

Nederlandse norm

NEN-ISO 20421-1

(en)

Cryogenic vessels - Large transportable vacuum-insulated vessels - Part 1: Design, fabrication, inspection and testing (ISO 20421-1:2006, IDT)

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- ISO 20421-1:2006.IDT

Preview

Normcommissie 341 045 "Cryogene vaten voor opslag en transport van vloeibare ind.gassen"

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Preview

**Cryogenic vessels — Large transportable
vacuum-insulated vessels —**

**Part 1:
Design, fabrication, inspection and
testing**

*Réceptacles cryogéniques — Réceptacles transportables isolés sous vide
de grande contenance —*

Partie 1. Conception, fabrication, inspection et essais



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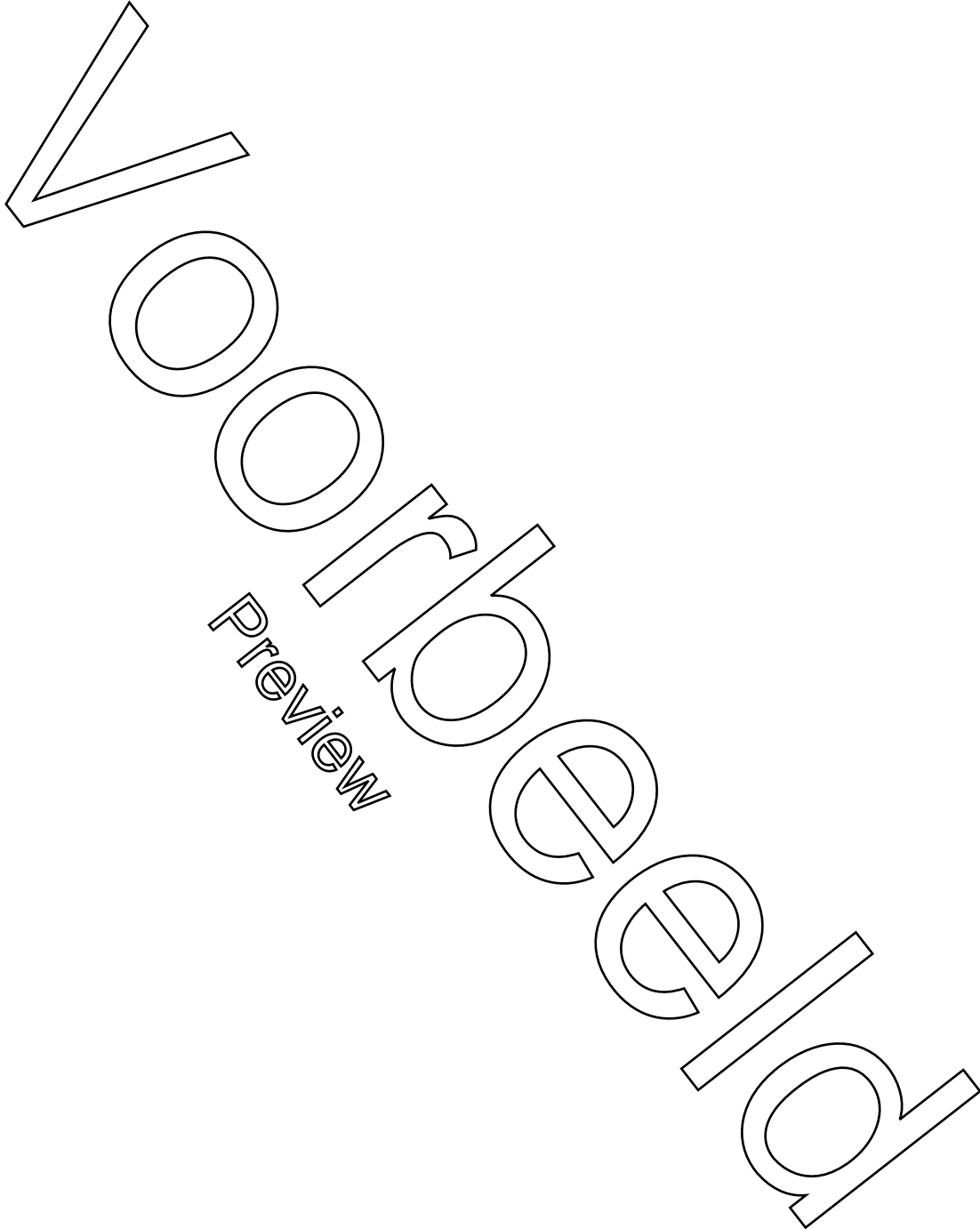
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Foreword

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.

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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.

ISO 20421-1 was prepared by Technical Committee ISO/TC 220, *Cryogenic vessels*.

