

**Specification for the design and
manufacture of site built, vertical,
cylindrical, flat-bottomed, above
ground, welded, steel tanks for the
storage of liquids at ambient
temperature and above**

Specification for the design and manufacture of site
built, vertical, cylindrical, flat-bottomed, above
ground, welded, steel tanks for the storage of liquids
at ambient temperature and above

EESTI STANDARDI EESSÕNA

NATIONAL FOREWORD

Käesolev Eesti standard EVS-EN 14015:2004 sisaldab Euroopa standardi EN 14015:2004 ingliskeelset teksti. Käesolev dokument on jõustatud ja selle kohta on avaldatud teade Eesti standardiorganisatsiooni ametlikus väljaandes. Standard on kättesaadav Eesti standardiorganisatsioonist.	This Estonian standard EVS-EN 14015:2004 consists of the English text of the European standard EN 14015:2004. This document is endorsed on with the notification being published in the official publication of the Estonian national standardisation organisation. The standard is available from Estonian standardisation organisation.
---	--

Käsitlusala: This European Standard specifies the requirements for the materials, design, fabrication, erection, testing and inspection of site built, vertical, cylindrical, flat bottomed, above ground, welded, steel tanks for the storage of liquids at ambient temperatures and above, and the technical agreements that need to be reached (see annex A).	Scope: This European Standard specifies the requirements for the materials, design, fabrication, erection, testing and inspection of site built, vertical, cylindrical, flat bottomed, above ground, welded, steel tanks for the storage of liquids at ambient temperatures and above, and the technical agreements that need to be reached (see annex A).
---	---

ICS 23.020.10

Võtmesõnad:

ICS 23.020.10

English version

Specification for the design and manufacture of site built,
vertical, cylindrical, flat-bottomed, above ground, welded, steel
tanks for the storage of liquids at ambient temperature and
above

Spécification pour la conception et la fabrication de
réservoirs en acier, soudés, aériens, à fond plat,
cylindriques, verticaux, construit sur site destinés au
stockage des liquides à la température ambiante ou
supérieure

Auslegung und Herstellung standortgefertigter,
oberirdischer, stehender, zylindrischer, geschweißter
Flachboden-Stahltanks für die Lagerung von Flüssigkeiten
bei Umgebungstemperatur und höheren Temperaturen

This European Standard was approved by CEN on 2 February 2004.

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.

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



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

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

Contents

page

Foreword	11
1 Scope	12
2 Normative references	13
3 Terms, definitions, symbols and abbreviations	15
3.1 Terms and definitions	15
3.2 Symbols	19
3.3 Abbreviations	21
4 Information and requirements to be documented	22
4.1 Information to be specified by the purchaser	22
4.2 Information to be agreed between the purchaser and the tank manufacturer	22
4.3 Information to be supplied by the tank manufacturer	22
4.4 Information to be supplied by the steel manufacturer	22
4.5 Information to be agreed between the steel manufacturer and the tank manufacturer	22
4.6 Information to be agreed between the purchaser and the cover supplier	22
4.7 Information to be agreed between the tank manufacturer and the cover supplier ..	22
4.8 Information to be supplied by the cover supplier	22
5 Requirements	22
5.1 Design pressure	22
5.2 Design metal temperature	23
5.2.1 Maximum design metal temperature	23
5.2.2 Minimum design metal temperature	23
5.3 Design density	24
5.4 Yield strength	24
6 Materials	24
6.1 Carbon and carbon manganese steels	24
6.1.1 Plate materials	24
6.1.2 Structural steel sections	30
6.1.3 Forgings	30
6.1.4 Pipes	31
6.1.5 Welding consumables	31
6.1.6 Charpy V-notch impact energy requirements of carbon and carbon manganese steels	31
6.1.7 Mountings	33
6.1.8 Thickness tolerances	33
6.2 Stainless steels	34
6.2.1 General	34
6.2.2 Plate materials	36
6.2.3 Structural steel sections	36
6.2.4 Forgings	36
6.2.5 Pipes	36
6.2.6 Welding consumables	37
7 Design loads	37
7.1 Loads	37
7.2 Load values	38
7.2.1 Liquid induced loads	38
7.2.2 Internal pressure loads	38

