SLOVENSKI STANDARD
SIST EN 13094:2015

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Nadomešča:
SIST EN 13094:2008
SIST EN 13094:2008/AC:2010

Cisterne za prevoz nevarnega blaga - Kovinski rezervoarji z delovnim tlakom pod 0,5 bar - Konstruiranje in izdelava

Tanks for the transport of dangerous goods - Metallic tanks with a working pressure not exceeding 0,5 bar - Design and construction

Tanks für die Beförderung gefährlicher Güter - Metalltanks mit einem Betriebsdruck von höchstens 0,5 bar - Auslegung und Bau

Citernes destinées au transport de matières dangereuses - Citernes métalliques ayant une pression de service inférieure ou égale à 0,5 bar - Conception et construction

Ta slovenski standard je istoveten z: EN 13094:2015

ICS:

13.300	Varstvo pred nevarnimi izdelki	Protection against dangerous goods
23.020.20	Posode in vsebniki, montirani na vozila	Vessels and containers mounted on vehicles

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EUROPEAN STANDARD

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English Version

Tanks for the transport of dangerous goods - Metallic tanks with a working pressure not exceeding 0,5 bar - Design and construction

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Foreword

This document (EN 13094:2015) has been prepared by Technical Committee CEN/TC 296 “Tanks for transport of dangerous goods”, the secretariat of which is held by AFNOR.

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of an identical text or by endorsement, at the latest by November 2015 and conflicting national standards shall be withdrawn at the latest by November 2015.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN [and/or CENELEC] shall not be held responsible for identifying any or all such patent rights.

This document supersedes EN 13094:2008.

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

This European Standard has been submitted for reference into the RID and/or in the technical annexes of the ADR.

Compared with EN 13094:2008, the following changes are the principal modifications which have been made:

a) a new form of protection was added to 6.9.2.2;

b) subclause 6.10 was revised;

c) for the protection of service equipment mounted on top of the tank, the addition of an alternative steel and, where longitudinal and transverse members are used, additional requirements for drainage were added;

d) references were updated, in particular related to welding and NDT standards;

e) literal mistakes were corrected.

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, 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 the United Kingdom.

1 Scope

This European Standard specifies requirements for the design and construction of metallic tanks with a maximum working pressure not exceeding 50 kPa gauge used for the transport of dangerous goods by road and rail for which Tank Code with letter “G” is given in Chapter 3.2 of ADR [2]. It also includes requirements for a system of identification of materials used in the construction of these tanks.

This European Standard specifies requirements for openings, closures and structural equipment.

NOTE 1 This document does not specify requirements for service equipment.

This European Standard is applicable to aircraft refuellers that are used on public roads. It is also applicable to inter-modal tanks (e.g. tank containers and tank swap bodies) for the transport of dangerous goods by road and rail.

NOTE 2 This document is not applicable to fixed rail tank wagons.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

EN 10204, *Metallic products — Types of inspection documents*

EN 12972:2007, *Tanks for transport of dangerous goods — Testing, inspection and marking of metallic tanks*

EN 13317, *Tanks for transport of dangerous goods — Service equipment for tanks — Manhole cover assembly*

EN 14025, *Tanks for the transport of dangerous goods — Metallic pressure tanks — Design and construction*

EN 14595, *Tanks for transport of dangerous goods — Service equipment for tanks — Pressure and Vacuum Breather Vent*

EN ISO 148-1, *Metallic materials — Charpy pendulum impact test — Part 1: Test method (ISO 148-1)*

EN ISO 3834-1, *Quality requirements for fusion welding of metallic materials — Part 1: Criteria for the selection of the appropriate level of quality requirements (ISO 3834-1)*

EN ISO 3834-2, *Quality requirements for fusion welding of metallic materials — Part 2: Comprehensive quality requirements (ISO 3834-2)*

EN ISO 5817, *Welding — Fusion-welded joints in steel, nickel, titanium and their alloys (beam welding excluded) — Quality levels for imperfections (ISO 5817)*

EN ISO 6892-1, *Metallic materials — Tensile testing — Part 1: Method of test at room temperature (ISO 6892-1)*

EN ISO 7500-1, *Metallic materials — Verification of static uniaxial testing machines — Part 1: Tension/compression testing machines — Verification and calibration of the force-measuring system (ISO 7500-1)*

