
**Cryogenic vessels — Static vacuum
insulated vessels —**

**Part 2:
Operational requirements**

Réipients cryogéniques — Réipients fixes isolés sous vide —

Partie 2: Exigences de fonctionnement

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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 on the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the WTO principles in the Technical Barriers to Trade (TBT) see the following URL: Foreword - Supplementary information

The committee responsible for this document is ISO/TC 220, *Cryogenic vessels*.

This second edition cancels and replaces the first edition (ISO 21009-2:2006), which has been technically revised.

ISO 21009 consists of the following parts, under the general title *Cryogenic vessels — Static vacuum insulated vessels*:

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

Cryogenic vessels — Static vacuum insulated vessels —

Part 2: Operational requirements

1 Scope

This part of ISO 21009 specifies operational requirements for static vacuum insulated vessels designed for a maximum allowable pressure of more than 50 kPa (0,5 bar). It may also be used as a guideline for vessels designed for a maximum allowable pressure of less than 50 kPa (0,5 bar).

This part of ISO 21009 applies to vessels designed for cryogenic fluids specified in ISO 21009-1.

Static cryogenic vessels are often partly equipped by the manufacturer, but may be installed or re-installed by another party, such as the operator, user or owner.

NOTE 1 For the installation of these vessels, additional requirements can apply; these are defined in specific regulations.

NOTE 2 Some requirements of this standard can be covered by local regulations, e.g. safety distances, occupational safety and health. Where there is a conflict between the requirements of this International Standard and any applicable local regulation, the local regulation always takes precedence.

2 Normative references

ISO 21009-2:2015

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

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

ISO 21009-1, *Cryogenic vessels — Static vacuum-insulated vessels — Part 1: Design, fabrication, inspection and tests*

3 Terms and definitions

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

3.1

putting into service

operation by which a vessel (3.8) is prepared to be used

Note 1 to entry: It applies to either a new vessel being used for the first time or an existing vessel being returned to service.

3.2

filling

operation by which a vessel (3.8) undergoes a prefill check, filling with a cryogenic fluid and an after-fill check

3.3

withdrawal

operation by which the product is taken from a vessel (3.8) connected to the supply system

3.4
outdoor location

location outside of any building or structure and not enclosed by more than two walls

3.5
underground location

area or room whose ground or floor is on all sides significantly lower than the adjacent ground surfaces

Note 1 to entry: Installations are to be considered on an individual basis after a suitable and sufficient risk assessment has been carried out.

3.6
safety distance

minimum distance separating a piece of equipment from its inherent hazard that will mitigate the effect of a likely foreseeable incident and prevent a minor incident escalating into a larger incident

Note 1 to entry: The safety distance will also be determined to provide protection from foreseeable external impact (e.g. roadway, flare) or activities outside the control of the operation (e.g. plant or customer station boundary).

3.7
gas release

escape of gas due to operating conditions, or to malfunctions that cannot be reasonably excluded

Note 1 to entry: Gas release for operating reasons can be produced, for example, on vent lines and pressure-release lines.

Note 2 to entry: Gas escape due to malfunctions which cannot be excluded can occur, for example, in the case of overfilling, failure of fittings, loose connections, faulty operation, and leakages.

3.8
vessel

thermally insulated vessel intended for use with one or more cryogenic fluids in a stationary condition

[SOURCE: ISO 21009-1, 3.19, modified: Term changed to short form "vessel" for this document]

3.9
authorized person

person authorized by the applicable regulations

4 Personnel training

Only persons trained for the specific task shall be allowed to install, put into service, fill, handle, operate or maintain the vessel and its equipment.

The training programme shall include

- normal operating procedures;
- product and hazard identification;
- safe operating limits;
- emergency procedures;
- physical and chemical properties of the vessel's contents and their effects on the human body;
- personnel protective equipment (e.g. safety boots, goggles, gloves).

Training shall be repeated as necessary to ensure that personnel remain competent. A training record shall be maintained which details the information personnel have received.

5 General safety requirements

5.1 General

Identification labels and plates shall not be removed or defaced.

Appropriate warning signs regarding product and operational hazards and personnel protective equipment requirements shall be displayed.

Parts under pressure shall be disconnected only if they have been previously depressurized.

All surfaces which may come in contact with the product shall be kept free from oil and grease. For cleanliness requirements, see ISO 23208.

Leaking valves or connections should be depressurized before rectification. When this is not possible, leaking valves under pressure shall be tightened using suitable tools and procedures. Direct flame or intense heat shall never be used to raise the pressure or de-ice frozen components.