7.2.3	Thermally induced loads	38
7.2.4	Dead loads	38
7.2.5	Insulation loads	38
7.2.6	Live load	38
7.2.7	Concentrated live load	38
7.2.8	Snow loads	38
7.2.9	Rainfall	39
7.2.10	Wind	39
7.2.11	Seismic loads	39
7.2.12	Loads resulting from connected piping and attachments	39
7.2.13	Foundation settlement loads	39
7.2.14	Emergency loads	39
7.3	Load combinations	39
8	Tank bottoms	40
8.1	General	40
8.2	Materials	40
8.3	Design	43
8.4	Fabrication	43
9	Shell design	45
9.1	Design and test stress	45
9.2	Internal loads	48
9.3	Wind and vacuum loads	49
9.3.1	Stiffening rings	49
9.3.2	Primary stiffening ring (wind girder) design	51
9.3.3	Secondary stiffening ring (wind girder) design	51
9.4	Shell plate arrangement	54
9.5	Shell joints	54
10	Fixed roof design	54
10.1	Loads	54
10.2	Type of roof	54
10.3	Roof plating with supporting structure	54
10.4	Roof plating without supporting structure (membrane roofs)	56
10.5	Compression area at the junction of the shell and roof	56
10.6	Venting requirements	59
10.6.1	General	59
10.6.2	Scope of venting provided	59
10.6.3	Venting capacity	59
10.6.4	Accumulation of pressure and vacuum	59
10.7	Floating covers	59
11	Floating roof design	59
12	Tank anchorage	60
12.1	General	60
12.2	Anchorage attachment	60
12.3	Holding down bolt or strap	60
12.3.1	Allowable tensile stress	60
12.3.2	Cross-sectional area	60
12.4	Resistance to uplift during test	61
13	Mountings	61
13.1	Shell nozzles O/D 80 mm and above	61
13.2	Shell nozzles less than O/D 80 mm	71
13.3	Roof nozzles	71
13.4	Studded pad connections	73
13.5	Nozzle loads	73
13.6	Flush type clean-out doors and water draw-off sumps	73
13.6.1	General	73
13.6.2	Flush type clean-out doors	74

13.6.3	Water draw-off sumps	74
13.6.4	Combined water draw-off and clean-out sump.....	74
13.7	Nozzle welding details	74
13.8	Flange drilling.....	75
13.9	Post-weld heat treatment of nozzles.....	75
13.10	Heating and/or cooling systems.....	75
13.11	Stairways and walkways	78
13.12	Handrailing	78
13.13	Ladders	79
13.14	Earthing connections	79
13.15	Permanent attachments	79
13.16	Temporary attachments	79
14	Insulation	79
15	Shop fabrication of tank components	79
15.1	General.....	79
15.2	Reception and identification of materials.....	79
15.3	Handling and storage of materials	80
15.4	Material markings.....	80
15.5	Plate preparation and tolerances	81
15.6	Preparation of nozzle components	81
15.7	Plate forming and tolerances.....	81
15.8	Openings.....	81
15.8.1	Nozzles.....	81
15.8.2	Inspection windows	82
15.8.3	Nozzles for mixers	82
15.8.4	Clean-out doors.....	82
15.8.5	Reinforcement plates.....	82
15.8.6	Insert plates	82
15.9	Welding	82
15.10	Surface condition.....	83
15.11	Marking for erection purposes	83
15.12	Packing, handling and transport to site	83
16	Site erection and tolerances	84
16.1	General.....	84
16.2	Foundations.....	84
16.2.1	General.....	84
16.2.2	Peripheral tolerance.....	85
16.2.3	Foundation surface tolerance.....	85
16.3	Anchor points.....	85
16.4	Handling and storage	86
16.5	Rectification of parts damaged during transportation and handling	86
16.6	Bottom plates	86
16.7	Shell to bottom, and shell	86
16.7.1	Assembly tolerances of first shell course on flat bottom.....	86
16.7.2	Tolerance on shell geometry	87
16.7.3	Vertical tolerance	88
16.7.4	Tolerances on alignment of plates.....	88
16.7.5	Tolerances on shape of welded joints	88
16.7.6	Primary and secondary stiffening rings (wind girders)	89
16.8	Fixed roofs	89
16.8.1	General.....	89
16.8.2	Support framework	89
16.8.3	Roof plates.....	89
16.8.4	Roof plating and roof structure	90
16.8.5	Frangible roofs	90
16.9	Nozzles.....	90
16.10	External attachments.....	90
16.11	Internal attachments.....	90