EN ISO 9606-1, *Qualification testing of welders — Fusion welding — Part 1: Steels (ISO 9606-1)*

EN ISO 9606-2, *Qualification test of welders — Fusion welding — Part 2: Aluminium and aluminium alloys (ISO 9606-2)*

EN ISO 9712, *Non-destructive testing — Qualification and certification of NDT personnel (ISO 9712)*

EN ISO 10042, *Welding — Arc-welded joints in aluminium and its alloys — Quality levels for imperfections (ISO 10042)*

EN ISO 14732, *Welding personnel — Qualification testing of welding operators and weld setters for mechanized and automatic welding of metallic materials (ISO 14732)*

EN ISO 15607, *Specification and qualification of welding procedures for metallic materials — General rules (ISO 15607)*

EN ISO 15609-1, *Specification and qualification of welding procedures for metallic materials — Welding procedure specification — Part 1: Arc welding (ISO 15609-1)*

EN ISO 15609-2, *Specification and qualification of welding procedures for metallic materials — Welding procedure specification — Part 2: Gas welding (ISO 15609-2)*

EN ISO 15613, *Specification and qualification of welding procedures for metallic materials — Qualification based on pre-production welding test (ISO 15613)*

EN ISO 15614 (all parts), *Specification and qualification of welding procedures for metallic materials — Welding procedure test (ISO 15614, all parts)*

EN ISO 17635, *Non-destructive testing of welds — General rules for metallic materials (ISO 17635)*

EN ISO 17636-1, *Non-destructive testing of welds —- Radiographic testing — Part 1: X- and gamma-ray techniques with film (ISO 17636-1)*

EN ISO 17637, *Non-destructive testing of welds — Visual testing of fusion-welded joints (ISO 17637)*

EN ISO 17640, *Non-destructive testing of welds — Ultrasonic testing — Techniques, testing levels, and assessment (ISO 17640)*

ISO 1496-3, *Series 1 freight containers — Specification and testing — Part 3: Tank containers for liquids, gases and pressurized dry bulk*

3 Terms, definitions and symbols

3.1 Terms and definitions

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

3.1.1
baffle
structure, other than a surge plate, intended to inhibit the movement of the shell contents

3.1.2
capacity
total inner volume of shell or shell compartment

Note 1 to entry: When it is impossible to fill completely the shell or shell compartment because of its shape or construction, this reduced capacity should be used for the determination of the degree of filling and for the marking of the tank.

3.1.3
competent authority
authority or authorities or any other body or bodies designated as such in each country and in each specific case in accordance with domestic law

Note 1 to entry: Attention is drawn to ADR [2] and to the OTIF regulations (commonly referred to as RID) [3] in respect of Competent Authorities.

3.1.4
maximum working pressure
highest of the four pressures P_d, P_r, P_v and P_{ts}

3.1.5
partition
hermetically sealed dividing wall between adjacent compartments in compartmented tanks

3.1.6
section modulus
second moment of area of a structure (and, where appropriate, its associated shell) about its neutral axis divided by the maximum distance from the neutral axis to the extreme fibre of the section used in the calculation

3.1.7
shell
sheathing containing the substance carried (including the openings and their closures)

3.1.8
specific resilience
integral of the applied force and the measured deflection of a test piece up to the point at which the test bar punctures the test piece, as indicated by the point of maximum force

3.1.9
global resilience
ability of a shell with multiple divisions or surge plates to withstand a sideways impact with a beam

3.1.10
mild steel
steel with a guaranteed minimum tensile strength of 360 N/mm^2 to 490 N/mm^2 and a guaranteed minimum elongation at fracture conforming to the requirement for steel specified in 5.2.2.3.1

3.1.11
reference steel
steel with a tensile strength of 370 N/mm^2 and an elongation after fracture of 27 %

3.1.12
surge plate
non-hermetically sealed wall in tanks or compartments of shells intended to reduce the effect of surge, mounted at right angles to the direction of travel, having an area of at least 70 % of the cross-sectional area of the shells where the surge plate is located

3.1.13
test pressure
highest effective pressure which arises in the tank during the pressure test

3.1.14
maximum design mass
sum of the tare of the tank and the maximum permissible load for which the tank is designed

3.2 Symbols

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

A percentage (%) elongation after fracture

A_1 minimum percentage (%) elongation after fracture of the metal used (see 6.9.1)