Valve outlets shall be kept clean, dry and free from contaminants.

Vessels and their accessories shall not be modified without proper authorization.

5.2 Safety considerations

In all operations and training, the following safety considerations shall be taken into account:

- Small amounts of cryogenic fluids will produce large volumes of vaporized gas. Spillage of oxygen can result in an oxygen-enriched atmosphere; spillage of other cryogenic fluids can result in an oxygen-deficient atmosphere. Provision is to be made for appropriate measures for this, e.g. ventilation.
- Due to the possibility of cold embrittlement, cryogenic fluids shall not come in contact with materials (metals or plastics) which are not suitable for low temperatures.
- Because of their extremely low temperatures, cryogenic fluids will produce cold burns when coming in contact with the skin. Cold burns can also be produced from contact with uninsulated equipment and pipe.
- Oxygen enrichment due to liquefaction of ambient air can occur on the cold surfaces of uninsulated equipment which contain fluids with a boiling point lower than that of oxygen.

6 Installation

6.1 General requirements

Vessels shall be installed and operated in such a way, that employees or third parties are not endangered. Necessary minimum safety distances shall be observed; see also [Annex A](#).

Vessels shall be installed so that the name plate is easily readable.

The installation should allow inspection of vessels on all sides. All vessel controls shall be capable of being operated safely.

Vessels shall be installed in such a way that their filling operation can be carried out safely and easily.

Vessels shall be erected in such a way that no inadmissible misalignment or inclination can occur due to

- the actual foundations;
- the inherent mass of the vessel including its contents;
- external forces, e.g. seismic loads, wind loads.

Gas from pressure-relief devices or vents shall be discharged to a safe place.

Appropriate warning signs regarding product hazards shall be displayed, e.g. in rooms, areas, or on vessels. The operating instructions shall also refer to the properties of the gas.

Vessels shall be installed in locations where there is sufficient ventilation such that the formation of dangerous explosive gas-air mixtures or an oxygen-deficient/-enriched atmosphere is avoided.

Vessels shall be installed in such a way that adequate space is provided for maintenance and cleaning, as well as for emergency cases.

The space for maintenance and cleaning should be at least 0,5 m around the installation.

Vessels shall not be installed in corridors, passages or thoroughfares, generally accessible lobbies, stairwells or near steps. Vessels should not be installed close to the aforementioned areas if traffic routes, escape routes or accessibility are limited.

Access by unauthorized persons should be prevented.

The area/foundation under vessels, as well as below detachable connections and fittings to the liquid phase of the vessel of oxidizing gases, shall be of non-combustible materials and free of oil, grease and other flammable contaminants.

Consideration shall also be given to the need for similar precautions for liquid-hydrogen or liquid-helium installations where significant air liquefaction may occur around uninsulated equipment.

NOTE To prevent a risk of brittle fracture, consideration should be given to the design temperature of the installation downstream of the installed or fitted vaporizing system and low temperature cut-off systems, if necessary.

6.2 Outdoor installation

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Vessels should be installed outdoors.

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The drainage of surface water from the place of installation shall be ensured.

On sloping sites, an installation (e.g. a wall) may be necessary to prevent gas from penetrating over the place of installation down into lower rooms, ducts, shafts or air intakes.

Vessels and their components shall be protected against mechanical damage, e.g. by vehicle buffer bars, enclosures, safety distances. The protection of vessel supports against leaking cryogenic fluid should be considered.

6.3 Indoor installation

If reasonable attempts to install the vessel outdoors fail, an indoor installation is permitted. Indoor installation shall comply with the following safety precautions.

The entrance of rooms in which vessels are installed shall be labelled. Reference shall be made to the relevant hazards of the gas.

Rooms shall:

- have self-closing doors, where these do not lead directly outside;
- consist of materials which are fire resistant or non-combustible, with the exception of windows and other closures of apertures in external walls;
- be separated from other rooms and have a fire resistance up to 30 min;
- be separated from rooms normally occupied by the public in a gas-tight manner and without any apertures;

- have adequate ventilation — gas release from the trycock valve shall be taken into account when assessing the ventilation requirements.

Precautions/procedures shall be implemented to ensure that personnel entering or within the rooms are not exposed to hazardous atmospheres.

Rooms containing vessels shall not be used in any other way which may be a danger to the vessels due to mechanical effects, fire or explosion.

All fill connections, hose drains, pressure gauges, liquid level gauges, and vents necessary to fill the vessel safely shall be fixed piping to a safe outdoor location. All pressure-relief devices shall be fixed piping to a safe outdoor location. All piping shall be compatible for the appropriate liquid and gaseous service and designed with no restrictions that affect the safe operation of the vessel.