16.12	Temporary attachments	90
17	Approval of welding procedures and welders	91
17.1	General	91
17.2	Welding procedure approval	91
17.2.1	General	91
17.2.2	Welding of test pieces	91
17.2.3	Examination and testing of test pieces	91
17.3	Welding Procedure Approval Record (WPAR)	92
17.3.1	Preparation	92
17.3.2	Range of approval	92
17.4	Welders and welding operators approval	92
17.5	Production control test plates	92
17.5.1	Horizontal welds	92
17.5.2	Vertical welds	93
18	Welding	93
18.1	General	93
18.2	Welding sequences	93
18.3	Welding of bottoms	93
18.3.1	Removal of coatings	93
18.3.2	Annular ring plates	93
18.3.3	Bottom plates	94
18.4	Welding of shell to bottom	94
18.5	Welding of shell	94
18.6	Welding of roof	94
18.7	Temporary welds	94
18.8	Atmospheric conditions	94
18.9	Preheating	95
18.10	Post-weld heat treatment	95
18.11	Repair welding	96
19	Testing and inspection	96
19.1	General	96
19.2	Qualification of NDT personnel	96
19.3	Test procedures	97
19.4	Type of inspections and examinations	97
19.4.1	Inspection of materials	97
19.4.2	Examinations of edges to be welded and joint preparations	97
19.4.3	Visual examination	97
19.4.4	Type and extent of examination and test of welds	98
19.4.5	Additional examinations if imperfections are found	102
19.5	Vacuum box test	103
19.6	Penetrant test	104
19.7	Magnetic particle examination	104
19.8	Soap bubble examination	104
19.8.1	Reinforcement plates	104
19.8.2	Fixed roof and roof to shell	104
19.8.3	Shell to bottom with double fillet weld	105
19.9	Radiographic examination	105
19.9.1	General procedure	105
19.9.2	Storage of films	105
19.10	Ultrasonic examination	105
19.11	Acceptance criteria	106
19.11.1	Imperfection acceptance criteria	106
19.11.2	Acceptable thinning after grinding	109
19.12	Dimensional check	110
19.13	Hydrostatic and pneumatic tests	110
19.13.1	General	110
19.13.2	Hydrostatic test liquid level	110
19.13.3	Pneumatic test pressure	110

