BS EN ISO 21029-2:2015

BSI Standards Publication

Cryogenic vessels — Transportable vacuum insulated vessels of not more than 1 000 litres volume

Part 2: Operational requirements

bsi.

...making excellence a habit.™

National foreword

This British Standard is the UK implementation of EN ISO 21029-2:2015. It supersedes BS EN 1251-3:2000 which is withdrawn.

The UK participation in its preparation was entrusted to Technical Committee PVE/18, Cryogenic vessels.

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

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

ISBN 978 0 580 78167 4

ICS 23.020.40

Compliance with a British Standard cannot confer immunity from legal obligations.

This British Standard was published under the authority of the Standards Policy and Strategy Committee on 30 September 2015.

Amendments issued since publication

Date	Text affected

EUROPEAN STANDARD

NORME EUROPÉENNE

EUROPÄISCHE NORM

EN ISO 21029-2

September 2015

ICS 23.020.40

Supersedes EN 1251-3:2000

English Version

Cryogenic vessels - Transportable vacuum insulated vessels of not more than 1 000 litres volume - Part 2: Operational requirements (ISO 21029-2:2015)

Récipients cryogéniques - Récipients transportables, isolés, sous vide, d'un volume n'excédant pas 1 000 litres - Partie 2: Exigences de fonctionnement (ISO 21029-2:2015)

Kryo-Behälter - Ortsbewegliche vakuumisolierte Behälter mit einem Fassungsraum von nicht mehr als 1 000 Liter - Teil 2: Betriebsanforderungen (ISO 21029-2:2015)

This European Standard was approved by CEN on 23 April 2015.

CEN members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration. Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the CEN-CENELEC Management Centre or to any CEN member.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CEN member into its own language and notified to the CEN-CENELEC Management Centre has the same status as the official versions.

CEN members are the national standards bodies of Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, Former Yugoslav Republic of Macedonia, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and United Kingdom.

EUROPEAN COMMITTEE FOR STANDARDIZATION
COMITÉ EUROPÉEN DE NORMALISATION
EUROPÄISCHES KOMITEE FÜR NORMUNG

CEN-CENELEC Management Centre: Avenue Marnix 17, B-1000 Brussels

European foreword

This document (EN ISO 21029-2:2015) has been prepared by Technical Committee ISO/TC 220 “Cryogenic vessels” in collaboration with Technical Committee CEN/TC 268 “Cryogenic vessels and specific hydrogen technologies applications” 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 March 2016, and conflicting national standards shall be withdrawn at the latest by March 2016.

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

This document supersedes EN 1251-3:2000.

This document has been prepared under a mandate given to CEN by the European Commission and the European Free Trade Association.

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

Endorsement notice

The text of ISO 21029-2:2015 has been approved by CEN as EN ISO 21029-2:2015 without any modification.

Contents

Page

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 21029-2:2004), which has been technically revised.

ISO 21029 consists of the following parts, under the general title *Cryogenic vessels — Transportable vacuum insulated vessels of not more than 1 000 l volume:*

— *Part 1: Design, fabrication, inspection and tests*

— *Part 2: Operational requirements*

Introduction

Elements of this part of ISO 21029 support the requirements of the UN Recommendations on the Transport of Dangerous Goods and other international, national, or local requirements.

Some requirements of this International Standard may 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.

INTERNATIONAL STANDARD **ISO 21029-2:2015(E)**

Cryogenic vessels — Transportable vacuum insulated vessels of not more than 1 000 litres volume —

Part 2: Operational requirements

1 Scope

This part of ISO 21029 specifies operational requirements for transportable vacuum insulated cryogenic vessels of not more than 1 000 l volume designed to operate above atmospheric pressure. Appropriate parts may be used as a guidance for a vessel design to operate open to the atmosphere.

For cryogenic vessels designed for personal medical use, other requirements can apply.

The scope includes putting into service, filling, withdrawal, transport within the location, storage, maintenance, periodic inspection, and emergency procedures.

For the transportation of these vessels by public road, rail, sea, and air, other additional requirements can apply; these are defined in specific regulations.

Transportable cryogenic vessels of not more than 1 000 l volume are often partly equipped by the manufacturer, but can be installed or re-installed by another party, such as the operator or owner. For this reason, some of the scope of this part of ISO 21029, which includes putting into service, inspection, filling, maintenance, and emergency procedure, overlaps with ISO 21029-1.