All pressure-relief devices shall be designed for indoor service.

In rooms, there shall be no

- air intake openings for the ventilation of other rooms;
- open ducts;
- duct inlets unprotected against the ingress of gas;
- open shafts;
- openings to lower rooms.

6.4 Safety distances

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The minimum safety distances are not intended to provide protection against catastrophic events or major releases, which should be addressed by other means to reduce their frequency and/or consequences to an acceptable level.

Included in safety distances are:

- distance between the vessel and neighbouring installations, buildings or public roads, in order to protect the vessel from any damage, such as heating as a result of fire or mechanical damage;
- distance between the vessel and an object outside the installation which has to be protected from the effects of a gas release arising from normal operation.

These distances are measured from those points on a vessel from which, in the normal course of operation, a release of product can occur, e.g. vent point, fill connection, flanges and other mechanical joints.

The safety distance is the distance, outside of which,

- in the case of flammable gases, danger through formation of an explosive atmosphere is eliminated, i.e. the lower explosive limit (LEL) is not exceeded;
- in the case of inert and oxidizing gases, danger from oxygen deficiency or enrichment is eliminated.

The safety distances may be reduced if a suitable and sufficient risk assessment is completed and documented by the owner/operator.

Recommended safety distances based on experience and calculation of minor release are given in [Annex A](#).

7 Inspection

7.1 General

The tests and inspections shall be carried out by an authorized person.

7.2 Inspection before putting into service

The inspection consists in

- checking of markings and labelling;
- checking the completeness of the handover documents;
- checking the equipment;
- checking the installation.

7.3 Marking and labelling

It shall be confirmed that marking and labelling meet the requirements specified in ISO 21009-1.

7.4 Handover documents

In addition to the manufacturer's documentation, where necessary the vessel shall be accompanied by vessel-specific documents and instructions for all items supplied, covering

- operations;
- auxiliary equipment;
- inspection records.

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As appropriate, these documents shall be retained by the owner or user of the vessel.

The user shall have appropriate operating instructions available. Such instructions may be attached to the vessel in a permanent manner.

7.5 Equipment

Perform the following equipment checks, when related to safe operation of the vessel.

- Check devices against overpressure for availability, appropriate choice and setting, appropriate arrangement, safe venting location and, in so far as possible, for performance/correct operation.
- Check measuring devices for their availability and appropriate choice in respect of the suitability of the measuring range and, in so far as possible, for performance/correct operation.
- Check shut-off devices for availability, appropriate choice and arrangement in respect of pressure and temperature and, in so far as possible, for performance/correct operation.
- Check other fittings (e.g. fill couplings, gauges and controlling devices), in particular with regard to the medium to be supplied and vented; and where these are automatically driven or controlled, also their performance in the event of a power cut or loss of pneumatic supply. As a minimum, coupling types for oxidizing and non-oxidizing products should be different.

The vessel's connections shall be tested for leak-tightness before putting into service.

7.6 Periodic inspection

7.6.1 General

No external or internal degradation mechanism is reasonably foreseeable on the inner vessel because of the nature of cryogenic fluids, their temperatures, the metallic materials of construction used, and the fact that the inner vessel is inside an evacuated outer jacket.

Therefore, no in-service inspection of the inner vessel or the inside surface of the outer jacket is required.

NOTE Corrosion allowance on surfaces in contact with the operating fluid or exposed to the vacuum interspace between the inner vessel and the outer jacket as well as inspection openings is not provided in the inner vessel or on the outer jacket.

7.6.2 Inspections

The periodic inspection shall consist of

- an external visual inspection of the vessel and equipment;
- functional check of valves;
- leak tests under operating conditions;
- assessment of any changes of the operational conditions of the installation and its surroundings;
- assessment of the vacuum between inner vessel and outer jacket.

Vacuum measurement should only be performed when the thermal performance is deficient as noted by vessel operation.

The tests shall be carried out by an authorized person.

The inspection intervals shall be determined by the authorized person after considering local regulations, the operating conditions and the recommendations of the manufacturer, but should typically not exceed five years. The inspection shall be recorded.

NOTE For the re-inspection intervals, only the year of the date of the next inspection need be considered.

7.7 Inspection of pressure-relief devices

7.7.1 General

The examinations and the inspection intervals shall be determined by the authorized person according to the local regulations and operating conditions, taking into consideration the recommendations of the manufacturer. Recommended inspection intervals are given in [Table 1](#).