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Tanks for the transport of dangerous goods — Testing, inspection and marking of metallic tanks

National foreword

This British Standard is the UK implementation of EN 12972:2018+A1:2024. It supersedes BS EN 12972:2018, which is withdrawn.

The start and finish of text introduced or altered by amendment is indicated in the text by tags. Tags indicating changes to CEN text carry the number of the CEN amendment. For example, text altered by CEN amendment A1 is indicated by **EN A1**.

The UK participation in its preparation was entrusted to Technical Committee ALEX, Tanks for the transport of dangerous goods.

A list of organizations represented on this committee can be obtained on request to its committee manager.

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Tanks for the transport of dangerous goods - Testing, inspection and marking of metallic tanks

Citernes destinées au transport des matières
dangereuses - Épreuve, contrôle et marquage des
citernes métalliques

Tanks für die Beförderung gefährlicher Güter -
Prüfung, Inspektion und Kennzeichnung von
Metalltanks

This European Standard was approved by CEN on 20 May 2018 and includes Amendment 1 approved by CEN on 19 February 2024.

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Contents

	Page
European foreword.....	5
Introduction	6
1 Scope.....	7
2 Normative references.....	7
3 Terms, definitions, symbols and abbreviations.....	9
3.1 Terms and definitions	9
3.2 Symbols and abbreviations.....	11
4 Inspections and tests	12
4.1 General.....	12
4.2 Inspection for type approval.....	12
4.2.1 General.....	12
4.2.2 Content of inspection	13
4.2.3 Documentation.....	14
4.3 Inspection for modification of a tank.....	14
4.4 Initial inspection	15
4.4.1 Content of inspection.....	15
4.4.2 Documentation, certificate and marking.....	15
4.5 Periodic inspection.....	15
4.5.1 Content of inspection.....	15
4.5.2 Documentation, certificate and marking.....	16
4.6 Intermediate inspection	16
4.6.1 Content of inspection.....	16
4.6.2 Documentation, certificate and marking.....	16
4.7 A1 Exceptional inspections A1	16
4.7.1 General.....	16
4.7.2 A1 Exceptional inspection A1 after damage or repair of the shell.....	16
4.7.3 A1 Exceptional inspection A1 after the repair or replacement of service equipment	17
4.7.4 A1 Exceptional inspection A1 after replacement of service equipment involving the application of heat	17
4.7.5 A1 Exceptional inspection A1 after alteration to the tank.....	17
4.7.6 A1 Exceptional inspection A1 after exchange or repair of frame or structural equipment.....	17
4.7.7 A1 Exceptional inspection A1 before and after repair or replacement of the protective lining or coating.....	18
4.7.8 Documentation, certificate and marking.....	18
5 Procedures and documentation for inspections and tests.....	18
5.1 General.....	18
5.2 Examination of documents	19
5.2.1 Inspection for type approval.....	19
5.2.2 Initial inspection	20
5.2.3 Periodic inspection.....	21
5.2.4 Intermediate inspection	22
5.2.5 A1 Exceptional inspection A1	22
5.3 Check of the design characteristics	24
5.3.1 Content of inspection.....	24

5.3.2	Examination of the manufacturing conditions	24
5.3.3	Inspection of the materials and wall thicknesses	24
5.3.4	Examination of the manufacturing methods	24
5.3.5	Inspection of main dimensions	25
5.3.6	NDT of the welds	25
5.3.7	Mechanical tests	32
5.4	Inspection of the shell interior	35
5.4.1	Inspection of the condition of the shell	35
5.4.2	Inspection of protective lining or coating	35
5.5	Inspection of the tank exterior	35
5.5.1	Inspection of the condition of the tank	35
5.5.2	Inspection of the fastenings of the tank and its structural equipment	36
5.5.3	Inspection of marking	36
5.5.4	Inspection of earth connection	36
5.6	Hydraulic pressure test	36
5.6.1	General	36
5.6.2	Extent of test	36
5.6.3	Test pressure	37
5.6.4	Test liquid	38
5.6.5	Gas as test fluid	38
5.6.6	Pressurization	38
5.6.7	Test duration	38
5.6.8	Measurement	38
5.6.9	Evaluation of the test	39
5.7	Vacuum testing	39
5.7.1	Test procedure	39
5.7.2	Measurement	39
5.7.3	Evaluation of the test	39
5.8	Leakproofness test	39
5.8.1	General	39
5.8.2	Extent of test	40
5.8.3	Leakproofness test pressure	40
5.8.4	Leakproofness test fluid	41
5.8.5	Pressurization	41
5.8.6	Test duration	41
5.8.7	Special leakproofness test of the mounting of certain items of equipment	42
5.8.8	Evaluation of the test	42
5.9	Determination of water capacity	42
5.10	Inspection of service equipment	43
5.10.1	General	43
5.10.2	Inspection of service equipment for type approval of the tank	43
5.10.3	Inspection of service equipment for other inspections	43
5.10.4	Check of satisfactory operation of service equipment	43
5.11	Inspection of frame or other structural equipment of portable tanks and tank containers	44
5.11.1	Inspection of frame or other structural equipment for type approval	44
5.11.2	Initial, periodic, $\boxed{A_1}$ intermediate and exceptional inspection $\boxed{A_1}$ of the frame or other structural equipment of portable tanks and tank containers	45
5.12	Dynamic longitudinal impact test	45
5.12.1	Portable tanks	45
5.12.2	Tank-wagons	45
5.13	Test report, certificate and marking	45
5.13.1	Test report for type approval	45

5.13.2 Certificate of initial, periodic \square_{A1} , intermediate and exceptional inspection \square_{A1}	45
5.13.3 Marking.....	45
Annex A (informative) Applicable items of tank inspection — Survey Table	47
Annex B (normative) Technical data sheet for type approval	49
Annex C (informative) Certificate of initial, periodic \square_{A1} , intermediate and exceptional inspection \square_{A1}	53
Annex D (informative) Tank plates for fixed tanks (tank vehicles) and demountable tanks for the transport of dangerous goods.....	55
D.1 Tank plate	55
D.2 Content of the marking of the tank plate.....	56
Annex E (normative) Tank plates for tank containers intended for the transport of dangerous goods.....	57
Annex F (normative) Manufacturing tolerances (based on EN 13445-4 [19]).....	59
F.1 Surface geometry of welds.....	59
F.2 Middle line alignment.....	59
F.3 Surface alignment	59
F.3.1 Surface linear misalignment between parts	59
F.3.2 Joining of parts of different thickness	60
F.4 Tolerances for tanks	60
F.4.1 External diameter	60
F.4.2 Out of roundness	60
F.4.3 Deviation from the longitudinal axis	60
F.4.4 Irregularities in profile.....	60
F.4.5 Middle line angular misalignment.....	62
F.4.6 Dished ends	62
Bibliography.....	63

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European foreword

This document (EN 12972:2018+A1:2024) has been prepared by Technical Committee CEN/TC 296 “Tanks for the 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 2024, and conflicting national standards shall be withdrawn at the latest by November 2024.

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

This document includes Amendment 1 approved by CEN on 19 February 2024.

This document supersedes ^{A1} EN 12972:2018 ^{A1}.

The start and finish of text introduced or altered by amendment is indicated in the text by tags ^{A1} ^{A1}.

^{A1} *deleted text* ^{A1}

In comparison with EN 12972:2015, the following fundamental changes have been made:

- a) alignment with RID [1] and ADR [2] as known at publication of this document;
- b) update of the normative references;
- c) addition of requirements for NDT and manufacturing tolerances;
- d) amendment of hydraulic pressure test and leakproofness test;
- e) deletion of Subclauses 5.6.4 “Test fluid” and 5.6.5 “Precautions for gas as a test fluid”;
- f) deletion of Annex C “Hydraulic pressure testing with gases – hazards and precautions”.

Any feedback and questions on this document should be directed to the users’ national standards body. A complete listing of these bodies can be found on the CEN website.

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, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Republic of North Macedonia, Romania, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Türkiye and the United Kingdom.

Introduction

The types and frequencies of the inspections and tests as well as the responsibilities are given by the relevant regulations concerning the transport of dangerous goods. This document becomes mandatory if declared as such in the relevant regulation concerning the transport of dangerous goods. In all the other cases, it will remain voluntary like any European Standard, and aim at being used as a guidance for the testing, inspection and marking of metallic tanks.

<https://www.china-gauges.com/>

1 Scope

This document specifies testing, inspection and marking for the type approval, initial inspection, periodic inspection, intermediate inspection and \square_{A1} exceptional inspection \square_{A1} of metallic tanks (shell and equipment) of fixed tanks (tank vehicles), demountable tanks, tank-wagons, portable tanks and tank containers for the transport of dangerous goods.

This document is not applicable to battery-vehicles and battery-wagons comprising cylinders, tubes, pressure drums, bundles of cylinders, and multiple element gas containers (MEGCs), independent of whether the elements are receptacles or tanks.

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 590, *Automotive fuels – Diesel - Requirements and test methods*

EN 837-1, *Pressure gauges – Part 1: Bourdon tube pressure gauges - Dimensions, metrology, requirements and testing*

EN 837-2, *Pressure gauges – Part 2: Selection and installation recommendations for pressure gauges*

EN 837-3, *Pressure gauges – Part 3: Diaphragm and capsule pressure gauges - Dimensions, metrology, requirements and testing*

EN 12079-1, *Offshore containers and associated lifting sets – Part 1: Offshore container - Design, manufacture and marking*

EN 12663-2, *Railway applications - Structural requirements of railway vehicle bodies – Part 2: Freight wagons*

EN 13094:2015, *Tanks for the transport of dangerous goods - Metallic tanks with a working pressure not exceeding 0,5 bar - Design and construction*

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

EN ISO 3452-1, *Non-destructive testing - Penetrant testing – Part 1: General principles (ISO 3452-1)*

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

EN ISO 4136, *Destructive tests on welds in metallic materials - Transverse tensile test (ISO 4136)*

EN ISO 5173, *Destructive tests on welds in metallic materials - Bend tests (ISO 5173)*

\square_{A1} EN ISO 5817, *Welding - Fusion-welded joints in steel, nickel, titanium and their alloys (beam welding excluded) - Quality levels for imperfections (ISO 5817) \square_{A1}*

EN ISO 6520-1:2007, *Welding and allied processes - Classification of geometric imperfections in metallic materials – Part 1: Fusion welding (ISO 6520-1:2007)*

EN ISO 9015-1:2011, *Destructive tests on welds in metallic materials - Hardness testing – Part 1: Hardness test on arc welded joints (ISO 9015-1:2001)*

EN ISO 9016:2012, *Destructive tests on welds in metallic materials - Impact tests - Test specimen location, notch orientation and examination (ISO 9016:2012)*

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 9606-3, *Approval testing of welders - Fusion welding – Part 3: Copper and copper alloys (ISO 9606-3)*

EN ISO 9606-4, *Approval testing of welders - Fusion welding – Part 4: Nickel and nickel alloys (ISO 9606-4)*

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

A1 EN ISO 10042, *Welding - Arc-welded joints in aluminium and its alloys - Quality levels for imperfections (ISO 10042)*

EN ISO 10863, *Non-destructive testing of welds - Ultrasonic testing - Use of time-of-flight diffraction technique (TOFD) (ISO 10863) **A1***

EN ISO 11666, *Non-destructive testing of welds - Ultrasonic testing - Acceptance levels (ISO 11666)*

A1 EN ISO 13588, *Non-destructive testing of welds - Ultrasonic testing - Use of automated phased array technology (ISO 13588) **A1***

EN ISO 14731, *Welding coordination - Tasks and responsibilities (ISO 14731)*

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)*

A1 EN ISO 15626, *Non-destructive testing of welds - Time-of-flight diffraction technique (TOFD) - Acceptance levels (ISO 15626) **A1***

CEN ISO/TR 15608, *Welding - Guidelines for a metallic materials grouping system (ISO/TR 15608)*

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 15614-1, *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)*

EN ISO 15614-2, *Specification and qualification of welding procedures for metallic materials - Welding procedure test – Part 2: Arc welding of aluminium and its alloys (ISO 15614-2)*

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 17636-2, *Non-destructive testing of welds - Radiographic testing - Part 2: X- and gamma-ray techniques with digital detectors (ISO 17636-2)*

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

EN ISO 17638, *Non-destructive testing of welds - Magnetic particle testing (ISO 17638)*

EN ISO 17639:2013, *Destructive tests on welds in metallic materials - Macroscopic and microscopic examination of welds (ISO 17639:2003)*

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

EN ISO 17643:2015, *Non-destructive testing of welds - Eddy current examination of welds by complex plane analysis (ISO 17643:2015)*

EN ISO 19285, *Non-destructive testing of welds - Phased array ultrasonic testing (PAUT) - Acceptance levels (ISO 19285)*

EN ISO 23277:2015, *Non-destructive testing of welds - Penetrant testing - Acceptance levels (ISO 23277:2015)*

EN ISO 23278:2015, *Non-destructive testing of welds - Magnetic particle testing - Acceptance levels (ISO 23278:2015)*

IMO MSC/Circ. 860, Guidelines for the approval of offshore containers handled in open seas¹

UN Manual of Tests and Criteria, Part IV²

3 Terms, definitions, symbols and abbreviations

3.1 Terms and definitions

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

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

- IEC Electropedia: available at <http://www.electropedia.org/>
- ISO Online browsing platform: available at <http://www.iso.org/obp>

NOTE 1 The definitions of terms used in this document are taken as those given by the applicable regulations concerning the transport of dangerous goods unless otherwise stated.

NOTE 2 Additional terms and definitions can be found in EN 14564 [4].

¹ May be purchased from the International Maritime Organization (IMO), 4 Albert Embankment, Lambeth, London SE1 7SR, United Kingdom.

² May be purchased from the United Nations Economic Commission for Europe (UNECE), 8 Avenue de la Paix, 1202 Geneva, Switzerland.