2 Normative references

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 21010, *Cryogenic vessels — Gas/materials compatibility*

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

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 is prepared to be used, applying 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 transportable vessel 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 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

3.6
safety distance
distance from a piece of equipment with inherent hazard being the minimum separation 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 is determined in order 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
vessel
transportable cryogenic vessel as defined in ISO 21029-1

3.8
authorized person
person authorized by the applicable regulations

3.9
enterprise
any person or company that has a legal duty of care

3.10
filler
any enterprise that loads cryogenic fluids into a cryogenic vessel

3.11
owner
enterprise that legally owns the cryogenic vessel

3.12
operator
any enterprise for filling, storage, transport, and withdrawal of cryogenic product

4 Preliminaries before putting into service

4.1 General

Before putting into service, verification shall take place to ensure that the vessel is suitable for the intended service and that the marking, labelling, and handover documents are complete.

4.2 Marking and labelling

4.2.1 Marking

Marking shall be in accordance with the applicable design standard and/or regulations, e.g. ISO 21029-1.

4.2.2 Labelling

For labelling, the following shall be affixed:

a) flow sheet denoting operation;

b) unshortened identification of the fluid that is being transported in accordance with the transport and substance regulations and its net mass in accordance with the documentation;

c) danger labels in accordance with transport regulations;

d) risk and safety phrases associated with the gas content;

e) name and address of the fluid producer or supplier.

All vessels shall include a product identification label visible from all directions (e.g. 360° wrap-around tape), which can be easily read from a distance of 2 m, and securely affixed product labels at the inlet and outlet connections. Additionally, warning labels reading, "Never use adapters or try to change gas connections on the vessel when trying to attach a product distribution connection" shall be affixed at outlet connections.

4.3 Handover documents

In addition to the manufacturer's documentation where necessary, the cryogenic vessel shall be accompanied by vessel specific documents and instructions for all the following items:

— operations;

— auxiliary equipment;

— inspection records.

These documents shall be retained by the owner of the vessel.

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

5 Personnel training

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

The training programme shall include the following:

— normal 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 that the personnel have received.

6 Safety requirements

6.1 General

Marking and labelling shall not be removed or defaced.

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

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

Leaking valves or connections shall 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.

All surfaces which can come into contact with the product shall be cleaned for the intended service. For cleanliness requirements, see ISO 23208. Valve outlets shall be kept clean, dry, and free from contaminants.

Vessels and their accessories shall not be modified without proper authorization. It is recommended that the couplings be attached to the vessels and/or hoses in a manner that prevents unauthorized removal of the product couplings.

6.2 Safety considerations

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

— Small amounts of cryogenic fluids 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.

— 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.

— Vaporizing cryogenic fluids produce gases that are always heavier than air and can accumulate in lower areas (e.g. pits, trenches).

— Because of their extremely low temperatures, cryogenic fluids produce cold burns when coming into contact with the skin. Cold burns can also be produced from contact with uninsulated equipment.

— Oxygen enrichment due to liquefaction of ambient air can occur on the cold surfaces of uninsulated equipment that contains fluids with a boiling point lower than oxygen.

6.3 Safety distances

Minimum safety distances are not intended to provide protection against catastrophic events or major releases and these should be addressed by other means to reduce the frequency and/or consequences to an acceptable level.

Included in safety distances are the following:

— distances between vessels and neighbouring installations, buildings, or public roads, the purpose of which is 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 must 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, or other mechanical joints.

The safety distance is the distance, outside of which are the following:

— in the case of flammable gases, dangers 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, dangers from a lack of oxygen or enrichment are eliminated.

The minimum recommended safety distances defined in Annex A are based on experience and calculation of minor releases.

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

7 Putting into service

This operation shall follow a written procedure and the results of the steps involved shall be recorded (e.g. in a checklist). Such lists shall be retained by the operating company.

Vessel and accessories shall be visually checked for damage.

It shall verify the following:

— vessel and accessories are appropriate for the intended service, comply with the flow sheet, and are appropriately marked;

— set pressure, size and installation of pressure relief devices comply with the documentation. Devices requiring approval shall be correctly stamped and matching certificates shall be available;

— all valves are easy to operate;

— all labels are clearly displayed and appropriate for the product;

— all required tests have been carried out;

— the vessel and accessories are clean and compatible for the intended service according to ISO 23208 and ISO 21010.

