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Cryogenic vessels — Cleanliness for cryogenic service

Récipients cryogéniques — Propreté en service cryogénique

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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.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

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 23208 was prepared by Technical Committee ISO/TC 220, *Cryogenic vessels*.

ISO 23208 is based on the European Standard EN 12300.

Cryogenic vessels — Cleanliness for cryogenic service

1 Scope

This International Standard specifies the minimum requirements for the cleanliness of all surfaces of cryogenic vessels and associated accessories that are in contact with the cryogenic fluid at any expected operating conditions.

This International Standard defines the acceptable level of surface and particle contamination to minimize the risk of malfunction of equipment and ensure safety against ignition when in contact with oxygen or oxidizing fluids (see ISO 10156-2).

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 10156-2, *Gas cylinders — Gases and gas mixtures — Part 2: Determination of oxidizing ability of toxic and corrosive gases and gas mixtures*[1)]

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

3 Terms and definitions

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

3.1
cryogenic fluid
gas which is partially liquid because of its low temperature

NOTE 1 Includes totally evaporated liquids and supercritical fluids.

NOTE 2 In the context of this International Standard, refrigerated but non-toxic gases and mixtures of them are referred to as cryogenic fluids.

NOTE 3 See also ISO 21029-1, ISO 20421-1 and/or ISO 21009-1.

3.2
oxidizing fluid
cryogenic fluid with oxidizing properties (in accordance with ISO 10156-2)

1) To be published.

4 Requirements

4.1 General requirements

Chips, foreign matter, and major potentially loose particles such as oxide scale and weld spatter are not acceptable.

Particles visible under daylight or white light without magnification are not acceptable. Depending upon the design of the system, more stringent requirements for particle size may be required to avoid malfunction of equipment.

Free water shall not be detectable by visual examination.

4.2 Additional requirements for oxygen and oxidizing fluids

For oxygen and oxidizing fluids, hydrocarbon contamination, paint, adhesives, sealants and protective coating shall not be detectable by visual examination using white light unless they are oxygen compatible in accordance with ISO 21010.

The maximum acceptable hydrocarbon contamination (oil, grease, etc.) is 500 mg/m^2.

5 Cleaning procedure

Any cleaning procedure may be used, providing the requirements of 4.1 and 4.2, if relevant, are met. If solvent or cleaning agents are used, they shall be compatible with all materials to be cleaned in particular plastics. Special care shall be taken to remove any non-oxygen-compatible agents (see ISO 21010) from equipment cleaned for oxygen or oxidizing fluid service.

6 Cleanliness evaluation

An inspection and sampling method shall be selected to ensure that the requirements of 4.1 and 4.2, if relevant, are met. It shall take into account the cleaning procedure to be used, the equipment to be cleaned and its level of contamination. Cleanliness evaluation methods may include those listed in Annex A.

The method of inspection shall not itself result in contamination levels greater than those specified in 4.1 and 4.2.

The cleanliness evaluation method shall be documented and the results obtained shall be recorded.

7 Post-cleaning protection

After cleaning, items shall be protected to maintain their clean condition until used. To reduce the risk of condensing any atmospheric moisture during storage, consideration shall be given to purging and sealing the equipment.

Any packaging, plugs, etc. that can contact the clean surfaces shall be clean and removable without leaving any residue. Any packaging material shall be strong enough to resist the expected handling and storage conditions and be able to be sealed and waterproof.

Any protective gas used shall be dry, and oil and dust free.

Any pressurizing gas shall be kept at low pressure compatible with the strength of the packaging and should not exceed 0,5 bar.

NOTE The pressurized package may fall under regulations for transportable pressure vessels.

8 Identification

Evidence of conformity with the requirements of this International Standard shall be documented by either

— a certificate accompanying the equipment/item; or

— a label fixed to the protective packaging or equipment/item.

The certificate or label shall indicate

— "ISO 23208-O_2" when cleaned for oxygen or oxidizing fluids;

— "ISO 23208" when cleaned for other cryogenic fluids only.

If a protective gas is used, the type of gas and its pressure shall be legibly indicated.

Annex A
(informative)

Inspection methods

A.1 General

Various methods exist for determining the cleanliness acceptance of equipment and it is necessary that the method selected complements the cleaning method used. This annex covers the most practical and effective methods available. It is necessary that competent persons with the necessary training and relevant industrial experience perform this inspection.

All parts being checked by solvent flushing or immersion should be able to drain freely to empty the solvent. If an area is identified which cannot freely drain, a method should be developed to remove completely the solvent without leaving contamination.

For parts that are inaccessible for inspection after assembly, it may be necessary to disassemble or inspect parts prior to assembly. Consideration should be given to any contamination which may occur during the assembly of inspected components.

If an inspection reveals the presence of any contaminants, the item should be partially or totally recleaned. Persistent rejection requires a re-evaluation of the cleaning methods and quality control provisions before re-acceptance.

A.2 Direct visual examination with daylight or white light

This is the most common inspection method used to detect the presence of contaminants on equipment with easily accessible surfaces. This method will without magnification detect very small particulate matter and moisture, oils, grease, etc. in relatively small amounts.

The effectiveness of this method is dependent on the roughness of the inspected surface. The method can be used for sandblasted or mechanically cleaned steel surfaces.