3.1.1

expert

dependent on national law, individual person approved by the competent authority, or national body approved by the competent authority, or inspection body approved by the competent authority to perform designated inspections and tests in accordance with the scope of their approval

Note 1 to entry: According to RID/ADR testing and inspection duties are allocated to either the competent authority or to inspection bodies or individual experts approved by the competent authority. RID and ADR include detailed requirements on the qualification, obligations, accreditation and approval of these inspection bodies.

3.1.2

protective lining or coating

lining or coating protecting the metallic tank material against corrosion or reaction with the substances to be transported

Note 1 to entry: This does not apply to lining or coating used only to protect the substance to be carried.

3.1.3

repair

correction of a defect

Note 1 to entry: It does not include normal service and servicing operations of the shell or service equipment or replacement of gaskets or service equipment to the same specification.

3.1.4

technical code

code or standard(s) according to which the tank has been designed and constructed

Note 1 to entry: RID/ADR use this term in context with tanks which are NOT designed, constructed and tested according to referenced standards. For the purpose of this standard, EN 14025 [5] and EN 13094 are considered to be technical codes.

3.1.5

modification

<tanks for the transport of dangerous goods> work on an existing tank with a valid, or expired, or withdrawn type approval which causes a non-conformity with the type approval mentioned above

3.1.6

alteration

<tanks for the transport of dangerous goods> work on an existing tank with a valid, or expired, or withdrawn type approval leaving the tank inside the scope of the type approval provided the original type approval is in conformity with the relevant regulation on the transport of dangerous goods at the time of the work

3.2 Symbols and abbreviations

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

3.2.1 General symbols and abbreviations:

e	nominal shell thickness
D_i	internal tube diameter
NDT	non-destructive testing
λ	joint coefficient

3.2.2 NDT symbols (used in Tables 1 and 2):

VT	Visual testing
UT	Ultrasonic testing
PT	Penetrant testing
MT	Magnetic particle testing
RT	Radiographic testing
ET	Eddy current testing

3.2.3 Weld position symbols (see Figure 1, used in Table 1):

N	“Tee”-junction (weld node)
C	Circular (or transverse) joints of the same cylindrical or conical part and of a rotating or ring-shaped part
NC	Longitudinal joints or joints that do not belong to the C type

The weld of a hemispherical end is similar to a longitudinal weld (NC) when it is located beyond the cylindrical part of the end.

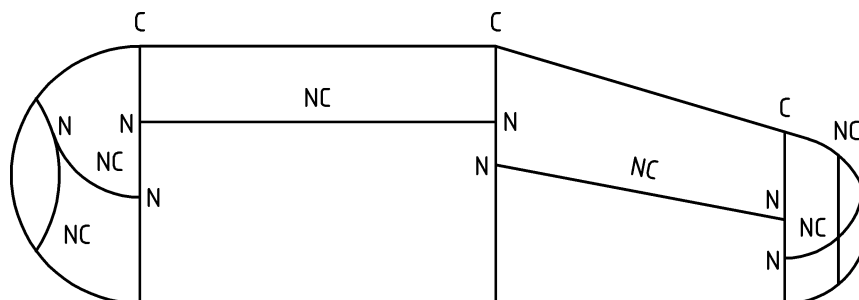


Figure 1 — Weld position symbols

3.2.4 \square_{A1} **Welding imperfection symbols (used in Table 3, Table 6 and Table 7) \square_{A1} :**

- a* nominal fillet weld throat thickness
- b* width of weld reinforcement (width of excess weld)
- d* diameter of pore
- h* height of imperfection
- l* length of imperfection
- t* wall or plate thickness
- w* width of imperfection

3.2.5 **Material property symbols (used in Annex B):**

- A* elongation at break
- R_e* yield strength
- R_m* tensile strength

3.2.6 **Manufacturing tolerance symbols (used in Annex F):**

- d₁* middle line alignment
- D* internal shell diameter
- O* out of roundness
- P* peaking

4 Inspections and tests

4.1 General

In accordance with the relevant regulations concerning the transport of dangerous goods, shells and their equipment shall undergo inspections for issuing the type approval certificate, inspection for modification of a tank and initial, intermediate and periodic inspections and \square_{A1} exceptional inspections \square_{A1} , if needed, as indicated in the survey table in Annex A and as given in this standard.

All inspections and tests carried out according to this document shall state the condition of the tank at the time of inspection or testing.

4.2 Inspection for type approval

4.2.1 General

The inspection for type approval shall be carried out on a prototype tank of either a single tank or a range of tanks. A type approval which includes a limited variation of the design will allow the following variations to the design without requiring a new approval, if there are no other conflicting technical or legal requirements:

- a decrease in the initial design temperature range;
- a decrease in the maximum gross mass;

- a reduction in volume only resulting from variations in diameter (not applicable to cross sections with recesses or protrusions) and length, providing related calculation and drawings include each proposed diameter, length and number of compartments of the shell under the most unfavourable conditions, i.e.:
 - greatest density of goods;
 - greatest shell length and diameter;
 - greatest water capacity of front compartment;
 - greatest water capacity of rear compartment. For non-cylindrical shells according to EN 13094:2015, 6.3, only the height may be reduced.

NOTE Attention is drawn to the permitted design variations with regard to reduction of volume of portable tanks, specified in the UTM Manual of Tests and Criteria, Part IV, Section 41;

- a variation in the grade of the material used may be allowed with the following reserves:
 - the same qualified welding procedures according to EN ISO 15614-1 or EN ISO 15614-2 are applicable;
 - calculation is carried out in the most unfavourable case, in particular the mechanical characteristics selected are for each element the lowest values of the grades used;
- movement or modification of nozzles and manholes provided that the same level of protection is afforded and the strength calculation takes into account the most unfavourable case;
- a decrease in the number of nozzles;
- an increase of the number of surge plates and baffles;
- an increase of the shell thickness(es) provided the same welding procedures are used;
- for pressure tanks, a decrease of the maximum working pressure;
- an increase in the thickness of the insulation used for additional protection;
- an increase in the effectiveness of the thermal insulation of the tank;
- the use of alternative service equipment if there is no change in the technical specification of the equipment and it is placed in the same location.

4.2.2 Content of inspection

4.2.2.1 Inspection for initial type approval

The inspection for initial type approval shall be carried out in accordance with the following subclauses:

- examination of documents (see 5.2.1);
- check of the design characteristics (see 5.3);
- inspection of the shell interior (see 5.4);

- inspection of the tank exterior (see 5.5);
- hydraulic pressure test (see 5.6);
- vacuum test (see 5.7, only if required and if no calculation or finite element analysis has been provided);
- leakproofness test (see 5.8);
- determination of water capacity (see 5.9);
- inspection of service equipment (see 5.10);
- inspection of frame or other structural equipment of portable tanks and tank containers (see 5.11);
- dynamic longitudinal impact test for portable tanks (see 5.12);
- check the marking on the tank (see 5.13.3).

4.2.2.2 Inspection for modifications to a type approval

Where a modification to the type approval is proposed, the applicable units of the inspection for initial type approval shall be reappraised. The inspection for type approval in the case of a modification shall be carried out on the parts that have been modified.

4.2.3 Documentation

The results of the inspection for type approval shall be recorded by the expert in a type examination report. The possible variations of the design which have been inspected as being in conformity with the legislation must be stated in the type examination report.

NOTE A preliminary report can be issued after examination of the documents.

A1 In the case of tank vehicles, a data sheet containing the information in Annex B shall be prepared in addition to the type examination report. In the case of other tanks, it is recommended that a data sheet containing the information in Annex B is prepared to assist the issuing of type approval in addition to the type examination report. Annex B shall cover the limits of the permitted variations of type approval according to 4.2.1. **A1**

4.3 Inspection for modification of a tank

In case of a modification of a tank already in service taking it outside the scope of the type approval, the inspection shall be carried out:

- to the parts to be modified, and
- with the applicable units of the inspection for type approval and of the initial inspection.

In this case, an approval certificate for modification of the tank shall be issued.

A1 NOTE The certificate for modification meets the requirements of the certificate referred to in 6.8.2.3.4 of RID [1] and ADR [2]. **A1**

4.4 Initial inspection

4.4.1 Content of inspection

The initial inspection shall be carried out in accordance with the following subclauses:

- examination of documents (see 5.2.2);
- check of the design characteristics (see 5.3);
- inspection of the shell interior (see 5.4);
- inspection of the tank exterior (see 5.5);
- hydraulic pressure test (see 5.6);
- leakproofness test (see 5.8);
- determination of water capacity (see 5.9; only where required by regulation for individual tanks);
- inspection of service equipment (see 5.10);
- inspection of frame or other structural equipment of portable tanks and tank containers (see 5.11);
- check of the marking of the tank plate (see 5.13.3).

For vacuum insulated tanks, a satisfactory vacuum in accordance with the manufacturer's specification shall be confirmed by measurement.

4.4.2 Documentation, certificate and marking

The results of the initial inspection shall be recorded by the expert on a certificate. An individual tank that has been tested and passed for type approval shall be issued with an initial inspection certificate. Certificate and marking shall be in accordance with 5.13.

4.5 Periodic inspection

4.5.1 Content of inspection

The periodic inspection shall be carried out in accordance with the following subclauses:

- examination of documents (see 5.2.3);
- inspection of the shell interior (see 5.4);
- inspection of the tank exterior (see 5.5);
- hydraulic pressure test (see 5.6);
- leakproofness test (see 5.8);
- inspection of service equipment (see 5.10);
- inspection of frame or other structural equipment of portable tanks and tank containers (see 5.11).

For vacuum insulated tanks, the inspection of the shell interior and the hydraulic pressure test are not required provided that a satisfactory vacuum in accordance with the manufacturer's specification is confirmed by measurement and simultaneously a leakproofness test is carried out.

If openings have been made in shells intended for the carriage of refrigerated liquefied gases, the method by which they are hermetically closed before the shells are returned to service shall be inspected according to 4.7.5.

In the case of tanks intended for the carriage of powdery or granular substances, the hydraulic pressure test may be omitted and replaced by the leakproofness test (see 5.8).

4.5.2 Documentation, certificate and marking

The results of the periodic inspection shall be recorded by the expert on a certificate. Any defect found which can impair the safety of the tank or the equipment and any related repairs carried out shall be recorded on the certificate. Certificate and marking shall be in accordance with 5.13.

4.6 Intermediate inspection

4.6.1 Content of inspection

The intermediate inspection shall be carried out in accordance with the following subclauses:

- examination of documents (see 5.2.4);
- inspection of the shell interior (see 5.4; only where required by regulation);
- inspection of the tank exterior (see 5.5);
- leakproofness test (see 5.8);
- inspection of service equipment (see 5.10);
- inspection of frame or other structural equipment of portable tanks and tank containers (see 5.11; only where required by regulation).

4.6.2 Documentation, certificate and marking

The results of the intermediate inspection shall be recorded by the expert on a certificate. Any defect found which can impair the safety of the tank or the equipment and any related repairs carried out shall be recorded on the certificate. Certificate and marking shall be in accordance with 5.13.

4.7 \square_{A1} Exceptional inspections \square_{A1}

4.7.1 General

The following subclauses describe what shall be done where a tank is presented to an \square_{A1} exceptional inspection \square_{A1} .

4.7.2 \square_{A1} Exceptional inspection \square_{A1} after damage or repair of the shell

The \square_{A1} exceptional inspection \square_{A1} after damage of the shell which can have impaired the safety of the tank, and/or after repair, shall be carried out in accordance with the following subclauses to the extent as is applicable:

- examination of documents (see 5.2.5);
- check of the design characteristics (see 5.3);

- inspection of the shell interior (see 5.4);
- inspection of the tank exterior (see 5.5);
- hydraulic pressure test (see 5.6);
- leakproofness test (see 5.8);
- inspection of service equipment (see 5.10);
- inspection of frame or other structural equipment of portable tanks and tank containers (see 5.11).

4.7.3 [A1] Exceptional inspection [A1] after the repair or replacement of service equipment

The [A1] exceptional inspection [A1] after the repair or replacement of the service equipment shall be carried out in accordance with the following subclauses to the extent as is applicable:

- examination of documents (see 5.2.5);
- check of the design characteristics (see 5.3);
- leakproofness test (see 5.8);
- inspection of service equipment (see 5.10).

4.7.4 [A1] Exceptional inspection [A1] after replacement of service equipment involving the application of heat

The [A1] exceptional inspection [A1] after exchange of the service equipment involving the application of heat (for example welding or cutting) which can have impaired the safety of the tank or the service equipment shall be carried out in accordance with the following subclauses to the extent as is applicable:

- examination of documents (see 5.2.5);
- check of the design characteristics (see 5.3);
- inspection of the shell interior (see 5.4);
- inspection of the tank exterior (see 5.5);
- hydraulic pressure test (see 5.6);
- leakproofness test (see 5.8);
- inspection of service equipment (see 5.10).

4.7.5 [A1] Exceptional inspection [A1] after alteration to the tank

If there is an alteration to the tank the applicable units of the inspection for type approval shall be reappraised.

4.7.6 [A1] Exceptional inspection [A1] after exchange or repair of frame or structural equipment

The [A1] exceptional inspection [A1] after exchange or repair of frame or structural equipment shall be carried out in accordance with the following subclauses to the extent as is applicable:

- examination of documents (see 5.2.5);
- check of the design characteristics (see 5.3);
- inspection of the tank exterior (see 5.5)
- inspection of frame or other structural equipment of portable tanks and tank containers (see 5.11).

4.7.7 **[A1] Exceptional inspection [A1] before and after repair or replacement of the protective lining or coating**

The [A1] exceptional inspection [A1] before and after repair or replacement of the existing protective lining or coating whose defect can impair the safety of the tank shall be carried out in accordance with the following subclauses to the extent as is applicable:

- examination of documents (see 5.2.5);
- check of the design characteristics (see 5.3);
- inspection of the shell interior (see 5.4):
 - before the repair of the protective lining or coating;
 - after the removal of the protecting lining or coating; and
 - after repair or replacement of the protective lining or coating;
- hydraulic pressure test after application of heat (for example burning of the existing lining) which can have impaired the safety of the tank (see 5.6);
- leakproofness test (see 5.8).