The vessel shall be purged with an appropriate gas until the gas emerging from the vessel is sufficiently dry and pure for the intended service.

The vessel shall be cooled in accordance with the manufacturer's recommendations. Steps shall be taken to avoid any uncontrolled pressure rise due to rapid liquid evaporation. The cooling gas chosen shall take into account the risk of solidification.

Measuring and controlling devices (e.g. level gauge, pressure regulator, etc.) shall be checked for correct operation and setting.

8 Location

The following requirements listed in this clause are valid for storage as well as other activities such as filling, withdrawal, etc.

— Vessels shall be located in a suitable area such as in the open air or in a sufficiently ventilated enclosed area, away from sources of heat (e.g. welding source, open fire, etc.). Hot work shall be subjected to appropriate safety measures. The area shall be kept clear and suitable access shall be provided.

— Adequate ventilation shall be provided. In locations over ground level, natural ventilation is generally sufficient, provided that the room is large enough or that the outdoor area is not enclosed by walls. In other circumstances, forced ventilation or other precautions shall be provided.

— Vessels should not be located underground. However, where this is unavoidable, relief device outlet(s) should be piped to a safe external venting point. As an alternative, appropriate marking (e.g. indicating the risk of asphyxiation) and sufficient continuous ventilation to deal with product releases should be provided. The vent pipework shall be designed in such a way as to ensure proper pressure relief from the vessel and to prevent the accumulation or blockage of rainwater by airborne material. The same measures shall be taken if vessels are indoors for extended periods (i.e. overnight or weekends).

— The floor of the designated area shall be level and strong enough to take the mass of the full vessel. The vessel shall be located at a sufficient distance from the normal paths used by people or vehicles. Water accumulation in the vicinity of the vessel shall be avoided.

— For filling and withdrawing oxidizing liquids and cryogenic liquids colder than liquid nitrogen, the connections shall be located over a non-combustible surface, such as concrete.

— Vessels and their components shall be protected against mechanical damage.

— In case of emergency, adequate means of escape shall be provided. Emergency exits shall be kept clear at all times.

— All doors/gates should preferably be outward opening and wide enough to provide easy access and exit routes for personnel.

— Vessels which exhibit a risk of toppling over shall be firmly secured in the upright position.

— The operating area shall be clearly marked with appropriate warning signs. These can be displayed on the vessel, provided they do not hide the mandatory vessel markings.

— Access by unauthorized persons shall be prevented. On sites without sufficient supervision, fencing shall be provided.

9 Transport

This clause refers to the transport of vessels. Additional requirements can apply for transport on public roads, rail, waterways, sea, and air. Before transport, the vessels shall be examined for signs or damage or leaks and valves shall be checked to ensure that they are operational and in the correct position.

Cryogenic vessels should never be subjected to impacts or falls; these could damage the outer jacket or the suspension system of the inner vessel causing loss of insulating properties. Where vehicles are used (either powered or unpowered), the vessels shall be secured against toppling over.

The vessels shall be handled only by those means for which they are designed and equipped.

Because of the potential hazard of oxygen deficiency or enrichment where a lift is stopped for a certain period between floors, vessels shall not be transported in lifts together with persons, unless adequate safety precautions have been taken.

Vehicles used for transport should have well-ventilated cargo areas and wherever possible separate cargo and passenger compartments. Where this is not possible, or in cases of doubt as to the effectiveness of the ventilation, an atmosphere monitor should accompany the personnel travelling with the vessel. Vessels should be transported in their correct position and shall be securely fixed by appropriate means.

NOTE 1 Some regulations require separate cargo and passenger compartments.

NOTE 2 Different recommendations can apply for the transport in cars.

10 Filling

10.1 General

The following operations shall be carried out in accordance with a written procedure.

10.2 Prefill checks

Prior to filling, the filler shall examine the condition of the vessel as indicated in Table 1.

The vessel shall not be filled if any of these acceptance criteria cannot be met. Prior to filling, all non-compliances shall be corrected.

