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Third edition
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Cryogenic vessels — Static vacuum-insulated vessels —

Part 2: Operational requirements

Récipients cryogéniques — Récipients fixes isolés sous vide —

Partie 2: Exigences de fonctionnement

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Foreword

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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 document 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).

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This document was prepared by Technical Committee ISO/TC 220, *Cryogenic vessels*, in collaboration with the European Committee for Standardization (CEN) Technical Committee CEN/TC 268, *Cryogenic vessels and specific hydrogen technologies applications*, in accordance with the Agreement on technical cooperation between ISO and CEN (Vienna Agreement).

This third edition cancels and replaces the second edition (ISO 21009-2:2015), which has been technically revised.

The main changes are as follows:

— updated definition of “authorized person”;

— updated requirements for protective clothing to prevent exposure to cryogenic fluids;

— added requirements for dealing with oxygen-enriched condensation;

— added requirements to use the results of a risk assessment for the design on underground installations;

— added requirements to use measures such as gas monitoring systems and ventilation to mitigate hazards for underground installations;

— added requirements to consider the risks associated with spill containment (diking) for outdoor installations if diking is needed;

— added requirements that controls for filling an indoor tank from an outdoor source shall be accessible to the operator and that vents shall be piped to a safe location;

— added requirements that automatic control devices shall fail to a safe operating mode upon the loss of power or pneumatic supply;

— added requirement to remove moisture as well as contaminants during a first fill;

— added option to use approved first fill procedure in place of manufacturer instructions;

— added requirements to ensure the fill process does not fill beyond a maximum level and pressure;

— added requirement to cap fill fittings to avoid moisture or contaminant entry to the tank;

— added separate recommended procedures for purging hydrogen tanks with helium and for other inert gases;

— updated safety distances for flammable cryogenic fluids.

A list of all parts in the ISO 21009 series can be found on the ISO website.

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.

Cryogenic vessels — Static vacuum-insulated vessels —

Part 2: Operational requirements

1 Scope

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

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

Static cryogenic vessels are often partly equipped by the manufacturer, but can 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.

NOTE 2 Some requirements of this document can be covered by local regulations, e.g. safety distances, occupational safety and health.

NOTE 3 Additional requirements can apply to the operation of large scale and field-fabricated vessels.

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

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

3 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:

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

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

3.1
putting into service
operation by which a *vessel* (3.7) 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* (3.7) undergoes a prefill check, filling with a cryogenic fluid, and an after-fill check

3.3
outdoor location
location outside of any building or structure and not enclosed by more than two walls

3.4
underground location
area or room whose ground or floor is on all sides lower than the adjacent ground surfaces

3.5
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 also can 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).

3.6
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 release 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.

3.7
vessel
thermally insulated vessel intended for use with one or more cryogenic fluids in a stationary condition

[SOURCE: ISO 21009-1:2022, 3.17, modified — The term “static cryogenic vessel” was changed to “vessel”; the Note to entry was removed.]

3.8
authorized person
trained and qualified person approved or assigned by the applicable regulations to perform specific types of duties

4 Personnel training

Only authorized 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);

— basic risk assessment methods and techniques;

— hazards of the cryogenic liquid stored in the vessel.

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

5 General safety requirements

5.1 General

The following requirements shall be taken into account in operating instructions:

— 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 come in contact with the product shall be kept free from oil and grease. Cleaning shall be in accordance with 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:

— Systems for oxygen service shall consider the compatibility of the materials.

— 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 shall be made for appropriate measures for this, e.g. ventilation or usage of self-contained breathing apparatus.

— Due to the possibility of cold embrittlement, cryogenic fluids shall not come in contact with materials (metals or plastics) which are not suitable for lower bound of the design temperatures.

— Hydrogen embrittlement shall be considered for materials exposed to hydrogen.

— 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. When using vessels, it is necessary to use protective means for exposed areas of the face and skin, as well as clothing which does not allow spilled cryogenic liquid to enter into the shoes.

— Oxygen enrichment due to liquefaction of ambient air can occur on the cold surfaces of equipment which contain fluids with a boiling point lower than that of oxygen, e.g. liquid helium or liquid hydrogen. Areas where this condensate can collect shall be considered for oxygen compatibility.

6 Installation

6.1 General requirements

The requirements in Clause 6 shall be taken into account in operating instructions.

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.

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/oxygen-enriched atmosphere is avoided.

Underground location installations shall be considered on an individual basis after a suitable and sufficient risk assessment has been carried out by the end user. Appropriate measures, such as gas monitoring systems and ventilation, shall be specified. Where the underground location is in a building, the requirements of 6.3 shall apply.

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 0,6 m around the installation.

Vessels shall not be installed in corridors, passages or thoroughfares, generally accessible lobbies, stair-wells 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 can occur around uninsulated equipment.

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.

It is possible that national regulations require that some duties concerning installations be performed under involvement of third party.

6.2 Outdoor installation

Vessels should be installed outdoors.

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

Spill containment areas inhibit the vaporization of spilled cryogenic fluids, which leads to longer time to clear the hazard. The risk of spill containment (diking) shall be considered.

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