4.7.8 **Documentation, certificate and marking**

The results of the [A1] exceptional inspection [A1] shall be recorded by the expert on a certificate. Any defects found which can impair the safety of the tank or the equipment and any related repairs carried out shall be recorded on the certificate. Certificate and marking shall be in accordance with 5.13.

A preliminary report may be issued after examination of documents.

5 **Procedures and documentation for inspections and tests**

5.1 **General**

A tank which fails one or more units of inspection shall, once the failure has been investigated and corrected, be retested in accordance with the requirements of those units. If, in the opinion of the expert, the repair may have affected the validity of any previous tests these tests shall be repeated.

Depending on the result of the inspections additional assessments, inspections and tests may be necessary to verify the conformity of the tank with the relevant regulation for the transport of dangerous goods.

Where the interior of a shell or compartment is to be inspected the tank shall be empty, clean and safe to enter (e.g. no electrical services, no heating, safe atmosphere) at the time of inspection. Permits of work according to the legislation dealing with safety and health at work shall be complied with. This is also a requirement when necessary for the safety of the inspecting personnel and any other persons in the vicinity especially when other inspections are carried out.

5.2 Examination of documents

5.2.1 Inspection for type approval

5.2.1.1 Required documents

Documents giving the following information shall be provided for the inspection for type approval by the manufacturer or his representative:

- name and address of the applicant;
- description of the tank prototype including planned variations to the design and its special characteristics;
- names and addresses of the manufacturer and the assembler of the tank; in the case of fixed tanks (tank vehicles) or tank-wagons the design of chassis or wagon; in the case of tank containers or portable tanks the manufacturer and design of frame if applicable;
- qualification of welders, welding procedure(s) and weld quality assurance system in accordance with the technical code; if the technical code does not contain requirements for:
 - qualification of the welder and welding procedure, the requirements of EN ISO 9606-1, EN ISO 9606-2, EN ISO 9606-3, EN ISO 9606-4, EN ISO 14732, EN ISO 15607, EN ISO 15609-1, EN ISO 15614-1 (level 1 or level 2), EN ISO 15614-2; and
 - qualification of the weld quality assurance system, the requirements of 5.3.4 shall be met as applicable;
- description of the assigned mode of operation (e.g. pressure discharging);
- indication of the portable tank instruction T (tank instruction) and TP (tank provision) or tank code and the applicable special provisions TA (type approval), TC (construction) and TE (equipment);
- if required, listing of all substances or groups of substances to be carried by the tank (especially for substances of class 2³ and special substances listed in the regulation for which additional requirements can apply);
- schematic drawing of the tank with listing of main dimensions;
- schematic drawings of the piping systems;
- data sheet with the operational data of the tank necessary for calculation;
- calculations of the tank and its fastenings according to the applicable regulation for the transport of dangerous goods and, if required, verification by testing of the tank and its fastenings;

³ i.e., substances of class 2 according to the applicable regulation for the transport of dangerous goods.

- drawings necessary for verifying the manufacture of the tank, of its equipment and of its fastenings, including an assembly drawing and a parts list indicating the materials;
- drawings for marking (tank plates and others);
- specifications of the service equipment with the relevant technical data including certificates of compliance with the appropriate technical codes, standards and requirements;
- suitability of the safety equipment including the calculation of the relief capacity if relevant;
- material specification for all materials used for construction of the tank showing values of material properties as required by the relevant regulation and by the applied technical code (this includes welding filler materials, auxiliary welding materials and protective lining or coating);
- for prototype tank, material test certificates as required by the applied technical code for all materials used for construction of the tank showing values of material properties as required by the relevant regulation; this includes welding filler materials, auxiliary welding materials and protective lining or coating;
- record of tests carried out on production control test plates if required by the technical code and/or the relevant regulations concerning the transport of dangerous goods (the records and the relation between the test plates and the tanks shall be verified by the expert);
- when using a protective lining or coating, requirements of the lining or coating manufacturer for a test to confirm that the protective lining or coating has been applied in accordance with the manufacturer's specification;
- necessary requirements for determination of the holding time, for tanks for refrigerated liquefied gases, as applicable;
- record of NDT carried out on the welds;
- **[A1]** the qualification certificate of personnel who performs NDT **[A1]**;
- if relevant, validation of the NDT technique used;
- heat treatment procedure and records of heat treatment.

5.2.1.2 Examination of documents

The documents shall be examined to determine that the requirements of the relevant dangerous goods regulations and technical code have been fulfilled. The compatibility of tank material and any coating or lining and equipment with the assigned dangerous goods shall be verified.

5.2.2 Initial inspection

5.2.2.1 Required documents

The documents shall provide the following information for the initial inspection:

- application for initial inspection;
- type approval certificate;
- information given in the application of type approval where necessary (see 5.2.1.1);

- qualification of welders, welding procedure(s) and weld quality assurance system in accordance with the technical code; if the technical code does not contain requirements for:
 - qualification of the welder and welding procedure, the requirements of EN ISO 9606-1, EN ISO 9606-2, EN ISO 9606-3, EN ISO 9606-4, EN ISO 14732, EN ISO 15607, EN ISO 15609-1, EN ISO 15614-1 (level 1 or level 2), EN ISO 15614-2; and
 - qualification of the weld quality assurance system, the requirements of 5.3.4 shall be met as applicable;
- material test certificates as required by the applied technical code for all materials used for construction of the tank showing values of material properties as required by the relevant regulation; this includes welding filler materials, auxiliary welding materials and protective lining or coating;
- record of tests carried out on production control test plates if required by the technical code and/or the relevant regulations concerning the transport of dangerous goods (the records and the relation between the test plates and the tank shall be verified by the expert);
- when using a protective lining or coating, proof of compatibility of the protective lining or coating with the dangerous goods to be transported;
- when using a protective lining or coating, proof that the protective lining or coating has been applied and tested in accordance with the tank manufacturer's specification;
- necessary requirements for determination of the holding time, for tanks for refrigerated liquefied gases, as applicable;
- record of NDT carried out on the welds;
- qualification certificate for personnel undertaking NDT;
- heat treatment procedure and records of heat treatment;
- calculation of water capacity, if applicable.

5.2.2.2 Examination of documents

The documents shall be examined to determine that the type approval has been complied with and that the requirements of the relevant dangerous goods regulations and the technical code have been fulfilled.

5.2.3 Periodic inspection

5.2.3.1 Required documents

The following documents or copies of them shall be provided for the periodic inspection:

- certificate of initial inspection if the tank has not been subject to periodic inspection;
- certificate of last periodic inspection, if applicable;
- certificate of intermediate inspection if carried out after the previous periodic inspection or after the initial inspection if there has been no periodic inspection;

- the technical data sheet according to Annex B, applicable only for tank vehicles with an initial inspection date after the publication of this issue of this document;
- necessary requirements for determination of the holding time, for tanks for refrigerated liquefied gases, as applicable;
- if required one or more of the documents mentioned in 5.2.1.1.

NOTE These can be found in the tank record according to the applicable regulations for the transport of dangerous goods.

5.2.3.2 Examination of documents

The documents shall be examined to determine that they are relevant to the tank to be examined. Any additional requirements and remarks given in these documents shall be taken into account.

5.2.4 Intermediate inspection

5.2.4.1 Required documents

The following documents or copies of them shall be provided for the intermediate inspection:

- certificate of initial inspection if the tank has not been subject to periodic inspection;
- certificate of last periodic inspection;
- the technical data sheet according to Annex B, applicable only for tank vehicles with an initial inspection date after the publication of this issue of this document;
- necessary requirements for determination of the holding time, for tanks for refrigerated liquefied gases, as applicable;
- if required one or more of the documents mentioned in 5.2.1.1.

NOTE These can be found in the tank record according to the applicable regulations for the transport of dangerous goods.

5.2.4.2 Examination of documents

The documents shall be examined to determine that they are relevant to the tank to be examined. Any additional requirements and remarks given in these documents shall be taken into account.

5.2.5 A1 Exceptional inspection A1

5.2.5.1 Required documents

As far as it is relevant for the A1 exceptional inspections A1 described in 4.7.2 to 4.7.6 and 4.7.8 the following information shall be provided:

- copy of certificate of type approval;
- information given in the application of type approval where necessary (see 5.2.1.1), alternatively the technical data sheet according to Annex B, applicable only for tank vehicles with an initial inspection date after the publication of this issue of this document;
- name and address of the undertaking carrying out the alteration to the tank or the repair;

- qualification of welders, welding procedure(s) and weld quality assurance system in accordance with the technical code; if the technical code does not contain requirements for:
 - qualification of the welder and welding procedure, the requirements of EN ISO 9606-1, EN ISO 9606-2, EN ISO 9606-3, EN ISO 9606-4, EN ISO 14732, EN ISO 15607, EN ISO 15609-1, EN ISO 15614-1 (level 1 or level 2), EN ISO 15614-2; and
 - qualification of the weld quality assurance system, the requirements of 5.3.4 shall be met as applicable;
- heat treatment procedure and records of heat treatment;
- material certificates to verify that the properties of the materials used for a repair or alteration to the tank are at least equivalent to those of the materials used for the original construction (this includes welding filler materials, auxiliary welding materials and protective lining or coating);
- record of NDT carried out;
- A_1 qualification certificate of personnel undertaking NDT A_1 ;
- if welding is carried out, a record of tests performed on the production control test plates if required by the technical code and/or the relevant regulations concerning the transport of dangerous goods (the records and the relation between the test plates and the tank shall be verified by the expert);
- when using a protective lining or coating, proof that the protective lining or coating has been applied and tested in accordance with the product specification;
- necessary requirements for determination of the holding time, for tanks for refrigerated liquefied gases, as applicable;
- if necessary for repair of service equipment, a schematic drawing of the piping systems;
- if piping is changed, schematic drawings of the piping systems;
- a description of work carried out.

NOTE A copy of the certificate of type approval may be found in the tank record according to the applicable regulations for the transport of dangerous goods.

The documents shall give the following information relevant to the A_1 exceptional inspection A_1 described in 4.7.7:

- proof of compatibility of the protective lining or coating with the dangerous goods to be transported;
- proof that the protective lining or coating has been applied and tested in accordance with the manufacturer's specification

5.2.5.2 Examination of documents

The documents shall be examined to determine that the requirements of the relevant dangerous goods regulations and the technical code have been fulfilled.

5.3 Check of the design characteristics

5.3.1 Content of inspection

The check of the design characteristics shall include:

- examination of the manufacturing conditions;
- inspection of the material grades and wall thicknesses;
- examination of the manufacturing methods;
- inspection of the condition of the tank;
- inspection of the main dimensions;
- NDT of the welds;
- testing of test plates (where required by regulation or relevant technical code).

If the check of the design characteristics is part of the inspection for type approval, the reference to type approval documents shall be taken as reference to design documents (see 5.2.1.1).

5.3.2 Examination of the manufacturing conditions

The suitability of the manufacturing equipment and the competency and qualifications of personnel shall be as required by the technical code.

5.3.3 Inspection of the materials and wall thicknesses

The materials used for the shell, the piping and the structural and service equipment shall correspond to the type approval and with the material certificates, where appropriate. The material certificates shall be as required by the technical code.

The tank shall be inspected to determine the traceability between the marking of the materials and the identification given by the material certificates.

The actual thickness of materials of the shell, the piping and the structural equipment shall not be less than that given by the type approval documents. This shall be verified by appropriate measurement on completion of the tank.

5.3.4 Examination of the manufacturing methods

The manufacturing methods and data of the heat treatment, the rolling and the forming of the materials used for the shell, the piping and the structural equipment shall be examined to ensure compliance with the design specifications of the tank.

The type of welded joints shall be examined to ensure compliance with the type specified in the design of the tank. Fillet weld sizes shall be as given in the design specification.

The weld quality assurance system procedure shall be in accordance with the relevant technical code. When the technical code does not contain requirements for the weld quality assurance system procedure, the requirements of EN ISO 3834-2 and EN ISO 14731 shall be met to the extent as is applicable. When the manufacturer weld quality assurance system has been approved according to the technical code or by default according to these standards, the verification may be limited to the verification of the validity dates and the scope of the certificate.

NOTE Special attention is made to aluminium alloys and their weldability problems, see EN 1011-4 [6].

5.3.5 Inspection of main dimensions

The main dimensions of the tank and if relevant of the framework shall be inspected for conformity with the dimensions given by the type approval documents.

5.3.6 NDT of the welds

5.3.6.1 General

The NDT of welds shall be carried out in accordance with the relevant regulation and the technical code used for design and construction of the tank or, if there is no requirement in the technical code, the requirements given in Table 1.

A1 Qualification of personnel who performs NDT (see associated certificate) shall be in accordance with the technical code; if the technical code does not contain qualification requirements, the qualification plan should be based on EN ISO 9712.

NOTE NDT can also be performed by personnel authorized for the applicable Standard from an organization accredited according to EN ISO/IEC 17020 [8] or EN ISO/IEC 17024 [9]. **A1**

All NDT of the welds shall be carried out after heat treatment of welds.

Manufacturers may undertake additional NDT prior to heat treatment.

All welds shall be visually inspected (VT) according to 5.3.6.3 before performing any other NDT.

The NDT of butt welds shall be by radiographic (RT), or ultrasonic (UT) methods. Welds which cannot be tested by RT or UT because of the design or the position of the weld shall be tested by dye penetrant (PT), magnetic particle (MT) or Eddy current (ET) testing according to Table 1.

NDT should be performed on each tank. The percentage of welds to be tested applies to the total length of welds of the same type. Two welds are considered as being of the same type if their welding procedures have the same qualification. The length of welds tested at nodes shall be taken into account for the calculation of length to be examined.

A1 When the joint coefficient λ is less than 1 and when the presence of an unacceptable defect is noted in the tested portion of a weld, NDT shall be extended to a portion of the weld with a length at least equal to that which has just been tested on each side of the defect. If this additional NDT gives rise to the observation of a new unacceptable defect, NDT shall be extended to all remaining welds made according to the same welding procedure. Repaired welds shall be inspected according to the same method as the original welds. The thickness of the rectified welds shall be verified against the required minimum thickness. **A1**

All NDT shall be stated in a test report that shall include at least the elements defined in the relevant testing standards.