Table 1 — Prefill checks

Item	Acceptance criteria for filling
Labelling and marking	
Data plate	Present, legible, and in accordance with 4.2
Inspection date	Within required period
Product identification labels	Legible and fitted to the correct product
Vessel	
	No obvious signs of damage, corrosion, dirt, oil, or grease No unusual cold spot No loss of vacuum
Accessories	
All accessories (valves, PRD, connections, etc.)	No obvious signs of damage or corrosion Free from dirt, oil, or grease No unusual ice
Valves	Operable
Pressure relief devices	In a place free from ice or other obstructions
Filling connection	Appropriate connection fitted for product identified by the product identification label and cap fitted (if required)
Pressure gauge	Positive pressure in vessel

An external visual inspection of the vessel and equipment shall be performed, to ensure that the vacuum between inner vessel and outer jacket remains intact (checking of abnormal frosting on tank surface, gas venting from a vacuum protection device, relief valves are continually venting). If the vessel has lost vacuum, the owner of the cryogenic vessel shall immediately investigate the cause of the vacuum loss. Where a vacuum loss is believed to be associated with an internal pipe failure, for example vapour escaping from the vacuum relief device(s), then the cryogenic vessel must be made safe by immediately reducing the pressure to atmospheric and emptying all cryogenic liquid in a safe manner. The reduction of pressure is the most significant action to reduce the level of hazard.

10.3 Preparations

Depending on the type of the cryogenic vessel, it may be filled by volume or by mass, taking into account product density. The necessary measuring equipment shall be in good working order and within the calibration period, where required.

If there is no residual pressure in the vessel prior to filling, it shall be purged to remove possible contaminants. For carbon dioxide vessels, only gaseous carbon dioxide shall be used for purging.

If the vessel is warm, it shall be cooled down in accordance with the manufacturer's recommendations. Carbon dioxide vessels shall be pressurized to at least 7 bar (0,7 MPa) with gaseous carbon dioxide before introducing liquid CO_2. The purity of the residual product in the vessel shall be analysed and recorded where required by specification. Where the residual purity is outside specification, the vessel shall be purged until it meets specification.

The fill hose shall be securely connected, purged, and cooled.

Where necessary, the pressure shall be reduced by venting to facilitate filling. For carbon dioxide, the pressure should not drop below 7 bar (0,7 MPa) to avoid forming of dry ice.

10.4 After fill checks

The vessel mass or level of contents and pressure shall be checked and, where necessary, the vessel shall be vented to reach the level required by specification.

Where required by specification, the vessel contents shall be analysed and recorded.

The filler shall check that all valves are closed, that no cold spots have developed, and that valves, piping, and fittings are free from leaks.

11 Product withdrawal

The operator shall ensure that the product and the pressure in the vessel are compatible with the supply system, that the correct hose connection is fitted and that the vessel is positioned in accordance with manufacturer's recommendations.

Before connecting the vessel for use, the operator shall ensure that backflow from the system into the vessel is not possible, and also that the liquid cannot become trapped without adequate pressure relief.

For de-icing frozen valves, use warm water or steam, but not electrical heat or flames.

12 Change of service

This operation shall follow a written procedure and the results of the steps involved shall be recorded. Such records shall be retained by the company who made or ordered the change of service of the cryogenic vessel.

The procedure shall include the following.

— Check that the vessel is designed for its intended service. Special attention shall be given to this point if the vessel is intended for oxidizing fluids.

— Depressurization, emptying, and disconnecting the vessel shall be performed in accordance with Clause 13.

— Where it is suspected that the vessel could have been contaminated, it shall be cleaned by using a suitable cleaning procedure.

— The vessel's fill and withdraw couplings, where necessary, shall be removed and replaced with the proper connection for the new product. The vessel's labelling shall be removed and replaced with the proper labelling. Relabelling over existing labels is not permitted.

If the vessel is intended for oxidizing fluids, the following additional requirements apply.

— The vessel and all piping and accessories shall be purged with inert gas until the outlet temperature is at least close to ambient temperature. The purge gas inlet temperature shall never exceed the maximum operating temperature of 50 °C.

— It shall be ensured that the vessel and all piping and accessories are not contaminated by hydrocarbons.

— Before the vessel is filled with an oxidizing fluid, the person responsible for filling shall verify that the procedure has been carried out correctly.

13 Taking out of service

This operation shall follow a written procedure and the results of the steps involved shall be recorded. If the vessel is intended for further service, such records shall be retained by the owner company.

The procedure shall include the following:

— emptying of the vessel and depressurizing to a positive pressure no greater than 2 bar (0,2 MPa), taking into account the properties of the product involved (e.g. solidification of CO_2, see 10.3);

— monitoring pressure and mass, if necessary; verifying that no line is obstructed.