B pitch circle diameter or, if elliptical, average of major and minor diameters, in millimetres (mm)

c distance from the start of a knuckle bend to the edge of a shell, in millimetres (mm)

NOTE 1 This is used for the attachment of a dished end to a shell.

e shell thickness, in millimetres (mm)

e_c thickness of a flat closure, in millimetres (mm)

e_d thickness of a domed closure, in millimetres (mm)

e_f thickness of a tank end or partition, in millimetres (mm)

e_{rs} thickness of a reinforcing section, in millimetres (mm)

e_r thickness of an opening flange, in millimetres (mm)

e_{rd} thickness of a domed closure flange, in millimetres (mm)

e_v adopted thickness of a shell, in millimetres (mm)

$e_{v,\,min}$ minimum thickness of a shell according to 6.9.1, in millimetres (mm)

e_0 minimum thickness of shell in reference steel, in millimetres (mm)

e_1 thickness of the thickest part of a shell, in millimetres (mm)

e_2 thickness of the thinner part of the metal used, in millimetres (mm)

g acceleration due to gravity, in metres per second squared (m/s^2)

NOTE 2 The value of g is 9,81 m/s^2.

L overlap of a lapped joint, in millimetres (mm)

L_c length of reinforcing piece, in millimetres (mm)

L_r length of reinforcing ring, in millimetres (mm)

L_0 initial gauge length of the test piece used in the tensile test, in millimetres (mm)

l length of transition between plates of different thickness, in millimetres (mm)

l_1 length of overlap of swaged edge, in millimetres (mm)

l_2 length of weld at base of swaged joint, in millimetres (mm)

N safety factor

P_d highest effective pressure allowed in a shell during discharge ("maximum discharge pressure allowed"), in MegaPascals (MPa)

P_r highest effective pressure allowed in a shell during filling ("maximum filling pressure allowed"), in MegaPascals (MPa)

P_{ts} opening pressure of the breather device, in MegaPascals (MPa)

P_v effective pressure to which a shell is subjected by the substance carried (including such extraneous gases as it might contain) at the design temperature, in MegaPascals (MPa)

P_x design pressure of tank, in MegaPascals (MPa)

R internal radius of a domed closure, in millimetres (mm)

R_d determined tensile strength, in Newtons per square millimetre (N/mm^2)

R_e apparent yield strength for steels having a clearly defined yield point or guaranteed 0,2 % proof strength for steels with no clearly defined yield point (1 % proof strength for austenitic steels) Newtons per square millimetre (N/mm^2)

R_{et} apparent yield strength for steels having a clearly defined yield point or guaranteed 0,2 % proof strength for steels with no clearly defined yield point (1 % proof strength for austenitic steels) at minimum design temperature Newtons per square millimetre (N/mm^2)

R_m tensile strength, in Newtons per square millimetre (N/mm^2)

R_{mt} tensile strength at minimum design temperature, in Newtons per square millimetre (N/mm^2)

R_{m1} minimum tensile strength of the metal used, in Newtons per square millimetre (N/mm^2)

S_B total tensile area, in square millimetres (mm^2)

S_0 initial cross-sectional area of a test piece used in the tensile test, in square millimetres (mm^2)

w effective depth of fillet weld (i.e. distance from the surface of the weld to the minimum penetration point of the molten metal into the base material)

Z_0 minimum section modulus in reference steel, in cubic centimetres (cm^3)

Z_1 minimum section modulus in the metal used, in cubic centimetres (cm^3)

σ_c design stress for cover material, according to 6.8, in Newtons per square millimetre (N/mm^2)

σ_r design stress for flange material, according to 6.8, in Newtons per square millimetre (N/mm^2)

4 Breather device and safety device

Tanks shall be equipped with a breather device fitted with a safety device to prevent the contents from spilling out if the tank overturns in accordance with EN 14595. For compartmented tanks, each compartment shall be equipped so.

5 Materials

5.1 General

5.1.1 The designer shall select the materials to be used in the construction of the tank using ferritic steel, austenitic steel, austenitic-ferritic stainless steel or aluminium alloy material standards published by a national or international standards body or otherwise approved by the competent authority. The material shall in any case meet the requirements specified in 5.2.