Magnifying glasses are not necessary, but it is important to have a sufficiently bright level of daylight or artificial white light.

Visual examination of the surfaces is appropriate for detecting

— moisture (free water);

— cleaning agents;

— flux residues from brazing, soldering or welding;

— rust and loose scale, weld spatters, particles, fibres or other foreign matter;

— organic material such as oil, grease and paint.

This direct visual examination method enables detection of the maximum acceptable hydrocarbon contamination level as specified in 4.2.

A.3 Direct visual examination method with ultraviolet light

Ultraviolet (UV) light causes many common, but not all, hydrocarbon or organic oils to fluoresce. A UV light with a wavelength of about 370 nm used in dark or near darkness at a distance of about 10 to 20 cm from the surface or piece being examined can show fluorescent areas for further inspection by other means such as wipe test. Fluorescent traces due to material residues known to be harmless are acceptable.

When considering a piece of equipment cleaned for use in oxygen service, it is important not to rely alone on the result of this test as, for example, some vegetable oils do not fluoresce under UV light. Therefore although this test can be useful, it is certainly not the most important inspection method and should be supported by white light and/or wipe tests.

NOTE Excessive exposure to direct or reflected UV light can cause eye and skin damage; therefore, care should be taken when it is being used and lamp manufacturers' instructions should be complied with.

A.4 Wipe test method

This test is useful when white light examination has been inconclusive.

The surface is rubbed lightly with a clean lint-free cotton or linen cloth or with a white filter paper.

This cloth or paper is examined under white light and/or UV light to find any contaminating traces. A light oxide discoloration is in some cases acceptable. Since it is not acceptable to leave paper or cloth particles on the equipment, this method is not recommended for rough or cast materials. In any case, for large surfaces it can only be used as a spot check.

A.5 Water break test

This test may be used to detect oily residues not found by other means. The surface is wetted with a spray of clean water. This should form a thin layer and remain unbroken for at least five seconds. Beading of the water droplets indicates the presence of hydrocarbon contaminants.

Any trace of water should be removed, see 4.1.

A.6 Solvent contamination test method

A.6.1 General

This inspection method is used to check the result of highly specialized methods of solvent cleaning when inaccessible surfaces or bigger installations have to be cleaned. For most small components it is easier and more economical to disassemble for inspection or to inspect before assembly. It should be taken into account that this method of cleaning and inspection is limited by the ability to reach and dissolve the contaminants if present. Local contamination in pockets of complex equipment may be detected using this method of inspection by getting successive slight but constant indications of contamination. Considerable experience is necessary to assess the results of this method.

The method of inspection is based on the comparison of used and unused solvent. The level of, or freedom from, contamination present during solvent cleaning can be closely followed by taking successive solvent samples during the entire cleaning process until inspection confirms that the acceptance International Standard is reached. Checking the amount of contaminants in a used sample is a good indication of the cleanliness level reached.

The amount of contaminants in a sample can be determined in three ways:

— mass of residue (laboratory test);

— volume of residue (laboratory test);

— light transmission.

A.6.2 Mass of residue

A known quantity (M_S) of a representative sample of unfiltered used solvent is contained in a small weighed beaker and is evaporated to dryness, being careful not to overheat the residue, and the mass (m_2) of the residue established. In the same manner, the mass (m_1) of residue from a similar quantity of clean unused solvent is determined. The difference in mass between the two residues and the quantity of representative sample used is related to the total quantity (M_V) of solvent used and is used to compute the amount of residual contaminant removed per square metre (m_C) of surface area A cleaned.

$$m_C = \frac{(m_2 - m_1)\, M_V / M_S}{A};$$

where

m_1 is the mass of residue (clean solvent), in mg;

m_2 is the mass of residue (used solvent), in mg;

M_S is the mass of representative sample (used solvent), in g or kg;

M_V is the total mass of solvent used (same units as for M_S);

A is the surface area of component cleaned, in m^2;

m_C is the mass of contamination present per area cleaned, in mg/m^2.

A.6.3 Volume of residue

A measured quantity of a sample of the unfiltered used solvent can be placed in a clear glass container and evaporated to dryness. The volume of residue can be measured directly and used to compute the volume of contaminant extracted per square metre of surface area cleaned. Greater sensitivity can be achieved by successive evaporation of quantities of the same extracted solvent batch in the same glass container.

A.6.4 Light transmission

A sample of the unfiltered used solvent is compared to a reference sample of unused solvent by comparing light transmission through the two samples simultaneously. The difference in colour or light absorption and in particle content of the solvents are a qualitative indication of the amount of contaminants dissolved. The quantity of any contaminants in a sample can be estimated by analysis techniques, e.g. making use of UV or infrared light.

Bibliography

[1] ISO 21009-1, *Cryogenic vessels — Static vacuum insulated vessels — Part 1: Design, fabrication, inspection and tests*[2)]

[2] ISO 21029-1, *Cryogenic vessels — Transportable vacuum insulated vessels of no more than 1 000 litres volume — Part 1: Design, fabrication, inspection and tests*

[3] ISO 20421-1, *Cryogenic vessels — Large transportable vacuum-insulated vessels — Part 1: Design, fabrication, inspection and tests*[2)]

2) To be published.

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