Multiple imperfections are not permitted. Any two adjacent imperfections separated by a distance smaller than the major dimension of the smaller imperfection shall be considered a single imperfection.

Table 1 — NDT to be performed on dangerous goods transport tank welds

Weld type		Tank weld coefficient		
		$\lambda = 0.8$	$\lambda = 0.9$	$\lambda = 1.0$
1) Full penetration butt welds	a) Length of circular welds of the shell symbol C	10 % RT or UT	25 % RT or UT	100 % RT or UT
	b) Length of non-circular welds of the shell symbol NC	10 % RT or UT	100 % RT or UT	100 % RT or UT
	c) "Tee"-junctions ^b (weld nodes) symbol N	100 % RT or UT	100 % RT or UT	100 % RT or UT
	d) Length of welds symbol C of internal tubes $D_i > 80$ mm	10 % RT	25 % RT	100 % RT
2) Full penetration fillet welds (tube, flange $D_i > 80$ mm)	a) length of welds $e \leq 12$ mm	10 % of PT ^a or MT ^a	50 % of PT ^a or MT ^a	100 % of PT ^a or MT ^a
	b) length of welds $e > 12$ mm	10 % of: PT ^a or MT ^a	50 % of: UT or RT	100 % of UT or RT
3) Length of welds of partially penetrated fillet welds — Partition welds — End welds including lap joint welds used for joining an end to the shell wall — Tube with $D_i > 80$ mm		10 % of PT ^a , ET ^a or MT ^a	50 % of: PT ^a , ET ^a or MT ^a	100 % of PT ^a , ET ^a or MT ^a
4) Length of welds of other elements welded directly on to the shell		—	25 % of PT ^a , ET ^a or MT ^a	50 % of PT ^a , ET ^a or MT ^a
5) Length of welds of internal tubes with $D_i < 80$ mm		—	—	100 % of the length of PT, ET, MT
6) Length of tube welds outside the shell with $D_i > 80$ mm		—	—	100 % of the length of RT
7) Length of tube welds outside the shell with $D_i \leq 80$ mm		—	—	100 % of the length of PT, ET, MT
^a Non-mandatory control for 1.1, 1.2, 8.1, 22.1, 22.4 and 23 groups of material as defined in CEN ISO/TR 15608. Nevertheless, NDT shall be performed where there is doubt of quality of welds. ^b The length of welds adjacent to those with symbol N and included in the NDT of these welds may be incorporated into the calculation of welds with symbols C and NC.				

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5.3.6.2 Limitations of NDT methods

If alternative NDT is specified in Table 1, then Table 2 shall apply.

Table 2 — Acceptable testing methods (based on EN ISO 17635:2016, Tables 2 and 3);

Materials	Internal discontinuity applicable testing methods	Surface discontinuity applicable testing methods
Ferritic steels	RT UT	MT PT ET
Austenitic-ferritic stainless steels	RT	MT ^a PT
Austenitic stainless steels Aluminium Nickel Titanium	RT	PT
^a If the application of the method to the material has been validated.		

The following limitations apply to detect internal discontinuities:

- for UT the material thickness shall be > 8 mm, $\overline{A_1}$ for UT-PA and UT-TOFD the material thickness shall be > 6 mm $\overline{A_1}$,
- for ET and MT the maximum usual depth of detection of defects is 2,5 mm.

5.3.6.3 Visual testing

5.3.6.3.1 General

The testing shall be performed according to EN ISO 17637 and 5.3.6.3.2 to 5.3.6.3.3.

5.3.6.3.2 Welding imperfections

$\overline{A_1}$ The acceptance criteria for visual testing shall comply with the relevant regulation and the relevant technical code as applicable, or, if there are no requirements in the technical code, the requirements given in Table 3. If, according to the relevant technical code, fatigue has to be addressed, EN ISO 5817 evaluation group B for steel and EN ISO 10042 for aluminium alloys shall be mentioned. $\overline{A_1}$

Table 3 — Acceptance criteria for welding imperfections

Imperfection	EN ISO 6520-1:2007 reference no.	Limit for detectable imperfection
Cracks and lamellar tears	100	Not permitted.
Surface pore	2017	Not permitted for pressure tanks and steel tanks; maximum diameter 1,5 mm for gravity discharge aluminium alloys tanks
Slag inclusions (all)	301 302 303 304	Not permitted if occurring at the surface (shall be removed and dressed).
Flux inclusions (all)		
Oxide inclusions (all)		
Metallic inclusions (all)		
Lack of fusion (side, root or inter-run)	401	Not permitted.
Lack of penetration	402	Not permitted.
Imperfect shape	500	These imperfections are normally accepted or rejected by visual testing and the same acceptance criteria shall be applied. These imperfections can occur on surfaces with no access for visual testing (e.g. internal tubes). In these cases other techniques should be considered as a basis for acceptance.
Undercut	5011 5012	$t \geq 16$ mm: $h = 0,5$ mm long imperfections. $6 \text{ mm} \leq t < 16$ mm: $h = 0,3$ mm for long imperfections; $h = 0,5$ mm for short imperfections. $t < 6$ mm: $h = 0,3$ mm for short imperfections; all undercuts $\sqrt{A_1}$ with smooth weld transition $\sqrt{A_1}$.
Shrinkage groove	5013	Long imperfections: not permitted. Short imperfections: $h = 1$ mm. All shrinkage grooves $\sqrt{A_1}$ with smooth weld transition $\sqrt{A_1}$.
Root concavity	515	Not permitted.
Root porosity	516	Not permitted.
$\sqrt{A_1}$ Excessive penetration	504	$h \leq 1 \text{ mm} + 0,6 b$, maximum 4 mm, with smooth weld transition. $\sqrt{A_1}$
Excessive convexity	503	$h = 1 \text{ mm} + 0,15 b$, maximum 3 mm, $\sqrt{A_1}$ with smooth weld transition $\sqrt{A_1}$.

Imperfection	EN ISO 6520-1:2007 reference no.	Limit for detectable imperfection
Excess weld metal	502	$h = 1 \text{ mm} + 0,15 b$, \square_{A1} with smooth weld transition \square_{A1} .
Excessive asymmetry of fillet weld	512	$h = 2 \text{ mm} + 0,15 a$.
Irregular surface	514 509 511 513	Excess weld metal shall be of continuous and regular shape with complete filling of groove, \square_{A1} with smooth weld transition \square_{A1} .
Overlap	506	Not permitted.
Linear misalignment	507	See Annex F.
\square_{A1} Spatter	602	Shall be removed from all components in direct contact with the substance carried. \square_{A1}
Arc strike	601	Removed and dressed smooth, acceptance possible if minimum wall thickness is respected, and absence of cracks after removal of imperfections.
Torn surface	603	
Grinding mark	604	
Chipping mark	605	
Under flushing	606	Not permitted, other than any local under flushing which shall be related to the design characteristics (calculated thickness = minimum thickness for base material). Thickness shall be measured by ultrasonic method in case of doubt.
<p>NOTE Short imperfections: one or more imperfections of length not greater than 25 mm in any 100 mm length of weld, or a maximum of 25 % of the weld length for a weld shorter than 100 mm.</p> <p>Long imperfections: one or more imperfections of total length greater than 25 mm in any 100 mm length of the weld, or a minimum of 25 % for a weld shorter than 100 mm.</p>		

5.3.6.3.3 Manufacturing tolerances

If there are no requirements specified in the technical code for the design and construction of the tank, Annex F shall apply.

5.3.6.4 Penetrant testing, magnetic particle testing and eddy current testing

5.3.6.4.1 General

The testing shall be performed according the standards listed in Table 4.

Table 4 — Applicable standards for penetrant testing, magnetic particle testing and eddy current testing

Test methods	Standards
PT	EN ISO 3452-1
MT	EN ISO 17638
ET	EN ISO 17643

The acceptance criteria are given in 5.3.6.4.2.

Unacceptable indications are characterized by their shape and their dimensions.

They are either:

- linear (the largest dimension is larger than three times the smallest, see EN ISO 23277 or EN ISO 23278, as applicable), or
- nonlinear (the largest dimension is less or equal than three times the smallest, see EN ISO 23277 or EN ISO 23278, as applicable).

5.3.6.4.2 Acceptance criteria

Acceptance criteria shall be as specified in Table 5.

Adjacent indications that are separated by less than the length of the smaller indication shall be considered as a single continuous indication.

Table 5 — Acceptance criteria for all joint coefficients

PT EN ISO 23277:2015, level 2X	MT EN ISO 23278:2015, level 2X	ET EN ISO 17643:2015
The following are unacceptable: — linear indications exceeding 2 mm, — nonlinear indications the largest dimension of which is greater than 6 mm.	The following are unacceptable: — linear indications exceeding 1,5 mm, — nonlinear indications the largest dimension of which is greater than 3 mm.	If any indication is found a complementary PT or MT test shall be done.

5.3.6.5 Radiographic inspection

The radiographic inspection shall be performed according the class B improved techniques specified in EN ISO 17636-1 or EN ISO 17636-2, as applicable.

Ⓐ The acceptance criteria for radiographic inspection shall comply with the relevant regulation and the relevant technical code as applicable, or, if there are no requirements in the technical code, the requirements given in Table 6 and Table 7. Ⓐ

Table 6 — Acceptance criteria for radiographic inspection

Imperfection	EN ISO 6520-1:2007 reference	Limit for detectable imperfection
Cracks and lamellar tears	100	Not permitted.
Porosity	2011	See Table 7.
Uniformly distributed porosity	2012	See Table 7.
Localized (clustered) porosity	2013	See Table 7.
Linear porosity	2014	See Table 7.
Elongated cavity	2015	$l = 0,3 t$, maximum 5 mm; and $w = 2$ mm. Not permitted if occurring at a stop or restart.
Wormhole	2016	Same as for elongated cavity, see 2015.
Shrinkage cavity	202	$l = 0,3 t$, maximum 4 mm; and $w = 2$ mm. Not permitted if occurring at a stop or restart.
Slag and flux inclusions and oxide inclusions (parallel to the weld axis)	301 302 303	Not permitted if occurring at a stop or restart.
Slag and flux inclusions (random, not parallel to weld axis)	3012 3013 3022 3023	Individual length, maximum $0,3 t$.
Ⓐ ₁ Metallic inclusions other than copper	304	$h \leq 0,2 t$, maximum 2 mm. Ⓐ ₁
Copper inclusions	3042	Not permitted.
Lack of fusion (side, root or inter-run)	401	Not permitted.
Incomplete penetration	402	Not permitted.

Table 7 — Acceptance criteria for radiographic inspection of porosity

Imperfection	EN ISO 6520-1:2007 reference	For steels		For aluminium alloys	
		for joint coefficient 0,9 and 1	for joint coefficient 0,8	for joint coefficient 0,9 and 1	for joint coefficient 0,8
Porosity	2011	of which the diameter is greater than minimum of $a/3$ or 6 mm		of which the diameter is greater than $a/4$	
Linear porosity ^a	2014	of which the sum of the diameters exceeds a over a length equal to the smallest of the two values $12a$ or 50 mm		not permitted	
Localized (clustered) porosity ^b	2013	joint thickness in mm	max. dimension in mm	joint thickness	max. dimension in mm
		$a \leq 20$	6		
		$20 < a \leq 60$	$a/3$		
		$a > 60$	20		
		a over length $12a$	$2a$ over length $12a$	any thickness	6
Uniformly distributed porosity	2012	Not permitted if the total projected surface porosity exceeds 2 % of the considered projected surface of weld.			

^a Two inclusions or porosities are considered as belonging to the same alignment when the distance that separates them is less than six times the largest diameter.

^b Two inclusions or porosities are considered as belonging to the same cluster when the distance that separates them is less than six times the largest diameter.

5.3.6.6 Ultrasonic inspection

5.3.6.6.1 General

The ultrasonic inspection shall be performed according to EN ISO 17640, Level B $\boxed{A_1}$ or EN ISO 10863, Level C (for UT-TOFD) or EN ISO 13588, Level B (for UT-PA) $\boxed{A_1}$.

5.3.6.6.2 Acceptance criteria

Planar indications are unacceptable.

Non planar indication acceptance criteria shall be as specified in EN ISO 11666, Level 2 $\boxed{A_1}$ or EN ISO 15626, Level 1 (for UT-TOFD) or EN ISO 19285, Level 2 (for UT-PA) $\boxed{A_1}$.

5.3.7 Mechanical tests

5.3.7.1 General

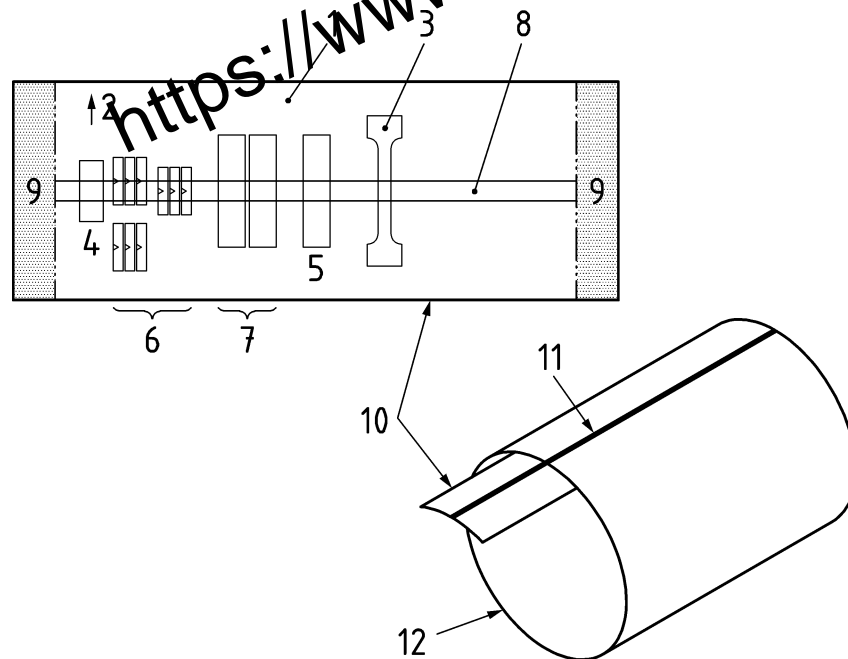
Mechanical tests shall be carried out if required by the relevant regulation (see e.g. RID/ADR 6.8.5).