ISO 20421 consists of the following parts, under the general title *Cryogenic vessels — Large transportable vacuum-insulated vessels*:

- Part 1: Design, fabrication, inspection and testing
- Part 2: Operational requirements

Voorbereid
Preview

Cryogenic vessels — Large transportable vacuum-insulated vessels

Part 1: Design, fabrication, inspection and testing

1 Scope

This part of ISO 20421 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 (dismountable tanks and portable tanks) attached to a means of transport, for one or more modes of transport.

This part of ISO 20421 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 part of ISO 20421 does not include the general vehicle requirements, e.g. running gear, brakes, lighting, etc., which are in accordance with the relevant standards/regulations.

This International Standard 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.

2 Normative references

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

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

ISO 4136, *Destructive tests on welds in metallic materials — Transverse tensile test*

ISO 5173, *Destructive tests on welds in metallic materials — Bend tests*

ISO 9016, *Destructive tests on welds in metallic materials — Impact tests — Test specimen location, notch orientation and examination*

ISO 9606-1, *Approval 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 personnel*

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

ISO 14732, *Welding personnel — Approval testing of welding operators for fusion welding and of resistance weld setters for fully mechanized and automatic welding of metallic materials*

ISO 20421-1:2006(E)

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

ISO 15613, *Specification and approval 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 — Part 1: Welding procedure tests for the arc welding of steels*

ISO 15614-2, *Specification and approval of welding procedures for metallic materials — Part 2: Welding procedure tests for the arc welding of aluminium and its alloys*

ISO 15614-3, *Specification and approval of welding procedures for metallic materials — Part 3: Welding procedure tests for the arc welding of aluminium and its alloys*

ISO 17636, *Non-destructive examination of welds — Radiographic 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 21013-1, *Cryogenic vessels — Safety devices for protection against excessive pressure — Part 1: Reclosable pressure-relief valves*

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 23208, *Cryogenic vessels — Cleanliness for cryogenic service*

ASME VIII-2

EN 1708-1, *Welding — Basic weld joint details in steel — Part 1: Pressurized components*

EN 10028-4, *Flat products made of steels for pressure purposes — Part 4: Nickel alloy steels with specified low temperature properties*

EN 10028-7, *Flat products made of steels for pressure purposes — Part 7: Stainless Steels*

EN 12300, *Cryogenic vessels — Cleanliness for cryogenic service*

EN 13068-3, *Non-destructive testing — Radioscopic testing — Part 3: General principles of radioscopic testing of metallic materials by X- and gamma rays*

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

EN 13445-4, *Unfired pressure vessels — Part 4: Fabrication*

UN Recommendations on the transport of dangerous goods — Model regulations (12th revised edition)

3 Terms and definitions

For the purposes of this part of ISO 20421, the following terms and definitions apply.

3.1

cryogenic fluid

refrigerated liquefied gas
gas which is partially liquid because of its low temperature

NOTE 1 This includes totally evaporated liquids and supercritical fluids.

NOTE 2 In the context of this part of ISO 20421, the refrigerated but non-toxic gases and gas mixtures given in Table 1 are referred to as cryogenic fluids.

Table 1 — Refrigerated but non-toxic gases

Classification code	Identification number, name and description ^a	
3 °A	Asphyxiant gases	
	1913	Neon, refrigerated liquid
	1951	Argon, refrigerated liquid
	1963	Helium, refrigerated liquid
	1970	Krypton, refrigerated liquid
	1977	Nitrogen, refrigerated liquid
	2187	Carbon dioxide, refrigerated liquid
	2591	Xenon, refrigerated liquid
	3136	Trifluoromethane refrigerated liquid
	3158	Gas, refrigerated liquid, N.O.S. (not otherwise specified)
3 °O	Oxidizing gases	
	1003	Air, refrigerated liquid
	1073	Oxygen, refrigerated liquid
	2201	Nitrous oxide, refrigerated liquid, oxidizing
3311	Gas, refrigerated liquid, oxidizing, N.O.S.	
3 °F	Flammable gases	
	1038	Ethylene, refrigerated liquid
	1961	Ethane, refrigerated liquid
	1966	Hydrogen, refrigerated liquid
	1972	Methane, refrigerated liquid or natural gas, refrigerated liquid, with high methane content
	3138	Ethylene, acetylene and propylene mixture, refrigerated liquid, containing at least 71,5 % ethylene with not more than 22,5 % acetylene and not more than 6 % propylene
3312	Gas, refrigerated liquid, flammable, N.O.S.	
^a Classification codes, identification number, name and description according to the United Nations.		