19.13.4	Conditions of implementation	110
19.13.5	Examination during filling	111
19.13.6	Filling	112
19.13.7	Checking and testing of roof (over pressure)	112
19.13.8	Test for tank stability under negative pressure	113
19.14	Empty checks	113
19.15	Accessories	113
19.15.1	External accessories	113
19.15.2	Internal accessories	113
20	Documentation and name-plate	114
20.1	Documentation	114
20.2	Name-plate	116
Annex A	(normative) Information and requirements to be documented	117
A.1	Information to be supplied by the purchaser	117
A.2	Information agreed between the purchaser and the manufacturer	119
A.3	Information to be supplied by the manufacturer	120
A.4	Information to be supplied by the steel manufacturer	121
A.5	Information to be agreed between the steel manufacturer and the tank manufacturer	121
A.6	Information to be agreed between the purchaser and the cover supplier	121
A.7	Information to be agreed between the tank manufacturer and the cover supplier	121
A.8	Information to be supplied by the cover supplier	121
Annex B	(informative) Operational and safety considerations for storage tanks and storage installations	122
B.1	General	122
B.2	Tank type	122
B.2.1	Stored product	122
B.2.2	Local climatic and geological conditions	122
B.3	Health, safety and environmental considerations	123
B.3.1	Containment	123
B.3.2	Fire protection	123
B.4	Attachments to tanks for safety or firefighting facilities	123
Annex C	(normative) Requirements for floating covers	124
C.1	General	124
C.2	Types of floating covers	125
C.3	Design and construction requirements	128
C.3.1	Design	128
C.3.2	Materials of construction	130
C.3.3	Cover fittings	133
C.3.4	Tank fittings	137
C.4	Installation	139
C.4.1	Tank examination	139
C.4.2	Examination and installation of the cover	139
C.4.3	Tests	140
C.5	Documentation	140
Annex D	(normative) Requirements for floating roofs	141
D.1	General	141
D.2	Roof types	141
D.3	Design	141
D.3.1	General	141
D.3.2	Buoyancy	142
D.3.3	Structural design	144
D.3.4	Roof stability under wind load	144
D.3.5	Pontoon manholes	144
D.3.6	Roof manhole	144
D.3.7	Centering and anti-rotation devices	144
D.3.8	Main roof drains	145

D.3.9	Emergency drains	145
D.3.10	Drain plugs	145
D.3.11	Vents.....	146
D.3.12	Seals.....	146
D.3.13	Support legs	146
D.3.14	Gauging device	147
D.3.15	Rolling ladder	147
D.3.16	Earthing cables	147
D.3.17	Foam dam	147
D.4	Prefabrication in the workshop	147
D.5	Marking, packing, handling, transport.....	148
D.5.1	General.....	148
D.5.2	Repair after damage during handling operations.....	148
D.6	Assembly	148
D.7	Welding	148
D.7.1	General.....	148
D.7.2	Support legs	148
D.7.3	Bulkheads.....	148
D.8	Inspection and testing	149
D.8.1	Welds.....	149
D.8.2	Pontoons.....	149
D.8.3	Checks.....	149
D.8.4	Drains	149
D.9	Documentation	149
Annex E (normative)	Requirements for rim seals for floating roofs	150
E.1	General.....	150
E.2	Design	150
E.3	Seal types	151
E.4	Weather shields.....	151
E.5	Application and technical details of rim seals.....	151
E.5.1	Mechanical shoe seals	151
E.5.2	Spring-forced lip primary seals	152
E.5.3	Liquid-filled primary seals.....	152
E.5.4	Foam-filled primary seals.....	152
E.5.5	Spring-forced pad or lip secondary seals	152
E.5.6	Compression plate secondary seals.....	153
E.5.7	Wiper seals	153
E.5.8	Integrated primary/secondary seals	153
E.6	Installation	153
Annex F (normative)	Selection of carbon and carbon manganese steel plate to alternative specifications to those in 6.1	156
F.1	Alternative national standards	156
F.2	General.....	156
F.3	Chemical composition.....	156
F.4	Mechanical properties	158
F.5	Impact testing.....	158
F.5.1	General.....	158
F.5.2	Impact properties	159
Annex G (informative)	Recommendations for seismic provisions for storage tanks	161
G.1	General.....	161
G.2	Design loads.....	161
G.2.1	Overturning moment.....	161
G.2.2	Effective mass of tank contents	162
G.2.3	Lateral force coefficients.....	163
G.3	Resistance to overturning.....	165
G.3.1	The tank contents	165
G.3.2	The thickness of the bottom plate.....	165
G.4	Shell compression	166

