter <math>U</math> in the range <math>U_{2a} &lt; U \leq U_{3a}</math>;</p> <p>c) Ground-supported tanks storing water-polluting liquids with parameter <math>U</math> in the range <math>U_{2b} &lt; U \leq U_{3b}</math>;</p> <p>d) Ground-supported tanks storing flammable liquids with parameter <math>U</math> in the range <math>U_{2c} &lt; U \leq U_{3c}</math>.</p>
Consequence Class 1	All other tanks within the scope of this standard.

NOTE 1 The recommended values for class boundaries are as follows:

**Table 2.1 b) — Recommended values for class boundaries**

Class Boundary	Recommended Value
$H_{ga}$	30 m
$U_{3a}$	27 m
$U_{3b}$	24 m
$U_{3c}$	15 m
$U_{2a}$	18 m
$U_{2b}$	15 m
$U_{2c}$	10 m

NOTE For the classification by Action Assessment Classes, see EN 1991-4.

(5) A higher Consequence Class than that required may always be adopted.