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Cryogenic vessels — Large transportable vacuum-insulated vessels —

Part 1: Design, fabrication, inspection and testing

Récipients cryogéniques — Récipients transportables isolés sous vide de grande contenance —

Partie 1: Conception, fabrication, inspection et essais

Reference number
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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT) see www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 220, *Cryogenic vessels.*

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

This second edition cancels and replaces the first edition (ISO 20421-1:2006), which has been technically revised. It also incorporates ISO 20421-1:2006/Cor 1:2007. The main changes compared to the previous edition are as follows:

— Subclause 12.3 has been revised;

— Annex D has been revised;

— Chinese materials have been added in Annex G.

A list of all parts in the ISO 20421 series can be found on the ISO website.

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Introduction

This document has been written so that it is suitable to be referenced in the UN Model Regulations[1].

This document does not include the general vehicle requirements, e.g. running gear, brakes, lighting, etc., for which the relevant standards/regulations apply.

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Cryogenic vessels — Large transportable vacuum-insulated vessels —

Part 1: Design, fabrication, inspection and testing

1 Scope

This document specifies requirements for the design, fabrication, inspection and testing of large transportable vacuum-insulated cryogenic vessels of more than 450 l volume, which are permanently (fixed tanks) or not permanently (demountable tanks and portable tanks) attached to a means of transport, for one or more modes of transport.

This document applies to large transportable vacuum-insulated cryogenic vessels for fluids specified in 3.1 and does not apply to vessels designed for toxic fluids.

This document does not include the general vehicle requirements, e.g. running gear, brakes, lighting, etc.

NOTE 1 This document does not cover specific requirements for refillable liquid-hydrogen tanks that are primarily dedicated as fuel tanks in vehicles. For fuel tanks used in land vehicles, see ISO 13985.

NOTE 2 This document does not cover specific requirements for refillable liquid hydrogen and LNG tanks that are primarily dedicated as fuel tanks in vehicles. For fuel tanks used in vehicles, see ISO 13985.

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.

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

ISO 4126-2, *Safety devices for protection against excessive pressure — Part 2: Bursting disc safety devices*

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

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

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

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

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

ISO 10474:2013, *Steel and steel products — Inspection documents*

ISO 10675-1, *Non-destructive testing of welds — Acceptance levels for radiographic testing — Part 1: Steel, nickel, titanium and their alloys*

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

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

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 15614-2, *Specification and qualification of welding procedures for metallic materials — Welding procedure test — Part 2: Arc welding of aluminium and its alloys*

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

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

ISO 20421-2, *Cryogenic vessels — Large transportable vacuum-insulated vessels — Part 2: Operational requirements*

ISO 21010, *Cryogenic vessels — Gas/material compatibility*

ISO 21011, *Cryogenic vessels — Valves for cryogenic service*

ISO 21028-1, *Cryogenic vessels — Toughness requirements for materials at cryogenic temperature — Part 1: Temperatures below -80 degrees C*

ISO 21028-2, *Cryogenic vessels — Toughness requirements for materials at cryogenic temperature — Part 2: Temperatures between -80 degrees C and -20 degrees C*

ISO 21013-3, *Cryogenic vessels — Pressure-relief accessories for cryogenic service — Part 3: Sizing and capacity determination*

ISO 23208, *Cryogenic vessels — Cleanliness for cryogenic service*

ASME VIII-2, *Rules for construction of pressure vessels, Division 2, Alternative Rules*

EN 13445-3, *Unfired pressure vessels — Part 3: Design*

3 Terms and definitions

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

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

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at http://www.electropedia.org/

3.1
cryogenic fluid
refrigerated liquefied gas
gas which is partially liquid because of its low temperature (see Table K.1)

Note 1 to entry: This includes totally evaporated liquids and supercritical fluids.

Note 2 to entry: In the context of this document, the refrigerated but non-toxic gases and gas mixtures given in Table K.1 are referred to as cryogenic fluids.

3.2
large transportable cryogenic vessel
tank
thermally insulated vessel of more than 450 l intended for the transport of one or more *cryogenic fluids* (3.1), consisting of an *inner vessel* (3.4), an *outer jacket* (3.5), all of the valves and *service equipment* (3.9) together with the structural parts

Note 1 to entry: The large transportable cryogenic vessel comprises a complete assembly that is ready for service.