If the equipment is intended to be taken into service again later, the following additional points apply.

— Purging of the vessel and all piping and accessories with inert gas.

— If there is a possibility that the vessel could be used for oxidizing fluids at a later time, then the cleaning and hydrocarbon checking steps outlined in Clause 12 shall be applied when the vessel is taken out of service.

— If the vessel is to be transported or stored, protective caps shall be fitted on all open connections.

— When in storage, a slight positive pressure of dry inert gas shall be maintained in the vessel and the vessel shall be labelled accordingly.

If the vessel is to be scrapped, it shall be purged with inert gas and labelled accordingly.

EXAMPLE “Purged with Nitrogen – To be scrapped”

Product identification labels shall be removed and nameplates rendered unusable.

14 Maintenance and repair

Maintenance is required to ensure that equipment remains in a safe condition. The responsibility for the maintenance and repair shall be established between the contracting parties (e.g. owner, filler). Following maintenance, the vessel shall comply with the current approval documentation.

Maintenance generally comprises the following:

— checking the condition of the vessel, piping, and accessories;

— checking the operability of valves;

— checking the operability of pressure relief devices:

  — Reclosable pressure-relief devices shall be functionally tested or replaced at intervals not exceeding five years by the owner/filler.

  — Inspection intervals may exceed five years, if system and equipment performance tests demonstrate proper functionality.

  — Non-reclosable pressure-relief devices shall be visually inspected.

— satisfactory examination shall be documented in the inspection records (see 4.3);

— minor repairs, e.g. changing of seals;

— cleaning external surfaces.

Equipment shall not be removed until pressure has been released or adequately isolated or depressurized.

Any leakage shall be rectified promptly and in a safe manner. Original spare parts should preferably be used. If this is not possible, spare parts with the same characteristics (e.g. with same set pressure, same sealing) shall be used.

Modifications in design, materials and equipment, or repairs shall be approved by an authorized person and documentation updated accordingly (see also ISO 21029-1).

Hot work (welding, soldering, and heating, etc.) shall be carried out to the same standard (fabrication, qualification of personnel, testing, certification, etc.) as during manufacture.

If, at any time, it is necessary to break the seal for adjustment of a pressure-relief valve, the valve shall be removed from service until it has been reset and sealed. Any adjustment necessary shall be made by the manufacturer or other company qualified by the manufacturer for the repair, adjustment, and testing of such valves. The organization making such adjustment shall attach a permanent tag with the setting, capacity, and date to the pressure-relief valve.

Vessels shall be internally clean, dry, and free from particulate matter and contaminants; vessels for oxidizing fluids shall be free from oil and grease.

CO_2 vessels shall be depressurised using a written procedure. Liquid carbon dioxide vessels that have lost pressure shall be repressurised using a written procedure. The material properties of the vessel shall be considered.

NOTE For guidance, see IGC Doc. 164/10/E, or CGA G-6.7.

15 Periodic inspection

The following inspection shall be performed at intervals not exceeding 10 years.

NOTE Regulations do not permit vessels that have exceeded the periodic inspection date (as marked on the vessel) to be refilled, but such vessels can continue to be emptied and/or transported for the periodic inspection.

a) Equipment and pressure-relief device check.

   — Reclosable pressure relief devices shall either be replaced or undergo a functional test (lift or set pressure test) either *in situ* or off the vessel.

   — Non-reclosable pressure-relief devices, where fitted, shall be replaced according to the instructions of the pressure relief device manufacturer.

b) All other equipment shall be checked for satisfactory function.

   Do the following for visual external examination:

   — check for signs of damage;

   — check content and legibility of data plate (see 4.2) and other markings.

c) Leak test.

   A gas test using an inert gas or the working medium at a minimum of 25 % of the permissible working pressure shall be carried out.

   The vessel integrity may be checked by a leak test (see above) and measurement of vacuum, if appropriate. Vacuum measurement shall only be performed when the thermal performance is deficient as noted by vessel operation.

Satisfactory inspection shall be documented in the inspection records (see 4.3).

16 Additional requirements for flammable gases

16.1 General safety requirements

16.1.1 General

Open vessels/dewars shall not be used.

Precautions shall be taken when approaching a leak as the product can ignite and produce a flame. Products such as hydrogen require specific care as the flame is invisible.