G.4.1	Unanchored tanks	166
G.4.2	Anchored tanks	166
G.4.3	Maximum allowable shell compression.....	167
G.4.4	Upper shell courses	168
G.5	Anchorage of tanks.....	168
G.5.1	Minimum anchorage required.....	168
G.5.2	Design of anchorage.....	168
G.6	Piping	169
G.7	Sloshing height	169
Annex H	(informative) Recommendations for other types of tank bottoms (double bottoms, elevated bottoms etc.).....	170
H.1	Non-fully supported bottoms.....	170
H.2	Double bottoms.....	171
H.2.1	General.....	171
H.2.2	Design	171
H.2.3	Leak detection	174
H.3	Elevated or beam supported tanks	174
H.4	Leak test.....	175
Annex I	(informative) Recommendations for tank foundations	176
I.1	General.....	176
I.2	Soil Investigation	176
I.2.1	General.....	176
I.2.2	Water tables	176
I.2.3	Seismic investigations	177
I.2.4	Sites to be avoided	177
I.3	Foundation design	177
I.3.1	General.....	177
I.3.2	Loading conditions	177
I.3.3	Allowable soil loading	177
I.3.4	Settlement.....	177
I.3.5	Soil improvement and piling.....	178
I.3.6	Drainage.....	178
I.3.7	Resistance to uplift.....	179
I.3.8	Membrane vapour barrier.....	179
I.4	Types of foundations.....	179
I.4.1	General.....	179
I.4.2	Pad foundations	179
I.4.3	Ring beam foundations	180
I.4.4	Surface raft foundations.....	180
I.4.5	Pile supported raft	180
Annex J	(informative) Example calculations of stiffening rings (wind girders).....	184
J.1	General.....	184
J.2	Section moduli	184
J.3	Worked examples of design of secondary stiffening rings (wind girders).....	184
J.4	Example 1	186
J.5	Example 2	187
Annex K	(normative) Design rules for tanks with frangible roof to shell joints.....	188
K.1	General.....	188
K.2	Construction.....	189
K.3	Materials.....	189
K.4	Design rules.....	190
Annex L	(normative) Requirements for venting systems	194
L.1	General.....	194
L.2	Types of vents and valves	195
L.2.1	General.....	195
L.2.2	Free vents for outbreathing and inbreathing	195
L.2.3	Pressure and vacuum relief valves	195

L.2.4	Vent pipes	195
L.2.5	Emergency venting valves	195
L.2.6	Venting systems with flame arresting capability	195
L.3	Calculation of maximum flow rates for normal outbreathing and inbreathing	196
L.3.1	General	196
L.3.2	Pump capacities	196
L.3.3	Thermal outbreathing and inbreathing	196
L.4	Calculation of maximum flow rates for emergency pressure venting	199
L.4.1	General	199
L.4.2	Fire	199
L.4.3	Malfunction of blanketing system	201
L.4.4	Other possible causes	201
L.5	Emergency vacuum venting	201
L.6	Testing venting devices	201
L.6.1	General	201
L.6.2	Test apparatus	202
L.6.3	Method	204
L.7	Manufacturers documentation and marking of venting devices	205
L.7.1	Documentation	205
L.7.2	Marking	205
Annex M (informative)	Tank anchorages	207
M.1	General	207
M.2	Holding down strap	207
M.3	Holding down bolt with individual chair	207
M.4	Holding down bolt with continuous support ring	207
Annex N (informative)	Weld details for the connection of mounting	211
N.1	Set-through mountings	211
N.2	Set-on mountings	215
N.3	Studded pad connections	216
Annex O (informative)	Flush-type clean-out doors and water draw-off sumps	217
O.1	Flush-type clean-out doors	217
O.1.1	General	217
O.1.2	Flush-type clean-out doors with insert plate reinforcement	217
O.1.3	Flush-type clean-out doors with plate reinforcement	218
O.2	Water-draw-off sumps	218
O.3	Combined water draw-off and clean-out sump	218
Annex P (informative)	Heating and/or cooling systems	225
P.1	General	225
P.2	Heat transfer fluid	225
P.3	Type of heating or cooling devices	225
P.4	Installation	226
Annex Q (informative)	Recommendations for the design and application of insulation ..	228
Q.1	General	228
Q.2	Design considerations	229
Q.2.1	General	229
Q.2.2	Dead load	229
Q.2.3	Wind loads	229
Q.2.4	Thermal expansion	230
Q.2.5	Movements due to hydrostatic pressure	230
Q.3	Mechanical support arrangement	230
Q.3.1	General	230
Q.3.2	Supports attached by welding	231
Q.3.3	Supports attached by adhesive	231
Q.3.4	External structural frame	233
Q.3.5	Secondary support members	233
Q.3.6	Roof insulation	233
Q.4	Design details	234