The test plate shall be aligned in continuity with the longitudinal welds. If the circumferential welds are carried out using a different qualified welding process the test plates shall be prepared separately.

When it is necessary to weld the test plates separately, the procedure used should duplicate that used in the construction of the tank.

Where difficulties are encountered with electro-slag welds in transferring from parts with different curvatures (e.g. from a cylinder to a flat coupon plate) the test plate may be welded separately either immediately before or immediately after the welds of the tank, using the same welding parameters.

If the test plates are required for circumferential welds they shall be welded separately from the tank providing the technique used in their preparation duplicates as far as possible the procedure used in the welding of the appropriate welds of the tank.



Key

- | | | | |
|---|-------------------|----|--------------------------|
| 1 | test plate detail | 7 | root bend test |
| 2 | rolling direction | 8 | longitudinal welded seam |
| 3 | tensile test | 9 | discard this area |
| 4 | Macro | 10 | test plate |
| 5 | face bend test | 11 | longitudinal weld |
| 6 | Charpy | 12 | shell |

Figure 2 — Test specimen location

The type and number of specimens to be taken from the test plate after final heat treatment shall be in accordance with Figure 2 for the particular material and thickness applicable.

The test plate shall be of sufficient size to allow for the required specimens including an allowance for retests. Prior to cutting the test pieces, the test plate shall be non-destructively tested in order to ensure that the test specimens are taken from sound areas.

Additional tests shall be done for some groups of materials as defined in CEN ISO/TR 15608:

- Micro examination (Mi) shall be done according to EN ISO 17639:2013 for 8.2 and 10 groups of materials;
- **A1** Hardness test (HT) shall be done according to EN ISO 9015-1:2011, where the shell is to be heat treated according to the regulation. **A1**

5.3.7.2 Tensile test

Transverse tensile test shall be carried out according to EN ISO 4136.

The testing and the acceptance criteria shall be as specified in EN ISO 15614-1. Special consideration should be given where the mechanical properties of the weld are below those of the shell material, e.g. 9 % Ni steels welded with austenitic filler metal.

5.3.7.3 Bend tests

Face bend test (FB) shall be carried out according to EN ISO 5173.

Root bend test (RB) shall be carried out according to EN ISO 5173.

The testing and the acceptance criteria shall be as specified in EN ISO 15614-1.

5.3.7.4 Impact tests

Except for the requirements set out in this clause, the impact tests (Charpy V-notch) for the base material shall be carried out in accordance with the requirements of EN ISO 148-1. Impact tests for the welds shall be carried out according to EN ISO 9016:2012, VW and VH.

The tests shall be carried out at the minimum design temperature, except for minimum design temperatures lower than $-196\text{ }^{\circ}\text{C}$, for which $-196\text{ }^{\circ}\text{C}$ shall be used.

Three impact test samples shall be taken from each position on test plate according to Figure 2, and the requirement of the applicable regulation.

For tanks having a test pressure ≥ 10 bar or intended for transport of class 2⁴ refrigerated liquefied gases, the sampling of impact specimens is carried out as follows:

- when $5\text{ mm} < e \leq 10\text{ mm}$:
 - 3 specimens with notch in the centre of the welded joint;
 - 3 specimens with notch in the heat-affected zone;
- when $10\text{ mm} < e \leq 20\text{ mm}$:
 - 3 specimens sampled in the centre of the thickness of the joint with notch in the centre of the welded joint;
 - 3 specimens with notch in the heat-affected zone;
- when $e > 20\text{ mm}$:
 - two sets of 3 specimens with notch in the welded joint (1 set on the upper face and 1 set on the lower face);
 - two sets of 3 specimens with notch in the heat-affected area (1 set on the upper face and 1 set on the lower face).

When different batches of material are used, add a set of 3 specimens with notch in the heat-affected zone from each batch that have not already been tested.

⁴ I.e., substances of class 2 according to the applicable regulation for the transport of dangerous goods.

Base material impact testing may be accepted if the material manufacturer testing laboratory is accredited according to EN ISO/IEC 17025 [10].

No impact test shall be carried out on sheets less than 5 mm thick or on their weld seams.

5.3.7.5 Macro examination

Macro examination (Ma) shall be carried out according to EN ISO 17639.

The macroscopic examination shall show complete fusion and shall be free of any assembly faults or any unacceptable defects, as defined in EN ISO 17639:2013, Table 1.

5.4 Inspection of the shell interior

5.4.1 Inspection of the condition of the shell

A complete visual inspection of the shell interior shall be performed (provided no protective lining or coating is used) to identify any surface defect.

The wall thickness shall be verified against that given by the type approval documents by appropriate measurement if the tank shows indication of reduction of wall thickness.

Any lining or coating not falling under the definition of protective lining or coating given in this document shall be visually inspected for integrity. In particular bonding defects or delaminations shall be identified and recorded in the certificate.

5.4.2 Inspection of protective lining or coating

The condition of the protective lining or coating shall be inspected by appropriate methods, e.g. spark test in accordance with the lining or coating manufacturer's specification, and in accordance with the manufacturer's recommendations. In particular bonding defects shall be identified and recorded in the certificate.

5.5 Inspection of the tank exterior

5.5.1 Inspection of the condition of the tank

A complete visual inspection shall be performed to identify any surface defect and indication of a leak such as dampness, softened paint or staining/unusual cleanliness. Any surface defects shall be evaluated by the expert.

The thicknesses of the shell wall and ends shall be verified against those given by the type approval documents by appropriate measurement if the tank shows indication of reduction of wall thickness. Alternatively, the verification may be replaced by the verification made during the inspection of the shell interior (see 5.4).

For an insulated tank or tank with a heating system that prevent direct access to the shell, and where no inspection of the interior is prescribed, the verification of the wall thickness may be waived if no external signs indicate possible reduction.

The inspection of the condition of the tank for the initial inspection shall be carried out before the attachment of any insulation, painting, protective lining or coating. For periodic and intermediate inspections, the removal of sheathing, thermal or other insulation or filler may be required by the expert when he has reasons to believe in the possible existence of defects of the shell, structural and/or service equipment. Sheathing, thermal or other insulation or filler need only be removed to the extent required to achieve a reliable appraisal of the condition of the tank.

For the inspection of the tank exterior after alteration or repair, the insulation, painting, protective lining or coating or filler shall be removed only to the extent to achieve a reliable appraisal of the tank.

5.5.2 Inspection of the fastenings of the tank and its structural equipment

The following elements shall be inspected by an appropriate method to ensure that they show no evidence for losing their structural integrity:

- structures supporting and reinforcing the tank;
- means of attachment of the tank to the frame or vehicle chassis, including rubbing plate;
- parts used for mounting the tank to the chassis; and
- any structural protective equipment e.g. the cover assembly, the sun shield.

Sheathing, thermal or other insulation and rubbing plate shall be removed only to the extent required to achieve a reliable appraisal.

5.5.3 Inspection of marking

The marking of the tank shall be verified against the requirements of the applicable regulations concerning the transport of dangerous goods, see 5.13.3.

5.5.4 Inspection of earth connection

Shells which are required to be fitted with an earth connection shall be inspected for conformity of the earth connection with the design requirements. The electrical continuity between the earth connection and the metallic parts of the tank and equipment, including any frame and where applicable between the earth connection and the vehicle chassis, shall be verified.

5.6 Hydraulic pressure test

5.6.1 General

Before the start of the test the tank shall be dry and clean on its outside so that any leakage can be detected. If the ambient temperature is below 0 °C a hydraulic pressure test with water is only allowed if the contents of the tank, of the measuring equipment and of the piping systems cannot freeze. The expert shall ensure that the test cannot be adversely effected by the weather conditions.

The hydraulic pressure test for the initial inspection shall be carried out before the attachment of any insulation, paint and surface coating, protective lining.

For the hydraulic pressure test for modification, alteration or repair of the tank, the insulation, painting, protective lining or coating shall be removed only to the extent to achieve a reliable appraisal of the tank.

The hydraulic pressure test may be replaced if allowed by the applicable regulation for the transport of dangerous goods.

5.6.2 Extent of test

The tank as a whole and, where present, each compartment shall be tested as prescribed in 5.6.3 to 5.6.8.

Exempted from this test are:

- service equipment such as breather devices, safety valves, bursting discs, porous disks and other devices designed to prevent any increase of pressure and closing devices at the end of each pipe (the closing devices may be included in the hydraulic pressure test, if appropriate) and
- sections of the filling and discharge system containing flow meters including gas extractors, and sections containing hose reels.

Exempted sections, vapour recovery manifolds of gravity-discharge tanks and air pressure lines shall be checked by a visual inspection for damage and leakage in combination with a leakproofness test according to 5.8.

The shell and its service equipment may be tested separately provided that they are subjected to a leakproofness test after assembly.

5.6.3 Test pressure

5.6.3.1 Test pressure of the whole tank

The hydraulic pressure test of the tank shall be carried out at the test pressure given by the tank plate or type approval documents. The test pressure shall be applied to the highest point of the tank. Where the measurement is taken elsewhere on the tank the pressure indicated by the pressure gauge shall be corrected to take account of the position of the pressure gauge and of the static head pressure of water.

5.6.3.2 Test pressure of compartments

5.6.3.2.1 Tank containers, portable tanks and tank-wagons

Each compartment of subdivided tank containers, portable tanks and tank-wagons shall be tested with the hydraulic pressure required by 5.6.3.1.

During the test of a compartment the adjacent compartment(s) shall be empty and unpressurized.

The test pressure shall be applied to the highest point of the tank. Where the measurement is taken elsewhere on the tank the pressure indicated by the pressure gauge shall be corrected to take account of the position of the pressure gauge and of the static head pressure of water.

5.6.3.2.2 Fixed tanks or demountable tanks

5.6.3.2.2.1 Pressure tanks

Each compartment of fixed tanks or demountable tanks shall be tested with a hydraulic pressure of minimum 1,3 times the maximum working pressure.

During the test of a compartment the adjacent compartment(s) shall be empty and unpressurized.

The test pressure shall be applied to the highest point of the tank. Where the measurement is taken elsewhere on the tank the pressure indicated by the pressure gauge shall be corrected to take account of the position of the pressure gauge and of the static head pressure of water.

5.6.3.2.2.2 Gravity-discharge tanks

Each compartment of fixed tanks or demountable tanks shall be tested with a hydraulic pressure of minimum 1,3 times the static pressure of the substance to be carried but not less than 1,3 times the static pressure of water with a minimum of 0,2 bar.

During the test of a compartment the adjacent compartment(s) shall be empty and unpressurized.

The test pressure shall be applied to the highest point of the tank. Where the measurement is taken elsewhere on the tank the pressure indicated by the pressure gauge shall be corrected to take account of the position of the pressure gauge and of the static head pressure of water.

5.6.3.3 Test of heating equipment

The hydraulic pressure test of heating equipment shall be carried out with the test pressure of the heating equipment given on the tank plate or in the documents of the type approval.

If not otherwise stated the following test pressures given in Table 8 shall be applied:

Table 8 — Test pressures for hydraulic pressure test of heating equipment

Type of heating equipment	Test pressure
Internal and external heating pipe (not connected with the tank shell)	1,5 × working pressure of heating equipment
External heating channel and heating tub (connected with the tank shell)	1,3 × working pressure of heating equipment

For the wall thicknesses, the following should be considered:

- adaptors: Wall thicknesses according to technical codes related to the calculation pressure of the tank,
- pipes: Wall thicknesses according to the design pressure of the heating equipment.

5.6.4 Test liquid

The liquid normally used for hydraulic pressure testing shall be water.

Other liquids may be used with agreement of the expert. Alternative test liquids shall have a flash point of more than 60 °C or be diesel fuel complying with EN 590 or gas oil or heating oil, light with a flash point as specified in EN 590. Toxic or corrosive liquids shall not be used.

5.6.5 Gas as test fluid

Gases may be used for the hydraulic pressure testing only if allowed by the applicable regulation for the transport of dangerous goods. Hydraulic pressure tests with gas as test fluid are not within the scope of this standard.

5.6.6 Pressurization

The tank may be filled with the test fluid and gradually pressurized before the expert commences witnessing the test.

When using a liquid for pressurizing, the tank shall be filled with the test liquid to not less than 99 % of the water capacity.

When using a standpipe for pressurizing, only water shall be used as a test fluid.

When using a gas for pressurizing the test liquid, the tank shall first be filled with the test liquid to not less than 99 % of the water capacity. A non-flammable, non-toxic gas shall be used to pressurize the space above the liquid. A safety device shall be included in the gas pressurizing system. The device shall ensure that the pressure in the shell cannot exceed 105 % of the required test pressure.

5.6.7 Test duration

The test pressure shall be held for the time necessary for the expert to carry out the hydraulic pressure test and its evaluation of the shell or compartment(s) under pressure but not less than 15 min for a non-insulated tank and not less than 30 min for an insulated tank (holding time).

5.6.8 Measurement

The test pressure may be measured either by the height of the column of test liquid standing in the standpipe or U-tube, or by other pressure gauges.

The accuracy of the measuring equipment shall be equal to or less than 1 % of full scale deflection (accuracy classes 0,1 to 1 according to EN 837-1 or EN 837-3). Proof of the accuracy shall be demonstrated. For selection and installation of mechanical pressure gauges EN 837-2 shall be used. Electronic pressure gauges may be used in the range attested by the gauge manufacturer.

5.6.9 Evaluation of the test

The tank fails the hydraulic pressure test if any of the following occur during the test period:

- a leak is detected;
- there is an unaccountable fall in pressure during the test period;
- there is visible permanent deformation.

When using gas as the test fluid the final evaluation shall be carried out after the holding time given in 5.6.7.

5.7 Vacuum testing

5.7.1 Test procedure

The tank shall start the test empty and at atmospheric pressure.