Care shall be taken in the choice of personnel clothing, to protect as much as is practicable against static charges and flames. Electrically conductive footwear shall be worn.

Fill/withdrawal connections shall be capped when not in use.

16.1.2 Electrical equipment

All equipment shall be in accordance with the requirements of the hazardous area classification.

In the classified area, personnel shall not be permitted to carry sources of flame, or non-approved electrical equipment. Consideration shall be given to all electric equipment, e.g. mobile phones and radio-transmitters.

16.1.3 Earthing system

All parts of the installation shall be bonded to ensure electrical continuity.

Major items of equipment such as the tank and vent stack shall be bonded directly to the earth point and not rely upon the piping as a means to earth.

Installations shall be earthed in accordance with national regulations. Consideration shall be given to the need for lightning protection.

For transferring processes between several installations or between static vessels and transportable vessels, equalizing of the electrical potentials is necessary.

The electrical equalization shall be made in a non-flammable environment.

16.2 Putting into service

Prior to filling, a vessel that is empty or depressurized shall be purged with an inert gas. Purging shall be continued until the gas within the vessel will not result in an explosive mixture forming during filling with the flammable fluid.

The purge gas shall be warm and dry in order to expel moisture from the vessel.

16.3 Location

Vessels shall not be stored underground or indoors for extended periods (i.e. overnight or weekends).

Vessels that are connected to product withdrawal systems should be located outdoors. However, they may be located indoors providing that the following requirements are met.

— The maximum quantity of flammable fluid within the vessel is less than 200 l, or between 200 l and 1 000 l providing the vessel is located in a room that has been specifically designed, for this purpose, e.g. one with ventilation control by gas monitoring devices.

— Where forced ventilation is provided, appropriate classified equipment shall be used.

— All pressure relief device and vent valve outlets shall be piped to a safe external venting point. The fire resistance of the materials in the vicinity of the vent discharge shall be considered.

— Gas detectors shall be fitted within the room, set to alarm when the gas concentration exceeds a critical limit. The alarm limit shall be set to a value not more than 25 % of the lower explosive limit.

For vessels which are located outdoors, safety distances are given in Annex A. For vessels which are located indoors, the entire room in which the vessel is located shall be considered a potentially hazardous area and be subject to individual assessment.

16.4 Transport

To prevent release of flammable gas during transport, the vessels should not be transported unless the expected duration of the journey is shorter than the pressure rise time from the vessel's pressure at the start of the journey to the pressure at which venting would start. All fill connection shall be capped.

Vessels shall not be transported in elevators or lifts.

Vessels shall not be transported in enclosed passenger or cargo compartments of vehicles.

16.5 Filling

Before starting the transfilling, the earthing conductor shall be connected, the integrity of the earthing systems shall be checked against obvious damage and the filling hose(s) purged free of air and impurities.

Filling shall only be undertaken outdoors.

16.6 Change of service

Vessels designed and used for flammable fluid service shall not be transferred to oxidizing, or inert gas service, without appropriate purging, cleaning, and design parameter verification.

16.7 Taking out service

The vessel shall be purged with inert gas by pressure swing purging until the flammable gas concentration in the inert gas is below 50 % of the lower explosive limit of flammable gas in the air.

16.8 Maintenance and repair

Where maintenance and repair work requires the vessels to be rendered inert, they shall be emptied using a safe procedure and purged with inert gas by pressure swing purging until the concentration of flammable gas in the inert gas is below 50 % of the lower explosive limit of the flammable gas in air.

17 Emergency equipment and procedures

Emergency procedures shall be prepared to cover fire or any other hazardous events, e.g. spills, which can occur. It is advisable that emergency procedures be prepared in conjunction with the emergency services and that local conditions be taken into consideration.

The procedure shall consider the following:

— properties of the cryogenic fluids;

— quantities involved;

— local topography;

— design of the vessel.

The procedure shall include the following:

— listing of emergency equipment required;

— nomination of back-up personnel/organisations for managing emergencies and procedures for contacting them both during and outside working hours;

— immediate self-help actions required (shut down, sounding alarms, evacuation from the area, summoning help, etc.).

The procedures shall be readily available to all personnel involved, regularly practised, and checked periodically to ensure that they are up to date.