ISO 20421-1:2006(E)

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

NOTE The large transportable cryogenic vessel comprises a complete assembly that is ready for service

3.3 thermal insulation
vacuum interspace between the inner vessel and the outer jacket

NOTE 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 vessel intended to contain the cryogenic fluid to be transported

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

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

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

3.8 documentation
technical documents delivered by the manufacturer to the owner consisting of:

- all certificates establishing the conformity with this part of ISO 20421 (e.g. material, pressure test, cleanliness, safety devices);
- a short description of the vessel (including characteristic data, etc.);
- a list of fluids and their net mass for which the cryogenic vessel is designed;
- an operating manual (for the user) which consists of:
 - a short description of the vessel (including characteristic data, etc.);
 - a statement that the vessel is in conformity with this part of ISO 20421;
 - the instructions for normal operation.

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

3.10**service equipment**

measuring instruments and filling, discharge, venting, safety, heating, cooling and insulating devices

3.11**manufacturer of the large transportable cryogenic vessel**

company that carries out the final assembly, including the final acceptance test, of the large transportable cryogenic vessel

3.12**gross volume of the inner vessel**

internal volume of the inner vessel, excluding nozzles, pipes, etc., determined at minimum design temperature and atmospheric pressure

3.13**tare mass**

mass of the empty large transportable cryogenic vessel

3.14**net volume of the inner vessel**

volume of the inner vessel, below the inlet to the relief devices, excluding nozzles, pipes, etc., determined at minimum design temperature and atmospheric pressure

3.15**net mass**

maximum allowable mass of the cryogenic fluid which may be filled

NOTE 1 The maximum allowable mass is equal to the mass of the cryogenic liquid occupying 98 % of the net volume of the inner vessel 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.

NOTE 2 Cryogenic liquid helium can occupy 100 % of the volume of the inner vessel at any pressure.

3.16**gross mass**

sum of tare mass plus net mass

3.17**pressure**

pressure relative to atmospheric pressure, i.e. gauge pressure

3.18**fixed tank**

tank vehicle

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

3.19**demountable tank**

large transportable vessel non-permanently attached to a vehicle

NOTE 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.

3.20**portable tank**

large transportable vessel designed primarily to be loaded onto a transport vehicle or ship

NOTE It can be lifted full and loaded and discharged without removal of structural element.

ISO 20421-1:2006(E)**3.21
maximum allowable pressure** p_s

maximum pressure permissible at the top of the vessel in its normal operating position

**3.22
relief plate/plug**

plate or plug retained by atmospheric pressure which allows relief of excess internal pressure, generally from the vacuum jacket

**3.23
bursting disc device**

a non-reclosing pressure-relief device ruptured by differential pressure

NOTE It is the complete assembly of installed components including where appropriate the bursting disc holder.

**3.24
pressure-strengthened vessel**

pressure 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 Pressure vessels made from solution heat-treated material will be subject to a controlled plastic deformation during the strengthening operation as its yield point is raised. Pressure vessels made from work-hardened material will be subject to little or no plastic deformation.

4 Symbols

For the purposes of this part of ISO 20421, the following symbols apply (units of measurement are in the column at right):

c	allowance for corrosion	mm
d_i	diameter of opening	mm
d_a	outside diameter of tube or nozzle	mm
f	narrow side of rectangular or elliptical plate	mm
l_b, l'_b	buckling length	mm
n	number of lobes	—
p	design pressure as defined in 10.3.2.2	bar
p	calculation pressure	bar
p_e	allowable external pressure limited by elastic buckling	bar
p_k	strengthening pressure	bar
p_p	allowable external pressure limited by plastic deformation	bar
p_s	maximum allowable pressure	bar
p_T	pressure test (see 6.2)	bar

r	radius, e.g. inside knuckle radius of dished end and cones	mm
s	minimum thickness	mm
s_e	actual wall thickness	mm
v	factor indicative of the utilization of the permissible design stress in joints or factor allowing for weakenings	—
x	(decay-length zone) distance over which governing stress is assumed to act	mm
A	cross-sectional area of reinforcing element	mm ²
C, β	design factors	—
D	shell diameter	mm
D_a	outside diameter, e.g. of a cylindrical shell	mm
D_i	internal diameter, e.g. of a cylindrical shell	mm
E	Young's modulus	N/mm ²
I	moment of inertia of reinforcing element	mm ⁴
R_e	minimum guaranteed yield stress or 0,2 % proof stress at 20 °C (1 % proof stress for austenitic steel)	N/mm ²
R_m	minimum guaranteed tensile strength at 20 °C	N/mm ²
K	material property used for design (see 10.3.2.3)	N/mm ²
K_T	material property at temperature T in °C (e.g. K_{20} for material property at 20 °C (see 10.3.2.3.2))	N/mm ²
R	radius of curvature, e.g. inside crown radius of dished end	mm
S	safety factor at design pressure, in relation with R_e	—
S_k	safety factor against elastic buckling at design pressure	—
S_p	safety factor against plastic deformation	—
Z	auxiliary value	—
ν	Poisson's ratio	—
u	out of roundness (see 11.5.4.2)	—

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