5.1.2 Materials used in the construction of shells shall be suitable for shaping. Materials shall be deemed unsuitable if, even though they meet the material requirements of this European Standard, the degree of shaping required by a particular shell design generates cracking or other signs of distress in the shell material.

5.1.3 Materials shall be used that are known to be resistant to brittle fracture and to stress corrosion cracking.

5.1.4 When tested in accordance with the appropriate clauses of EN ISO 15614-1, the properties of materials used in the fabrication of welded shells shall not be less than the minimum values specified for the material selected in accordance with 5.1.1 throughout the welded area after welding without post-weld heat treatment.

5.2 Material properties

5.2.1 Impact strength

Ferritic steel materials shall be tested in accordance with EN ISO 148-1 using a V-shaped notch, and shall have an impact strength of not less than 34 J/cm^2 at –20 °C (or at the minimum design temperature where this is lower). Impact tests shall be carried out on sheets of materials, or on their weld seams, where the sheet thickness is more than 5 mm.

5.2.2 Yield strength, tensile strength and elongation after fracture

5.2.2.1 General

5.2.2.1.1 The values of A, R_e and R_m to be used shall be the minimum values specified for the material selected in accordance with the relevant standard for the material with the exception of 5.2.2.1.2 and 5.2.2.1.3.

5.2.2.1.2 When austenitic steels are used, the value of R_e used in the calculation may exceed the minimum value in accordance with the relevant standard for the material specified for the material selected provided that:

— the higher values are attested in a certificate 3.1 issued in accordance with EN 10204;

— the value of R_e used in the calculation does not exceed 1,15 multiplied by the value of R_e as specified for the material selected in accordance with the relevant standard for the material.

5.2.2.1.3 When fine-grained steels are used, the value of R_e shall not exceed 460 N/mm^2 and the value of R_m shall not exceed 725 N/mm^2 in accordance with the specifications of the relevant standard for the material.

5.2.2.2 Yield strength and tensile strength

Steels with a ratio of R_e/R_m exceeding 0,85 shall not be used in the construction of welded tanks. The values specified in certificate 3.1 issued in accordance with EN 10204 shall be used to determine the R_e/R_m ratio.

5.2.2.3 Elongation after fracture

5.2.2.3.1 The material shall be tested in accordance with EN ISO 6892-1. The percentage elongation after fracture, A, shall be not less than:

— 16 % for fine grained steels;

— 20 % for other steels;

— 12 % for aluminium alloys.

5.2.2.3.2 Additionally, for steel, the percentage elongation after fracture, A, shall be not less than the value calculated using Formula (1):

$$A = \frac{10\,000 \text{ N/mm}^2}{R_\text{d}} \tag{1}$$

NOTE For A, R_d and R_{m1} only the numerical value with the unit according to 3.2 is given.

5.2.2.3.3 For sheet metal, when measuring the percentage elongation after fracture in accordance with EN ISO 6892-1, the axis of the tensile test piece shall be at right angles to the direction of rolling; where the material standard gives lower values in the direction of rolling, these values shall be used in the calculation.

5.2.2.3.4 When measuring the percentage elongation after fracture, a test piece of circular cross-section shall be used in which the initial gauge length is equal to five times the diameter. If test pieces of rectangular section are used, the gauge length shall be calculated using Formula (2):

$$L_0 = 5{,}65\sqrt{s_0} \tag{2}$$

NOTE Elongations based on fixed lengths can be converted to proportional elongations using EN ISO 2566-1 or EN ISO 2566-2 as applicable.

5.3 Compatibility of shell materials with substances carried

5.3.1 The manufacturer shall make available a list of the dangerous goods that may be carried without damage to the tank, or its lining. The substances or group of substances approved in the certificate shall be compatible with the characteristics of the tank and its service equipment.

NOTE RID/ADR (4.3.4.1.2) states that the listing of approved substances may be replaced by groups of substances according to the tank code taking into account any relevant special provision.

5.3.2 If contact between the substance carried and the material used for the construction of the shell is deemed likely to entail a progressive decrease in the thickness of the walls, this thickness shall be increased at manufacture by an appropriate amount.

NOTE This additional thickness, to allow for corrosion, is not taken into consideration in determining the minimum shell thickness (see 6.9.1).

5.3.3 If the shell is fitted with a non-metallic protective lining, only materials and their means of bonding to the shell that are known to remain leakproof, whatever the deformation liable to occur in normal conditions of carriage, shall be used.