All openings of the tank shall be closed except the discharge openings. A pressure of 1,5 times more severe than the external design pressure shall be created inside the tank and held for 5 min.

For vacuum-operated waste tanks it is sufficient, for practical reasons, to apply a negative internal pressure of 0,9 bar.

5.7.2 Measurement

The accuracy of the measuring equipment shall be equal to or less than 1 % of full scale deflection (accuracy classes 0,1 to 1 according to EN 837-1 or EN 837-3). Proof of the accuracy shall be given. For selection and installation of mechanical pressure gauges EN 837-2 shall be used. Electronic pressure gauges may be used in the range attested by the gauge manufacturer.

5.7.3 Evaluation of the test

The tank fails the test if any of the following occur:

- a leak is detected;
- there is an unaccountable rise of pressure at the pressure gauge;
- there is visible permanent deformation.

5.8 Leakproofness test

5.8.1 General

Before the beginning of the test the tank shall be dry and clean on its outside so that any leakage can be detected. If the ambient temperature is below 0 °C a leakproofness test with water is only allowed if the contents of the tank, of the measuring equipment and of the piping system cannot freeze.

For tanks which are not designed to be opened for operational reasons, it is recommended to perform the leakproofness test after all other tests and inspections.

5.8.2 Extent of test

The leakproofness test shall be carried out on the shell and its service equipment including any permanently attached hoses as well as on the tank after assembly in accordance with the requirements of 5.8.3 to 5.8.6 and 5.8.8. This testing shall include each compartment partition. During the test of a compartment the adjacent compartments shall be empty and unpressurized.

Where shut-off valves are fitted in series they shall be tested separately to ensure that with the pressure on the tank side of the device the leakage does not exceed the rate given in 5.8.8. This is also applicable for closing devices at the end of each pipe, except when the applicable regulation specifies that they shall not be tight.

When the device is a valve, the test is to determine the leak-tightness of the valve seat and the glands of the valve operating mechanism.

Where necessary, pipework shall have been isolated immediately adjacent to the pump / gas extractor / air eliminator / meter to facilitate the testing of the pipework and manifold (if fitted).

The leakproofness of breather devices which are designed to work at a maximum pressure lower than the leakproofness test pressure of the tank shall be tested according to 5.8.7.1. The leakproofness of breather devices which are designed to work at a maximum pressure lower than the leakproofness test pressure of bursting discs precedent to a relief valve shall be tested according to 5.8.7.2.

5.8.3 Leakproofness test pressure

The leakproofness test shall be carried out with the pressure given by the relevant regulation.

If there is no specific regulation the following test pressures given in Table 9 shall be applied, in these cases the expert shall decide the exact pressure applied for the leakproofness test.

Table 9 — Test pressures for leakproofness test

Kind of substance to be transported	Test fluid	Test pressure
liquids, solids in granular or powder form	liquid	For pressure tanks at least equal to the maximum (allowable) working pressure with a minimum of 0,2 bar. For gravity-discharge tanks at least equal to the static pressure of the most dense substance to be carried, the static pressure of water or 0,2 bar whichever is the highest.
liquids, solids in granular or powder form	gas	at least equal to 25 % of the maximum working pressure with a minimum of 0,2 bar
compressed or liquefied gases	liquid	not less than 20 % of the test pressure
compressed, liquefied or dissolved gases	gas	at least equal to 25 % of the maximum allowable working pressure
refrigerated liquefied gases	liquid, gas	not less than 90 % of the maximum (allowable) working pressure

The test pressure shall be applied to the highest point of the tank.

Where the measurement is taken elsewhere on the tank the pressure indicated by the pressure gauge shall be corrected to take account of the position of the pressure gauge and of the static head pressure of water. Internal leakproofness of shut-off devices shall be tested at the leakproofness test pressure as well as at a pressure of not more than 0,2 bar.

5.8.4 Leakproofness test fluid

The test fluid shall be compatible with the materials of the tank.

The test fluid shall in no case create a hazard to the inspecting personnel or any other persons in the vicinity.

5.8.5 Pressurization

5.8.5.1 General

The tank may be filled with the test fluid and gradually pressurized before the expert commences witnessing the test.

5.8.5.2 Only liquid as test fluid

The tank shall be filled with the test liquid to not less than 99 % of the water capacity.

When using a standpipe for pressurizing the tank, only water shall be used as a test fluid.

5.8.5.3 Liquid and gas as test fluids

For gravity-discharge tanks an alternative test procedure may be carried out using water or another liquid as follows:

- the tank shall be filled with the test liquid to not less than 95 % of the water capacity, a non-flammable, non-toxic gas shall be used to pressurize the space above the liquid and;
- a safety device shall be included in the gas pressurizing system. The device shall ensure that the pressure in the shell does not exceed 105 % of the required leakproofness test pressure.

5.8.5.4 Only gas as test fluid

When using only gas as test fluid

- the test area shall be sufficiently silent to hear the noise of a gas escape from a leakage,
- a written permit to work shall be given to any personnel necessary to be present in the vicinity of the tank regarding the risk of a leakproofness test with gas and the precautions necessary for safety at work,
- during the test duration according to 5.8.6 no work shall be carried out on the tank and
- a safety device shall be included in the gas pressurizing system. The device shall ensure that the pressure in the shell cannot exceed 105 % of the required test pressure.

5.8.6 Test duration

The test pressure shall be held for the time necessary for the expert to carry out the leakproofness test. In the case of a shell or compartment, the test shall not be less than 5 min.

5.8.7 Special leakproofness test of the mounting of certain items of equipment

5.8.7.1 Service equipment designed to work at a maximum pressure lower than the leakproofness test pressure of the tank

For items of service equipment which are designed to work at a maximum pressure lower than the leakproofness test pressure of the tank the following shall apply:

- They shall be blocked or the opening of the shell shall be blanked off for the test, if a blanking-off or blocking is not possible due to technical reasons they shall be removed and the shell blanked off for the test.
- The leakproofness test according to 5.8.3 to 5.8.6 shall be carried out on the shell with the other items of service equipment in place.
- When using gas as the test fluid for pressurization the removed items of service equipment shall be tested for leakproofness according to 5.8.3 to 5.8.6 at a pressure of 90 % of the minimum opening pressure of the service equipment.
- When exclusively using water as the test fluid for pressurization the removed items of service equipment shall be checked whether their gaskets are renewed and placed correctly and whether their fasteners are tightened with the torque according to the service equipment manufacturer's specification.

NOTE For the test of leaktightness in the 90°, 180° and 270° positions of the breather device, see 5.10.4.

5.8.7.2 Relief valve preceded by a bursting disc

Where a relief valve is preceded by a bursting disc, it shall be checked that the gaskets of the bursting disc are in good condition and, if necessary, renewed and placed correctly and that the fasteners are tightened with the torque according to the manufacturer's specification.

5.8.8 Evaluation of the test

The maximum allowable leakage rate shall be such that there is no visible weeping or formation of drops or bubbles.

NOTE This corresponds to Rate A as defined in EN 12266-1:2012, Table A.5 [11].

For this purpose, it is not necessary to enter adjacent compartments.

5.9 Determination of water capacity

The determination of water capacity shall be carried out using an appropriate calculation (if not forbidden), volumetric or gravimetric method. For volumetric and gravimetric methods any error shall be less than 1 % of the measurement value. If not otherwise required, the water capacity of the tank shall be determined for a reference temperature of 20 °C.

The volumetric or gravimetric determination of water capacity of the tank and, where appropriate, each compartment shall be carried out by completely filling the tank or compartment with water. When it is not possible to completely fill the shell or the shell compartment because of its shape or construction, this reduced capacity shall be used for the determination of the degree of filling and for the marking of the tank.

NOTE An appropriate method of determination of water capacity can be found in the International Organization of Legal Metrology's Recommendation OIML R 80 [12].

5.10 Inspection of service equipment

5.10.1 General

In the case of vacuum-operated waste tanks, the requirements of the relevant regulation shall additionally be inspected.

5.10.2 Inspection of service equipment for type approval of the tank

The inspection shall determine whether the service equipment and its marking conform to the requirements of the applicable regulations. The inspection shall also determine that all the service equipment is suitable for the operating conditions of the tank.

5.10.3 Inspection of service equipment for other inspections

The inspection shall determine that the service equipment and its marking is in accordance with that given in the type approval of the tank and/or the tank record.

5.10.4 Check of satisfactory operation of service equipment

5.10.4.1 General

All service equipment including any permanently attached hoses shall be inspected in the mounted position for correct functioning and satisfactory condition (e.g. regarding wear). Where it is not possible to inspect the equipment in the mounted position, e.g. in the case of breather devices, the equipment shall be tested separately.

The piping, valves, heating/cooling system, and gaskets shall be inspected for corroded areas, defects, or any other conditions, including leakage, that might render the tank unsafe for filling, discharge or carriage.

5.10.4.2 Flanged connections

Devices for tightening manhole covers shall be operative and there shall be no leakage at manhole covers or gaskets.

Any flanged connection or blank flange shall be inspected for missing or loose bolts or nuts.

5.10.4.3 Safety and breather devices

All safety and breather devices shall be inspected for corrosion, distortion and any damage or defect that could prevent their normal operation.

The parts of breather devices which are open during transport (e.g. breather valve) shall be tested

- to ensure that they are leaktight in the 90°, 180° and 270° positions and
- at a test pressure of at least 1,1 times the static pressure of the substances to be transported (e.g. petrol, diesel-, heating-oil) which arises from the possible fluid column on the breather device.

Breather devices shall be tested to verify correct opening at the relief pressure and that they re-seal.

All pressure relief devices of gravity-discharge tanks if accepted by the competent authority shall be tested by checking

- the start-to-open pressure for correct rating,
- the re-seal pressure for correct rating, if specified in the type approval,
- the leak tightness after re-sealing.

Pressure and vacuum relief valves of pressure tanks shall be tested by checking:

- the start-to-open-pressure, and
- the leak tightness after reseating.

Bursting discs, pressure gauges where fitted, and fusible elements shall be inspected:

- for integrity, and
- for correct rating in accordance with the applicable regulation for the transport of dangerous goods.

Porous discs shall be inspected for integrity.

Remote closure devices and self-closing stop valves shall be operated to demonstrate proper operation.

5.10.4.4 Pipework

Pipework including flexible joints and fixed hoses as part of the filling and/or discharging system shall be visually inspected. Paint or coating shall be removed where necessary.

5.11 Inspection of frame or other structural equipment of portable tanks and tank containers

5.11.1 Inspection of frame or other structural equipment for type approval

The frame or other structural equipment of a portable tank or tank container which has not been designed or constructed in accordance with a standard (e.g. ISO 1496-3 [13] or EN 1432 [14]) or other requirements (e.g. UIC 591 [15] and UIC 592-4 [16]) of off-shore tanks which have not been designed or constructed in accordance with IMO MSC/Circ. 860 or EN 12079-1 shall be shown to be suitable for the intended purpose either by calculation or, if required, by testing (e.g. the appropriate tests specified in ISO 1496-3).

In addition, any portable tank which meets the definition of a "container" within the terms of the International Convention for Safe Containers (CSC)⁵ [17] must fulfil the applicable requirements of that Convention.

⁵ According to the terms of the International Convention for Safe Containers (CSC):

"Container" means an article of transport equipment:

- (a) of a permanent character and accordingly strong enough to be suitable for repeated use;
- (b) specially designed to facilitate the transport of goods, by one or more modes of transport, without intermediate reloading;
- (c) designed to be secured and/or readily handled, having corner fittings for these purposes;
- (d) of a size such that the area enclosed by the four outer bottom corners is either:
 - (i) at least 14 sq. m. (150 sq. ft.) or
 - (ii) at least 7 sq. m. (75 sq. ft.) if it is fitted with top corner fittings;

the term "container" includes neither vehicles nor packaging; however, containers when carried on chassis are included.'

5.11.2 Initial, periodic, \square_{A1} intermediate and exceptional inspection \square_{A1} of the frame or other structural equipment of portable tanks and tank containers

The frame and other structural equipment must be inspected to determine that they are safe in accordance with the requirements of 6.7 RID/ADR resp. 6.7 IMDG Code [18]. This inspection shall include a visual inspection of the welded joints and the surface of all structural parts. Where necessary, the insulation shall be removed to the extent required by the expert to achieve a reliable appraisal of the condition of the frame or other structural equipment.

Any damage or corrosion which could influence the safety or function of the frame shall be repaired.

5.12 Dynamic longitudinal impact test

5.12.1 Portable tanks

Portable tanks meeting the definition of container in the International Convention for Safe Containers (CSC) shall be subjected to the dynamic longitudinal impact test prescribed in the UN Manual of Tests and Criteria, Part IV, Section 41.

5.12.2 Tank-wagons

For the dynamic, longitudinal impact test of tank-wagons, see EN 12663-2.

5.13 Test report, certificate and marking

5.13.1 Test report for type approval

A test report of the inspection for type approval shall be completed. The data sheet referred to in 4.2.3 is given in accordance with Annex B.

5.13.2 Certificate of initial, periodic \square_{A1} , intermediate and exceptional inspection \square_{A1}

Following the completion of the initial, periodic, \square_{A1} intermediate or exceptional inspection \square_{A1} a certificate shall be issued, even in the case of negative results to record the result of the inspection \square_{A1} *deleted text* \square_{A1} . An example for the certificate is given in Annex C.

Additional requirements or remarks, which might influence the next regular inspection or \square_{A1} exceptional inspection \square_{A1} , shall be stated on the certificate.

NOTE The certificate states the accordance or otherwise of the tank with the relevant regulations for the transport of dangerous goods at the date of inspection.

5.13.3 Marking

If there are no requirements concerning the marking of tanks according to dangerous goods regulations specified in another applicable technical code, then the following shall apply.

The tank plates for fixed tanks (tank vehicles) and demountable tanks shall contain the information required by Annex D.

\square_{A1} NOTE 1 For tank plates for tank-wagons, RID applies; see also EN 12561-1 [3]. \square_{A1} .