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3.3
insulation
vacuum interspace between the *inner vessel* (3.4) and the *outer jacket* (3.5)

Note 1 to entry: The space may or may not be filled with material to reduce the heat transfer between the inner vessel and the outer jacket.

3.4
inner vessel
pressure (3.16) vessel intended to contain the *cryogenic fluid* (3.1) to be transported

3.5
outer jacket
gas-tight enclosure which contains the *inner vessel* (3.4) and enables the vacuum to be established

3.6
normal operation
intended operation of the vessel at a *pressure* (3.16) not greater than the maximum allowable working pressure including the *handling loads* (3.7)

3.7
handling load
load exerted on the transportable cryogenic vessel in all normal conditions of transport including loading, unloading, moving and lifting

3.8
piping system
all pipes, tubes and associated components which can come in contact with *cryogenic fluids* (3.1) including valves, fittings, pressure-relief devices and their supports

3.9
service equipment
measuring instruments and filling, discharge, venting, safety, heating, cooling and insulating devices including any equipment for storing cooling fluids

3.10
manufacturer
<large transportable cryogenic vessel> company that carries out the final assembly, including the final acceptance test, of the *large transportable cryogenic vessel* (3.2)

3.11
gross volume
<of the inner vessel> internal volume of the *inner vessel* (3.4), excluding nozzles, pipes, etc., determined at minimum design temperature and atmospheric *pressure* (3.16)

3.12
tare mass
mass of the empty *large transportable cryogenic vessel* (3.2)

3.13
net volume
volume of the *inner vessel* (3.4), below the inlet to the relief devices, excluding nozzles, pipes, etc., determined at minimum design temperature and atmospheric *pressure* (3.16)

3.14
net mass
maximum allowable mass of the *cryogenic fluid* (3.1) which may be filled

Note 1 to entry: The maximum allowable mass is equal to the mass of the cryogenic liquid occupying 98 % of the *net volume* (3.13)of the *inner vessel* (3.4) under conditions of incipient opening of the relief device with the vessel in a level attitude and the mass of the gas at the same conditions in the remaining volume of the inner vessel.

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Note 2 to entry: Cryogenic liquid helium can occupy 100 % of the volume of the inner vessel at any *pressure* (3.16).

3.15
gross mass
sum of *tare mass* (3.12) plus *net mass* (3.14)

3.16
pressure
gauge pressure
pressure relative to atmospheric pressure

3.17
fixed tank
tank vehicle
large transportable vessel permanently attached to a vehicle or to units of running gear

3.18
demountable tank
large transportable vessel non-permanently attached to a vehicle

Note 1 to entry: When attached to the carrier vehicle, the demountable tank meets the requirements prescribed for a fixed tank. It is designed to be lifted only when empty.

3.19
portable tank
a thermally insulated tank having a capacity of more than 450 litres fitted with *service equipment* (3.9) and structural equipment necessary for the transport of refrigerated liquefied gases

Note 1 to entry: It can be lifted full and loaded and discharged without removal of structural element.

Note 2 to entry: The list of the refrigerated liquefied gases is available in Annex K.

3.20
maximum allowable working pressure
ps
maximum gauge *pressure* (3.16) permissible at the top of the vessel in its normal operating position

3.21
relief plate
relief plug
plate or plug retained by atmospheric *pressure* (3.16) which allows relief of excess internal pressure, generally from the vacuum jacket

3.22
bursting disc device
non-reclosing pressure-relief device ruptured by differential *pressure* (3.16)

Note 1 to entry: It is the complete assembly of installed components including the bursting disc holder, where appropriate.

3.23
pressure-strengthened vessel
pressure (3.16) vessel which has been subjected to a calculated and controlled internal pressure (strengthening pressure) after completion, the wall thickness of which is calculated on the basis of the stress at the strengthening pressure and not on the basis of the conventional design stress value of the material used

Note 1 to entry: *Pressure* (3.16) vessels made from solution heat-treated material are subject to a controlled plastic deformation during the strengthening operation as its yield point is raised. Pressure vessels made from work-hardened material are subject to little or no plastic deformation.

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