As a minimum measure, fire-fighting equipment should consist of one suitable fire extinguisher for the surroundings. If water is used to keep equipment cool in the event of fire, it should not be sprayed near relief device vents, because of the potential danger of plugging vents with ice.

For emergency procedure, see ERI-Cards (Emergency Response Intervention Cards), TREMcards (TRansport EMergency cards), and MSDS (Material Safety Data Sheet) as applicable.

Annex A
(informative)

Safety distances

Safety distances are subject to each country's national regulations. The distances shown in Table A.1 are recommendations.

Table A.1 — Safety distances

Location	Safety distance		
	m		
	Type of exposure		
	Inert fluid	Oxidizing fluid	Flammable fluid
Site boundary, vehicle parking areas, public road/railway lines	1	2	5
Area where open flames, smoking, or sources of ignition are permitted	1	3	5
Stocks of combustible materials, e.g. timber, including wooden buildings and structures	1	3	3
Pits, ducts, surface water drains, openings of systems below ground level	1	3	3
Offices, canteens, and areas where employees/visitors are likely to congregate	3	5	5
Compressors/ventilator air intakes	1	5	5
Bulk flammable liquids and LPG storage	3	5	5

Bibliography

[1] ISO 21029-1, *Cryogenic vessels — Transportable vacuum insulated vessels of not more than 1 000 litres volume — Part 1: Design, fabrication, inspection and tests*

[2] Doc IGC 164/10, Safe handling of liquid carbon dioxide containers that have lost pressure

[3] CGA G-6.7, *Safe Handling of Liquid Carbon Dioxide Containers That Have Lost Pressure*

This page deliberately left blank

This page deliberately left blank

British Standards Institution (BSI)

BSI is the national body responsible for preparing British Standards and other standards-related publications, information and services.

BSI is incorporated by Royal Charter. British Standards and other standardization products are published by BSI Standards Limited.

About us

We bring together business, industry, government, consumers, innovators and others to shape their combined experience and expertise into standards -based solutions.

The knowledge embodied in our standards has been carefully assembled in a dependable format and refined through our open consultation process. Organizations of all sizes and across all sectors choose standards to help them achieve their goals.

Information on standards

We can provide you with the knowledge that your organization needs to succeed. Find out more about British Standards by visiting our website at bsigroup.com/standards or contacting our Customer Services team or Knowledge Centre.

Buying standards

You can buy and download PDF versions of BSI publications, including British and adopted European and international standards, through our website at bsigroup.com/shop, where hard copies can also be purchased.

If you need international and foreign standards from other Standards Development Organizations, hard copies can be ordered from our Customer Services team.

Subscriptions

Our range of subscription services are designed to make using standards easier for you. For further information on our subscription products go to bsigroup.com/subscriptions.

With **British Standards Online (BSOL)** you'll have instant access to over 55,000 British and adopted European and international standards from your desktop. It's available 24/7 and is refreshed daily so you'll always be up to date.

You can keep in touch with standards developments and receive substantial discounts on the purchase price of standards, both in single copy and subscription format, by becoming a **BSI Subscribing Member**.

PLUS is an updating service exclusive to BSI Subscribing Members. You will automatically receive the latest hard copy of your standards when they're revised or replaced.

To find out more about becoming a BSI Subscribing Member and the benefits of membership, please visit bsigroup.com/shop.

With a **Multi-User Network Licence (MUNL)** you are able to host standards publications on your intranet. Licences can cover as few or as many users as you wish. With updates supplied as soon as they're available, you can be sure your documentation is current. For further information, email bsmusales@bsigroup.com.

BSI Group Headquarters

389 Chiswick High Road London W4 4AL UK

Revisions

Our British Standards and other publications are updated by amendment or revision.

We continually improve the quality of our products and services to benefit your business. If you find an inaccuracy or ambiguity within a British Standard or other BSI publication please inform the Knowledge Centre.

Copyright

Useful Contacts:

Customer Services
Tel: +44 845 086 9001
Email (orders): orders@bsigroup.com
Email (enquiries): cservices@bsigroup.com

Subscriptions
Tel: +44 845 086 9001
Email: subscriptions@bsigroup.com

Knowledge Centre
Tel: +44 20 8996 7004
Email: knowledgecentre@bsigroup.com

Copyright & Licensing
Tel: +44 20 8996 7070
Email: copyright@bsigroup.com

bsi.

...making excellence a habit.™