Q.4.1	Nozzles and manholes.....	234
Q.4.2	Stairway connections	234
Q.4.3	Supports near stiffening rings (wind girders).....	235
Q.4.4	Roof projection.....	235
Q.4.5	Stiffening rings (wind girders).....	235
Q.4.6	External shell stiffening rings (wind girders) and bottom-to-shell insulation.....	235
Q.5	Corrosion protection	235
Q.6	Insulation	235
Q.6.1	General.....	235
Q.6.2	Nozzle connections and manholes	237
Q.6.3	Stiffening rings (wind girders).....	239
Q.7	Cladding.....	240
Q.7.1	General.....	240
Q.7.2	Side-wall cladding.....	240
Q.7.3	Roofing cladding.....	240
Q.8	Securing insulation materials.....	241
Q.8.1	Slab or block insulation with metal cladding	241
Q.8.2	In situ foam behind metal cladding	241
Q.8.3	Spray foam.....	242
Q.8.4	Roofs	242
Q.9	Fire hazard	242
Annex R (normative)	Surface finish	243
R.1	Internal surfaces in contact with the product.....	243
R.1.1	General.....	243
R.1.2	Carbon and carbon manganese steel tanks.....	243
R.1.3	Stainless steel tanks.....	243
R.2	External surfaces	246
R.2.1	General.....	246
R.2.2	Carbon and carbon manganese steel tanks.....	246
R.2.3	Stainless steel tanks.....	246
Bibliography		247

Foreword

This document (EN 14015:2004) 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 May 2005, and conflicting national standards shall be withdrawn at the latest by May 2005.

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, Slovakia, Slovenia, Spain, Sweden, Switzerland and United Kingdom.

This European Standard reflects the current practice within the oil, petrochemical, chemical, food and general bulk liquid storage industry, both European and world-wide. The practice is based on the theory of design stresses or allowable stresses.

There is a parallel pre-standard, ENV 1993-4-2 Tanks. It is based on the Limit State Theory (LST), which is being used more and more by the structure steel and reinforced concrete industry.

Experience in designing steel storage tanks to LST is limited, and there is little information on which to base the values for load factors, load combinations and serviceability. When sufficient experience has been gained in designing tanks to, and credible values become available for load factors, etc., it is envisaged that there may be a gradual move towards the use of LST for the design of tanks covered by this European Standard.

1 Scope

1.1 This document specifies the requirements for the materials, design, fabrication, erection, testing and inspection of site built, vertical, cylindrical, flat bottomed, above ground, welded, steel tanks for the storage of liquids at ambient temperatures and above, and the technical agreements that need to be reached (see Annex A).

This document does not apply to tanks where the product is refrigerated to maintain it as a liquid at atmospheric pressure (see prEN 14620).

This document is concerned with the structural integrity of the basic tank structure and does not provide requirements for considering process design, operational issues, safety and firefighting facilities, in-service inspection, maintenance or repair. These aspects are covered in detail in other Codes of Practice (see Annex B).

1.2 This document applies to closed-top tanks, with and without internal floating covers (see Annex C) and open-top tanks, with and without floating roofs (see Annexes D and E). It does not apply to 'lift-type' gas holders.

1.3 This document applies to storage tanks with the following characteristics:

- a) design pressure less than 500 mbar¹⁾ and design internal negative pressure not lower than 20 mbar (see 5.1 for pressure limitations);
- b) design metal temperature not lower than -40 °C and not higher than +300 °C (see 5.2.2);
- c) maximum design liquid level not higher than the top of the cylindrical shell.