5.3.4 If shells intended for the carriage of liquids having a flash-point of not more than 60 °C are fitted with non-conductive protective linings, precautions shall be taken to prevent the accumulation of electrostatic charges that could present a danger of ignition.

NOTE This requirement is also applicable to UN No. 1361 carbon and UN No. 1361 carbon black, packing group II.

6 Design

6.1 General

A shell may have a circular, elliptical or box-shaped cross-section or combinations thereof.

Shell projections outside the basic cross-section of a shell shall be kept to a minimum and protection shall be provided from all directions on the shell.

6.2 Design verification

The design of a tank shall be verified in accordance with one or a combination of the following methods:

a) for shells with a circular cross-section, EN 14025 or any one of the methods specified in Annex A;

b) for shells with non-circular cross-sections:

   1) dynamic testing (A.2);

   2) finite element stress analysis (A.3);

   3) reference design based on experience of the Competent Authority with existing tank designs (A.4);

   4) calculation method (A.5).

Documentation shall be produced that gives evidence of the design verification.

The design shall in any case conform to the minimum requirements of this European Standard.

6.3 Requirements for shells of non-circular cross-section

For shells of non-circular cross-section:

a) the radius of convexity of the shell wall shall not exceed 2 m at the sides and 3 m radius at the top and the bottom;

b) there shall be a minimum radius of 200 mm linking the top/bottom and side convexities; and

c) an equivalent diameter shall be calculated on the basis of the cross-sectional area.

6.4 Dynamic conditions

6.4.1 The dynamic conditions appropriate to the design temperature specified in 6.7, and requirements of the pressure test in EN 12972, shall be met without exceeding the stress levels specified in 6.8.

6.4.2 Shells, their attachments and their structural equipment shall be designed to withstand the forces and dynamic pressures resulting from the combination of the highest value of P_v or P_{ts} with, separately, each of the following, without exceeding the design stress in 6.8:

— in the direction of travel, an acceleration of 2 g on the maximum design mass (in the case of self-supporting trailers the maximum design mass shall include the mass of axles, wheels and tyres and shall be deemed to act at the coupling point); if any account is taken of surge plates in calculations, their effect shall be proven;

— at right angles to the direction of travel, an acceleration of 1 *g* acting on the maximum design mass;

— vertically upwards, an acceleration of 1 *g* acting on the maximum design mass;

— vertically downwards, an acceleration of 2 *g* acting on the maximum design mass;

— where the shell constitutes a stressed self-supporting member of a vehicle, the stresses thus imposed in addition to stresses from other sources.

6.4.3 With the following exceptions, a tank which has a maximum length of less than 2,9 m shall be designed to withstand the forces specified in 6.4.2, except that in all horizontal directions the forces shall be twice the maximum design mass:

— a tank permanently mounted on a vehicle chassis;

— a demountable tank on a road vehicle which can be fitted to the chassis only in one orientation.

6.5 Pressure conditions

6.5.1 The tank shell shall be designed to withstand a maximum test pressure which shall be the greater of:

a) the pressure created by a column of water equal to twice the depth of the tank multiplied by the relative density of the most dense substance to be carried;

b) the pressure created by a column of water equal to twice the depth of the tank;

c) 1,3 times the maximum working pressure.

6.5.2 Except for tanks for inter-modal tanks, compartments of compartmented tanks shall be designed to withstand a test pressure which subjects all parts of a compartment to a pressure at least equal to 1,3 × (P_{ta} + P_{ts}).

The test pressure shall be applied to the highest point of the compartment, and no account shall be taken of the pressure arising from the static head of the test liquid.

6.6 Partial vacuum conditions

The shell and partitions shall be capable of withstanding a vacuum condition of 3 kPa below atmospheric pressure.

6.7 Design temperature

The minimum design temperature range shall be –20 °C to +50 °C. Where the tank is likely to be subjected to more severe conditions, the design temperature range shall be extended within the range –40 °C to +50 °C, as applicable. The design temperature range of tanks intended for substances to be carried at elevated temperatures shall be extended at least to the maximum working temperature.

6.8 Design stress

The maximum stress in the material of the tank and its supporting structure shall not exceed the lower of 0,75 R_e or 0,5 R_m; for tank containers and tank swap bodies, the stress in the material of the supporting structure shall not exceed 0,66 R_e.