The tank plates for tank containers shall contain the information required by Annex E. In these annexes the sequence of information and the general layout is normative. To avoid any linguistic misunderstanding the lines of the plates shall be numbered (see annexes). The minimum height of the letters shall be 3 mm.

Any modification to any data on the tank plate, including the satisfactory completion of an initial, periodic \square_{A1} , intermediate or exceptional inspection \square_{A1} , required by this document shall be attested by the expert's stamp close to the modified information.

The wording on the tank plate for fixed tanks (tank vehicles), demountable tanks and tank containers shall be in one of the official languages of the country of registration and, as an option, in English.

NOTE 2 For portable tanks, see 4.2 and 6.7 RID/ADR/IMDG Code.

Markings not necessarily required to be given on the tank plate shall comply with the relevant regulation. If information is given on the tank plate as well as in other places (e.g. on the shell) this information shall be identical. In each case the information shall comply with the valid documents. When the tank plate is not continuously welded, at least one fixation shall be stamped. The stamp shall overlap the fixation on the plate. Fixations used shall be non-reusable and shall be compatible with the plate material and the shell material for electrolytic corrosion.

To provide identification in case of loss of the tank plate the serial number of the tank shall be stamped directly in the shell at a place where the stamping is not reducing the strength of the shell (e.g. neck ring, flange).

To ensure that the tank plates remain legible it is recommended that the plates are either engraved or stamped.

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Annex A
(informative)

Applicable items of tank inspection — Survey Table

Table A.1 shows a summary of the applicable items of tank inspection.

Table A.1 — Applicable items of tank inspection

Type of inspection (Subclause)	Inspection for type approval	Inspection for modification of a tank	Initial inspection	Periodic inspection	Intermediate inspection	Exceptional inspection ^(A1)					Before and after repair or replacement of protective lining or coating	
						After damage or repair of the shell	After repair or replacement of service equipment	After replacement of service equipment involving the application of heat	After alteration to the tank	After exchange or repair of frame or structural equipment		
Examination of documents (5.2)	X	X	X	X	X	X	X	X	X	X	X	X
Check of the design characteristics (5.3)	X	X	X	—	—	X	X	X	X	X	—	—
Inspection of the shell interior (5.4)	X	X	X	X	X ^a	X	—	—	X	—	—	X
Inspection of the tank exterior (5.5)	X	X	X	X	X	X	—	—	X	—	—	—
Hydraulic pressure test (5.6)	X	X	X	X	—	X	—	X	X	X	—	—
Vacuum testing (5.7)	X ^a	X ^a	—	—	—	—	—	—	X ^a	—	—	—

Type of inspection (Subclause)	Inspection for type approval	Inspection for modification of a tank	Initial inspection	Periodic inspection	Intermediate inspection	Exceptional inspection ^(A1)					Before and after repair or replacement of protective lining or coating	
						After repair or replacement of service equipment	After replacement of service equipment involving the application of heat	After alteration to the tank	After exchange or repair of frame or structural equipment	After repair or replacement of service equipment		
Leakproofness test (5.8)	X	X		X	X	X	X	X	X	X	—	—
Determination of water capacity (5.9)	X	X	X	—	—	—	—	—	—	—	—	—
Inspection of service equipment (5.10)	X	X	X	X	X	X	X	X	X	X	—	—
Inspection of frame or other structural equipment of portable tanks and tank containers (5.11)	X	X	X	X	X ^a	X	—	—	X	—	—	—
Dynamic longitudinal impact test (5.12)	X ^a	—	X ^a	—	—	—	—	—	—	—	—	—
Test report, certificate and marking (5.13)	X	X	X	X	X	X	X	X	X	X	X	X

^a If required by regulation.

Annex B
(normative)

Technical data sheet for type approval

0	General:	
0.1	Manufacturer	
0.1.1	Name:	
0.1.2	Address:	
0.2	Manufacturing location:	
0.3	Type:	
0.4	Tank code, portable tank instruction, special provisions:	
0.5	IMO tank type/tank instruction, special provisions:	
0.6	If required (e.g. 6.8, 6.7 RID/ADR): Substances/groups of substances to be carried:	
1	Characteristics and general description	
1.1	General description:	
1.1.1	Shell section:	
1.1.2	Internal lining:	
1.1.3	Technical code:	
1.2	Tank type (on chassis or self-supporting):	
1.3	End type (e.g. torispherical, spherical):	
1.4	Internal baffle or partition type:	
1.5	Insulation (material, thickness, cladding):	
2	Dimensions	
2.1	Total length (maximum):	
2.2	Maximum height and maximum width of the shell:	
2.3	Radius of convexity of the shell walls:	
2.3.1	Top:	
2.3.2	Bottom:	
2.3.3	Sides:	
2.3.4	Corners:	
2.4	Minimum thickness of the shell (indicate the corrosion allowance):	
2.5	Minimum thickness of the ends (indicate the corrosion allowance):	

2.6	Minimum thickness of the partitions (indicate the corrosion allowance):	
2.7	Minimum thickness of the baffles and surge plates (indicate the corrosion allowance):	
2.8	Water capacity	

Compartment	1	2	3	4	5	6	7	8	Total
Water capacity in l									

2.9	Description of the reinforcements:	
2.9.1	Side reinforcement against impact:	
2.9.2	External design pressure:	
2.10	Maximum distance between two reinforcements:	

2.11	Design temperature and working temperature, if necessary (maximum and minimum):	
2.12	Pressure:	
2.12.1	Maximum working pressure (gauge pressure):	
2.12.2	Design pressure:	
2.12.3	Calculation pressure:	
2.12.4	Test pressure:	
2.12.5	Negative internal design pressure (e.g. partial vacuum condition):	
2.13	Measures used for additional protection if wall thickness reduction shall be applied:	
3	Construction	
3.1	Shell wall material:	
3.1.1	Grade:	
3.1.2	Minimum mechanical properties according to normative reference ^a : (R_e , R_m , A , product $R \times A$)	
3.1.3	Heat treatment:	
3.1.4	Protective lining (internal and resp. external):	
3.1.5	Other lining:	
3.2	Shell end material:	
3.2.1	Grade:	
3.2.2	Minimum mechanical properties according to normative reference ^a : (R_e , R_m , A , product $R \times A$)	

3.2.3	Heat treatment:	
3.2.4	Protective lining (internal and resp. external):	
3.2.5	Other lining:	
3.3	Partition material	
3.3.1	Grade:	
3.3.2	Minimum mechanical properties according to normative reference ^a : (R_e , R_m , A , product $R \times A$)	
3.3.3	Heat treatment:	
3.3.4	Protective lining (internal and resp. external):	
3.3.5	Other lining:	
3.4	Frame/attachment material:	
3.4.1	Grade:	
3.4.2	Minimum mechanical properties according to normative reference:	
3.4.3	Heat treatment:	
3.5	Tank	
3.5.1	Construction of the ends:	
3.5.1.1	Length of the cylindrical part of the end, if required by the technical code:	
3.5.1.2	Knuckle radius:	
3.5.1.3	Radius of spherical part:	
3.5.1.4	Description of attachment to the shell wall (e.g. see drawing number ...):	
3.5.2	Construction of partitions:	
3.5.2.1	Length of the cylindrical part of the end, if required by the technical code:	
3.5.2.2	Knuckle radius:	
3.5.2.3	Radius of spherical part:	
3.5.2.4	Description of attachment to the tank (e.g. see drawing number ...):	
3.5.3	Construction of the baffles and surge plates:	
3.5.3.1	Description of baffles and surge plates and their attachment to the tank (e.g. see drawing number ...):	
3.5.4	Welding procedures:	
3.5.5	Welding coefficient:	
3.6	Manholes or cleaning openings	
3.6.1	Type of closure:	

3.6.2	Dimensions:	
3.7	Service equipment	
3.7.1	Description of pipes passing through the tank shell (e.g. drain tubes, vapour recovery tubes):	
3.7.2	General description of loading and discharge systems including schematic drawings:	
3.7.3	Listing of the service equipment with the relevant technical data or relevant standard:	
3.7.4	Heating system	
3.7.4.1	Type of heating system:	
3.7.4.2	Material heating coils:	
3.7.4.3	Test pressure of heating coils:	
3.7.5	Gasket (compatibility of the gaskets with the carried products):	
3.7.6	Other devices (type of attachment to the shell):	
3.8	Protection of the tank and its equipment	
3.8.1	Top (type and characteristics):	
3.8.2	Equipment located underneath the tank (type and characteristics):	
3.8.3	Rear end (type and characteristics):	
3.9	Attachment of the tank:	
4	Miscellaneous	
4.1	List of design documents and drawings:	
4.2	Maximum permissible gross and tare mass if applicable:	
[A1] deleted text [A1]		
4.3	Any additional information:	
4.4	Place of stamping of serial number on the shell:	
<p>^a When austenitic steels are used, the specified minimum values of R_e and R_m according to the material standards may be exceeded by up to 15 % if these higher values are attested in the inspection certificate. An additional minimum wall thickness arising from these values should be stated in this data sheet.</p>		

Annex C
(informative)

Certificate of initial, periodic A_1 , intermediate and exceptional inspection A_1

In Table C.1, an example for a certificate according to 5.13.2 is given.

Copying of the certificate is permitted.

Table C.1 — Example for a certificate according to 5.13.2

Name of the expert's organization and address		Sign of expert's organization								
Number of test report: _____								Number of type approval _____		
Applicant/ User _____								Name of manufacturer _____		
Street _____								Country _____		
Postal Code _____								Manufacturer's serial number _____		
Town _____								Year of manufacture _____		
Country _____								Date and kind of last inspection _____		
		Owner's/operator's tank identification _____								
IMO tank type/tank instruction/tank code/special provision(s) _____										
Wall thickness shell, required: _____ mm, actually measured: _____ mm										
Wall thickness ends, required: _____ mm, actually measured: _____ mm										
Wall thickness partitions, required: _____ mm, actually measured: _____ mm										
Test pressure: _____ bar										
Maximum allowable working pressure: _____ bar, external design pressure _____ bar										
Design pressure: min. _____ bar, max. _____ bar										
Compartment	1	2	3	4	5	6	7	8	total	
Water capacity in l										
Examination of documents	0								Leakproofness test tank/equipment	0
Check of the design characteristics	0								Vacuum testing	0
Inspection of the shell interior	0								Determination of water capacity	0
Inspection of the tank exterior	0								Inspection of frame or other structural equipment of portable tanks	0
Hydraulic pressure test	0									

Inspection of service equipment	0						
Safety valve set to _____ bar overpressure		Vacuum valve set to _____ bar underpressure					
Other inspections and tests							
Remarks/defects which can impair the safety of the tank or the equipment:							
Additional requirements of type approval:							
Initial inspection	0	passed	0	failed	0	ADR	0
Periodic inspection		passed	0	failed	0	RID	0
Intermediate inspection	0	passed	0	failed	0	IMDG Code	0
<input type="checkbox"/> Exceptional inspection <input type="checkbox"/>	0	passed	0	failed	0	Other	0
Next regular inspection	_____	Location and date of inspection		_____			
Periodic inspection	0						
Intermediate inspection	0	Signature and stamp _____					
Inspections carried out in accordance with <input type="checkbox"/> EN 12972:2018+A1:2024 <input type="checkbox"/>							
Remarks							

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Annex D
(informative)

Tank plates for fixed tanks (tank vehicles) and demountable tanks for the transport of dangerous goods

D.1 Tank plate

The general layout of the tank plate for fixed tanks (tank vehicles) and demountable tanks for the transport of dangerous goods shall be as given in table D.1.

According to RID/ADR, the use of “bar” instead of “MPa” is allowed.

NOTE If applicable, the requirements of Directive 2010/35/EC according to the Pi-marking will be applied in addition.

Table D.1 — Tank plate

EN 12972:2018+A1:2024

1	Manufacturer			
2	Approval number			
3	Manufacturer's serial number			
4	Year of manufacture			
5	Test pressure	a) whole tank	MPa	
		b) compartments	MPa	
6	Water capacity of the tank (total) /	litres		
	Water capacity of the compartments	l	l	l
		l	l	l
7	Design temperature	°C		
8	Tank material and material reference			
9	Material protective lining/coating			
10	Insulation			
11	Maximum working pressure	MPa		
12	External design pressure			
13	Name of dangerous good(s)	14 Maximum allowable gross mass	15 Maximum filling pressure	16 Filling temperature
		kg	MPa	°C
17	Stamps of expert (initial, intermediate and periodic inspection)			

Lines 5 b), 7, 9, 10, 11, 13, 14, 15 and 16 only if required, otherwise to be omitted.

D.2 Content of the marking of the tank plate

The content of the tank plate for fixed tanks (tank vehicles) and demountable tanks for the transport of dangerous goods shall be as given in Table D.2.

Table D.2 — Content of the marking of the tank plate

No.	Content
1	Manufacturer's name or mark
2	Approval number given by the competent authority or body designated by this authority
3	Serial or production number issued by the manufacturer
4	Year of manufacture
5	Test pressure of the shell as a whole and test pressure by compartment in MPa (gauge pressure where the test pressure of each compartment is less than the test pressure of the shell)
6	Water capacity in litres; after the indication of litres followed by the symbol "S" if the shell or the compartments of more than 7 500 l are divided by surge plates into sections of not more than 7 500 l water capacity.
7	Design temperature in °C (if above 50 °C or below -20 °C)
8	A₁ Materials of the shell and of the ends, if different, as well as material grades and references to materials standards, if available. A₁
9	Material of protective lining or coating if applicable. Brand names may be used if they are in common use
10	Type of insulation of the tank in words, e.g. "thermally insulated" or "thermally insulated by vacuum", if applicable
11	Maximum working pressure (gauge) in MPa
12	External design pressure in MPa
13	The proper shipping name and in the case of n.o.s. entries the technical name of the gas(es) for which the tank is approved
14	Maximum allowable mass of gases according to no 13
15	Maximum filling pressure of gases at 15 °C
16	Filling temperature of gases if below -20 °C
17	Month and year of the initial inspection and of each subsequent intermediate and periodic inspection and stamp of the expert who carried out the inspection followed by the letter "L" in the case of an intermediate inspection or "P" in the case of an initial or periodic inspection
The lines 5 b), 7, 9, 10, 11, 13, 14, 15 and 16 only if required, otherwise to be omitted.	