1.4 The limits of application of this document terminate at the following locations.

- face of the first flange in a bolted flange connection;
- first threaded joint on the pipe or coupling outside of the tank shell, roof or bottom;
- first circumferential joint in a pipe not having a flange connection.

1.5 This document is applicable to steel tanks with a maximum design strength $\leq 260 \text{ N/mm}^2$.

1.6 In addition to the definitive requirements, this document also requires the items detailed in Annex A to be documented. For compliance with this document, both the definitive requirements and those required in Clause 4 have to be satisfied.

¹⁾ All pressures are in mbar gauge unless otherwise stated.

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 287-1: 2004, *Qualification test of welders - Fusion welding - Part 1: Steels*

EN 288-2, *Specification and approval of welding procedures for metallic materials — Part 2: Welding procedure specification for arc welding*

EN 444, *Non-destructive testing- General principles for radiographic examination of metallic material by X- and gamma- rays*

EN 462-1, *Non-destructive testing – Image quality of radiographs – Part 1: Image quality indicators (wire type). Determination of image quality value*

EN 462-2, *Non-destructive testing – Image quality of radiographs – Part 2: Image quality indicators (step/hole type). Determination of image quality value*

EN 473, *Non destructive testing - Qualification and certification of NDT personnel - General principles*

EN 485 (all parts), *Aluminium and aluminium alloys — Sheet, strip and plate*

EN 499, *Welding consumables — Covered electrodes for manual metal arc welding of non alloy and fine grain steels — Classification*

EN 571-1, *Non destructive testing - Penetrant testing — Part 1: General principles*

EN 754 (all parts), *Aluminium and aluminium alloys — Cold drawn rod/bar and tube*

EN 755 (all parts), *Aluminium and aluminium alloys — Extruded rod/bar, tube and profiles*

EN 970, *Non-destructive examination of fusion welds - Visual examination*

EN 1092-1, *Flanges and their joints - Circular flanges for pipes, valves, fittings and accessories, PN designated — Part 1: Steel flanges*

EN 1290, *Non-destructive examination of welds - Magnetic partical examination of welds*

EN 1418, *Welding personnel - Approval testing of welding operators for fusion welding and resistance weld setters for fully mechanized and automatic welding of metallic materials*

EN 1435, *Non-destructive examination of welds — Radiographic examination of welded joints*

EN 1593, *Non-destructive testing — Leak testing — Bubble emission techniques*

EN 1600, *Welding consumables — Covered electrodes for manual metal arc welding of stainless and heat resisting steels — Classification*

EN 1714, *Non-destructive examination of welded joints - Ultrasonic examination of welded joints*

prEN 1759-1: 2000, *Flanges and their joints - Circular flanges for pipes, valves, fittings and accessories, Class designated - Part 1: Steel flanges, NPS ½ to 24*

EN 1991-1-3:2003, *Eurocode 1 - Actions on structures - Part 1-3: General actions - Snow loads*

EN 10025:1992, *Hot rolled products of non-alloy structural steels — Technical delivery conditions*

EN 10028-2: 1993, *Flat products made of steels for pressure purposes — Part 2: Non-alloy and alloy steels with specified elevated temperature properties*

EN 10028-3: 1993, *Flat products made of steels for pressure purposes — Part 3: Weldable fine grain steels, normalized*

EN 10029: 1991, *Hot rolled steel plates 3 mm thick or above — Tolerances on dimensions, shape and mass*

EN 10045-1, *Metallic materials — Charpy impact test — Part 1: Test method*

EN 10088-1, *Stainless steels — Part 1: List of stainless steels*

EN 10088-2: 1995, *Stainless steels — Part 2: Technical delivery conditions for sheet/plate and strip for general purposes*

EN 10088-3: 1995, *Stainless steels — Part 3: Technical delivery conditions for semi-finished products, bars, rods and sections for general purposes*

EN 10113-2: 1993, *Hot-rolled products in weldable fine grain structural steels — Part 2: Delivery conditions for normalized/normalized rolled steels*

EN 10113-3: 1993, *Hot-rolled products in weldable fine grain structural steels — Part 3: Delivery conditions for thermomechanical rolled steels*

EN 10204: 2004, *Metallic products — Types of inspection documents*

EN 10210-1: 1994, *Hot finished structural hollow sections of non-alloy and fine grain structural steels — Part 1: Technical delivery requirements*

EN 10216-1, *Seamless steel tubes for pressure purposes — Technical delivery conditions - Part 1: Non-alloy steel tubes with specified room temperature properties*

EN 10216-2, *Seamless steel tubes for pressure purposes - Technical delivery conditions - Part 2: Non-alloy and alloy steel tubes with specified elevated temperature properties*

EN 10216-3, *Seamless steel tubes for pressure purposes - Technical delivery conditions - Part 3: Alloy fine grain steel tubes*

EN 10216-5, *Seamless steel tubes for pressure purposes — Technical delivery conditions — Part 5: Stainless steel tubes*

EN 10217-1, *Welded steel tubes for pressure purposes — Technical delivery conditions - Part 1: Non-alloy steel tubes with specified room temperature properties*

EN 10217-2, *Welded steel tubes for pressure purposes - Technical delivery conditions - Part 2: Electric welded non-alloy and alloy steel tubes with specified elevated temperature properties*

EN 10217-3, *Welded steel tubes for pressure purposes - Technical delivery conditions - Part 3: Alloy fine grain steel tubes*

EN 10217-5, *Welded steel tubes for pressure purposes - Technical delivery conditions - Part 5: Submerged arc welded non-alloy and alloy steel tubes with specified elevated temperature properties*

prEN 10217-7, *Welded steel tubes for pressure purposes — Technical delivery conditions — Part 7: Stainless steel tubes*

EN 10222 (all parts), *Steel forgings for pressure purposes*

EN 10250 (all parts), *Open steel die forgings for general engineering purposes*

EN 12874, *Flame arresters - Performance requirements, test methods and limits for use*

ENV 1991-2-1, *Eurocode 1: Basis of design and actions on structures — Part 2-1: Actions on structures — Densities, self-weight and imposed loads*

ENV 1993-1-1, *Eurocode 3: Design of steel structures — Part 1-1: General rules and rules for buildings*

ENV 1993-4-2, *Eurocode 3: Design of steel structures — Part 4-2: Silos, tanks and pipelines — Tanks*

EN ISO 4063, *Welding and allied processes — Nomenclature of processes and reference numbers (ISO 4063:1998)*

EN ISO 6520-1, *Welding and allied processes — Classification of geometric imperfections in metallic materials — Part 1: Fusion welding (ISO 6520-1: 1998)*

EN ISO 14122-1, *Safety of machinery — Permanent means of access to machinery - Part 1: Choice of fixed means of access between two levels (ISO 14122-1:2001)*

EN ISO 14122-2, *Safety of machinery -- Permanent means of access to machinery -- Part 2: Working platforms and walkways (ISO 14122-2:2001)*

EN ISO 14122-3, *Safety of machinery -- Permanent means of access to machinery -- Part 3: Stairs, stepladders and guard-rails (ISO 14122-3:2001)*

EN ISO 14122-4, *Safety of machinery -- Permanent means of access to machinery -- Part 4: Fixed ladders (ISO 14122-4:1996)*

EN ISO 15607:2003, *Specification and qualification of welding procedures for metallic materials - General rules (ISO 15607:2003)*

EN ISO 15614-1:2004, *Specification and qualification of welding procedures for metallic materials - Welding procedure test - Part 1: Arc and gas welding of steels and arc welding of nickel and nickel alloys (ISO 15614-1:2004)*

3 Terms, definitions, symbols and abbreviations

3.1 Terms and definitions

For the purpose of this document, the following terms and definitions apply:

3.1.1

design pressure

maximum permissible pressure in the space above the stored liquid

3.1.2

design internal negative pressure

maximum permissible negative pressure in the space above the stored liquid

3.1.3

set pressure

pressure at which the pressure relief device first opens