A₁

Annex E
(normative)

Tank plates for tank containers intended for the transport of dangerous goods

The general arrangement of the tank plate for tank containers intended for the carriage of dangerous liquids, gases and solids shall comply with Tables E.1, E.2 and E.3. Include lines 6.1, 7, 9, 10, 11, 13, 14, 15 and 16 only if required; otherwise, these lines can be omitted.

NOTE This Annex is not applicable to portable tanks; see 5.13.3.

Table E.1 — General information

1 - Manufacturer			
2 - Approval number			
2.1 - Applicable regulation	ADR ^a	RID ^a	^b
2.2 - Construction standard - technical code			
2.3 - Manufacturer's type identification			
3 - Manufacturer's serial number			
4 - Year of manufacture			
5 - Test pressure			kPa or bar ^e
6 - Total water capacity of the tank ^c			Litres
6.1 - Water capacity of partitions ^c			Litres
7 - Design temperature(s)			°C
8 - Tank material			
8.1 - Material standards			
9 - Material protective lining/coating			
10 - Insulation ^d			
11 - Maximum working pressure			kPa or bar ^e
12 - External design pressure			kPa or bar ^e
18 - Tare			kg
19 - Maximum permissible gross weight			kg
20 - Tank code / Instruction code			
21 - Special provisions			
22 - Owner's name			
22.1 - Operator name			

17 – Inspection body stamps and dates followed by the code of type of inspection (Initial inspection, intermediate and periodical inspection, and exceptional inspection)	
<p>a Strike out the unnecessary mention.</p> <p>b Marking according to Directive 2010/35/EU for gases.</p> <p>c The indication of the volume in litres in lines 6 and 6.1 shall be followed by the symbol “S” if the tank or compartments of more than 7 500 l are divided by baffles into sections with a maximum water capacity of 7 500 l.</p> <p>d Gases tanks equipped with thermal insulation shall be marked “thermally insulated” or “thermally insulated by vacuum”, in the language of the country of registration of the tank, and at least in French or English or German, unless a different agreement between the states concerned is concluded.</p> <p>e The unit of measurement chosen between bar and kPa shall be indicated after the numerical value.</p>	

Table E.2 — Supplement for compressed or liquefied gases

13 – Dangerous good(s) designation	14 – Maximum mass in kg ^b	15 – Maximum filling pressure in (kPa or bar) ^a	16 – Minimum filling temperature in °C

a The unit of measurement chosen between bar and kPa shall be indicated after the numerical value.
b Means maximum permissible load mass in kg.

Table E.3 — Supplement for refrigerated liquefied gases

13 – Dangerous good designation	14 – Maximum mass in kg ^b	15 – Maximum filling pressure in (kPa or bar) ^a	16 – Reference holding time in (days or hours) ^c

a The unit of measurement chosen between bar and kPa shall be indicated after the numerical value.
b Means maximum permissible load mass in kg.
c The unit of time chosen between days and hours shall be indicated after numerical value.

Annex F
(normative)

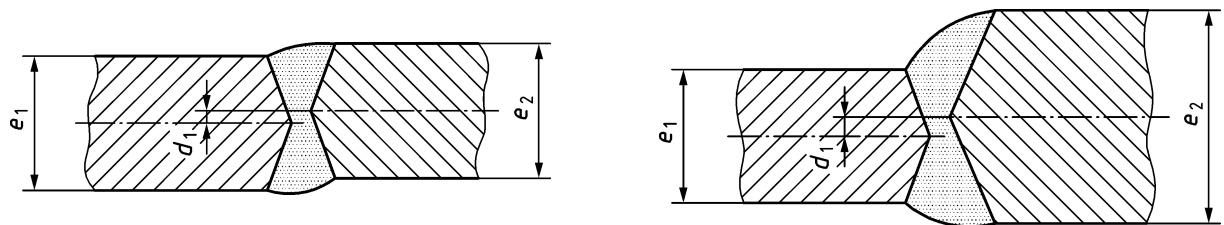
Manufacturing tolerances (based on EN 13445-4 [19])

F.1 Surface geometry of welds

The surface geometry of welded butt and fillet joints shall meet the requirements of Table 3 unless the manufacturer specifies more stringent requirements.

F.2 Middle line alignment

The misalignment tolerances of middle lines shall be as specified below and in Figure F.1.



a) Middle line alignment d_1 at equal thickness

$$e_1 = e_2$$

b) Middle line alignment d_1 at different thickness

$$e_1 \leq e_2$$

Figure F.1 — Middle line alignment d_1

The adjacent components in welds shall be aligned within the tolerances of $d_1 = \min(e_1/4 ; 3,0 \text{ mm})$ or better for:

- cylinders,
- cones,
- dished ends,
- rectangular/prismatic structures, and
- spherical components.

F.3 Surface alignment

F.3.1 Surface linear misalignment between parts

Where there is misalignment at the surface between parts of the same nominal thickness the transition across the weld shall be smooth and gradual with a slope of 1 in 4 over the width of the weld. If this taper cannot be accommodated within the weld width it is permissible to either:

- a) grind the higher plate surface, where this will not reduce the joint thickness at any point below the nominal specified plate thickness minus the plate thickness tolerance, or
- b) build up the lower plate surface with added weld metal.

F.3.2 Joining of parts of different thickness

Where different thicknesses are being joined a taper shall be produced by either:

- a) taper the thicker plate in accordance with the design drawing and then applying the requirements above for the same nominal thickness parts, or
- b) obtain the required slope across the width of the welds, or by a combination of weld build up on the lower surface with added weld metal and thereafter obtain the required slope across the weld width.

F.4 Tolerances for tanks

F.4.1 External diameter

For cylindrical and spherical pressure tanks the mean external diameter derived from the circumference shall not deviate by more than 1,5 % from the specified external diameter.

For non-cylindrical structures, each external dimension shall not deviate by more than 1,5 % from the specified external dimension.

F.4.2 Out of roundness

Out of roundness (O) shall be calculated in accordance with Formula (F.1):

$$O = \frac{2 \times (D_{\max} - D_{\min})}{D_{\max} + D_{\min}} \times 100 \quad (\text{F.1})$$

It shall not exceed the following values:

- a) 1,5 % for the ratio of $e/D < 0,01$
- b) 1,0 % for the ratio of $e/D \geq 0,01$

The determination of the out of roundness need not consider the elastic deformation due to the tare mass of the pressure tank. Irregularities in tank profile (e.g. dents, buckling, flats on nozzle positions) shall be also within the tolerances in a) and b).

For non-cylindrical tanks, D shall be replaced by the equivalent diameter of the tank.

F.4.3 Deviation from the longitudinal axis

The deviation from the longitudinal axis over the length of the tank shall not exceed 0,5 % of the length of the shell.

F.4.4 Irregularities in profile

- a) Local irregularities in tank profile

Irregularities in profile (e.g. dents, buckling, flats on nozzle positions) shall be smooth and the depth shall be checked by a 20° gauge and shall not exceed the following values:

- 1) 2 % of the gauge length, or
- 2) 2,5 % of the gauge length provided that the length of the irregularities does not exceed one quarter of the length (with a maximum of 1 m) of the shell part between two circumferential joints.

b) Peaking on longitudinal butt welds

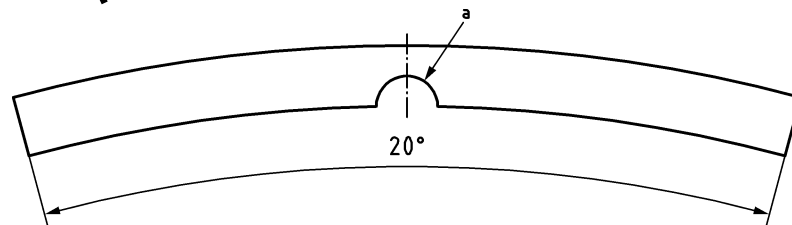
When irregularity in the profile occurs at the welded joint and is associated with “flats” adjacent to the weld, the irregularity in profile or (peaking) shall not exceed the values given in Table F.1.

Measurement for peaking shall be made by means of a 20° profile gauge (or template), see Figure F.2, or other types of gauge such as a bridge gauges or needle gauges.

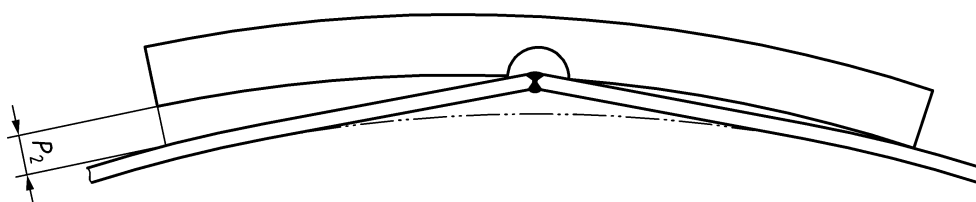
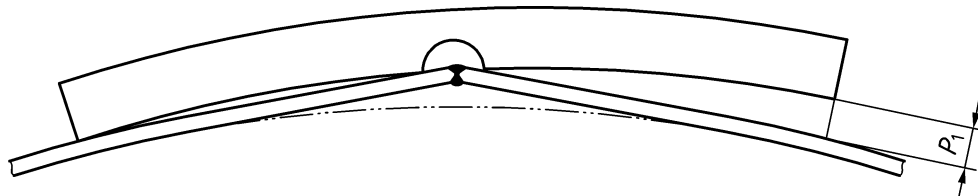
For outwards peaking two readings shall be taken, P_1 and P_2 , on each side of the joint, at any particular location, the maximum peaking is determined using Formula (F.2)

$$P = 0,25 \times (P_1 + P_2) \quad (F.2)$$

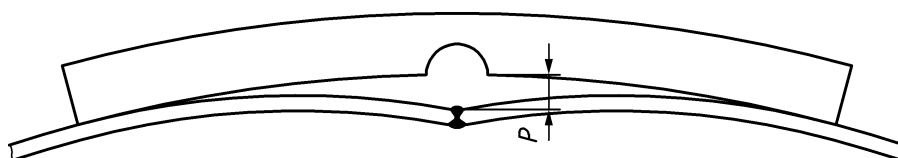
The inwards peaking P shall be measured. The inside radius of the gauge shall be equal to the nominal outside radius of the tank.



a) Sufficient cut-out to adequately keep clear of the weld reinforcement (excess weld)



b) For outwards peaking two readings P_1 and P_2 shall be taken



c) For inwards peaking P shall be measured

Figure F.2 — Gauge details, measurement of peaking

Measurements shall be taken at approximately 250 mm intervals on longitudinal seams to determine the location with the maximum peaking value. The maximum peaking value shall be in accordance with Table F.1.

Table F.1 — Maximum permitted peaking P at longitudinal welds for shells subject to predominantly non cyclic loads

Dimensions in millimetres

Shell ratio wall thickness e to diameter D	Maximum permitted peaking P
$e/D \leq 0,025$	5
$e/D > 0,025$	10





F.4.5 Middle line angular misalignment

The middle line angular misalignment shall not exceed the value given by the drawings.

F.4.6 Dished ends

The knuckle radius shall not be less than specified by the design and the crown radius shall not be greater than specified by the design.

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- [3]  EN 12561-1, *Railway applications – Tank wagons – Part 1: Identification plates for tank wagons for the carriage of dangerous goods* 
- [4] EN 14564, *Tanks for transport of dangerous goods - Terminology*
- [5] EN 14025, *Tanks for the transport of dangerous goods - Metallic pressure tanks - Design and construction*
- [6] EN 1011-4, *Welding - Recommendations for welding of metallic materials – Part 4: Arc welding of aluminium and aluminium alloys*
- [7] EN ISO 17635:2016, *Non-destructive testing of welds - General rules for metallic materials (ISO 17635:2016)*
- [8]  EN ISO/IEC 17020, *Conformity assessment - Requirements for the operation of various types of bodies performing inspection (ISO/IEC 17020)*
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- [11] EN 12266-1:2012, *Industrial valves - Testing of metallic valves – Part 1: Pressure tests, test procedures and acceptance criteria - Mandatory requirements*
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- [13] ISO 1496-3, *Series 1 freight containers - Specification and testing – Part 3: Tank containers for liquids, gases and pressurized dry bulk*
- [14] EN 1432, *Swap bodies - Swap tanks - Dimensions, requirements, test methods, operation conditions*
- [15] UIC 591, *Roller units for horizontal transshipment - Technical conditions governing their use in international traffic*⁹

⁶ May be purchased from the Intergovernmental Organisation for International Carriage by Rail (OTIF), Gryphenhübeliweg 30, 3006 Bern, Switzerland.

⁷ May be purchased from the United Nations Sales Section, Geneva, or bookstores and distributors of United Nations Publications.

⁸ May be purchased from the International Organization of Legal Metrology (OIML), 11, Rue Turgot, 75009 Paris, France.

- [16] UIC 592-4, *Swap bodies for grab handling and spreader gripping - Technical conditions*¹⁰
- [17] International Convention for Safe Containers (CSC)
- [18] International Maritime Dangerous Goods (IMDG) Code¹¹
- [19] EN 13445-4, *Unfired pressure vessels – Part 4: Fabrication*

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⁹ May be purchased from the International Union of Railways (UIC), 16 Rue Jean Rey, 75015 Paris, France.

¹⁰ May be purchased from the International Union of Railways (UIC), 16 Rue Jean Rey, 75015 Paris, France.

¹¹ May be purchased from the International Maritime Organization (IMO), 4 Albert Embankment, Lambeth, London SE1 7SR, United Kingdom.

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Useful Contacts

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Tel: +44 345 086 9001

Email: cservices@bsigroup.com

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Tel: +44 345 086 9001

Email: subscriptions@bsigroup.com

Knowledge Centre

Tel: +44 20 8996 7004

Email: knowledgecentre@bsigroup.com

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Email: copyright@bsigroup.com

BSI Group Headquarters

389 Chiswick High Road London W4 4AL UK