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Gas cylinders — Safe handling

Bouteilles à gaz — Sécurité de manutention

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Foreword

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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.

International Standard ISO 11625 was prepared by Technical Committee ISO/TC 58, *Gas cylinders*, Subcommittee SC 4, *Operational requirements for gas cylinders*.

Annex A of this International Standard is for information only.

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Introduction

The following guidelines are for the guidance of users, fillers or shippers of gas cylinders and are based upon experience. Some precautions are also applicable to gas manufacturers and distributors. It should not be assumed that every applicable safety precaution or regulation is contained herein.

Gas cylinders are constructed, maintained and used in accordance with applicable regulations and are safe for the purposes for which they are intended. Accidents occurring during the transportation, handling, usage and storage of these cylinders can generally be traced to failure to follow the guidelines set forth in this International Standard.

Users of compressed gases, permanent, liquefied or dissolved, should become familiar with the properties and inherent hazards of the products they use. Valuable information pertaining to each specific gas is contained within its product labelling and safety data sheet.

NOTE — Regulations and practice for LPG (Liquid Petroleum Gas) may differ in some small aspects from this International Standard. National regulations take precedence.

Gas cylinders — Safe handling

1 Scope

This International Standard specifies requirements for safe handling, use and storage of gas cylinders for permanent, liquefied or dissolved compressed gases. This standard applies to gas cylinder sizes from 0,5 l to 150 l water capacity.

2 Normative References

The following standards contain provisions which, through reference in this text, constitute provisions of this International Standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent editions of the standards listed below. Members of IEC and ISO maintain registers of currently valid International Standards.

ISO 32:1977, *Gas cylinders for medical use — Marking for identification of content.*

ISO 5145:1990, *Cylinder valve outlets for gases and gas mixtures — Selection and dimensioning*.

ISO 7225:1994, *Gas cylinders — Precautionary labels*.

ISO/TR 7470:1988, *Valve outlets for gas cylinders — List of provisions which are standardized or in use*.

ISO 10156:1996, *Gases and gas mixtures — Determine limitation of the fire potential and oxidizing ability for the selection of cylinder valve outlets*.

ISO 10286:1996, *Gas cylinders — Terminology*.

ISO 10298:1995, *Determination of the toxicity of gas or gas mixtures*.

ISO 10463:1993, *Cylinders for permanent gases — Inspection at time of filling*.

ISO 11113:1995, *Cylinders for liquefied gases (excluding acetylene and LPG) — Inspection at time of filling*.

ISO 11117:—[1)], *Gas cylinders — Valve protection caps and valve guards for industrial and medical gas cylinders — Design, construction and tests*.

ISO 11372:1995, *Cylinders for dissolved acetylene — Inspection at the time of filling.*

ISO 13338:1995, *Determination of the tissue corrosiveness of a gas or gas mixture*.

1) To be published.

3 Definitions

For the purposes of this International Standard, the following definitions, as well as those given in ISO 10286 apply.

3.1 gas manufacturer: Anyone who produces compressed gas and/or fills transportable gas cylinders.

3.2 handling: Moving, connecting or disconnecting a gas cylinder under normal conditions of use.

3.3 manifold: A gas distribution system which transfers product through multiple outlets/inlets from/to gas cylinders.

3.4 misuse: Utilizing a gas cylinder for a purpose other than that for which it was made, i.e., roller, support, etc.

3.5 transfilling: The transfer of compressed gas from one cylinder to another.

4 Gas cylinder filling

Gas cylinders are filled in accordance with the relevant national regulations and standards. ISO 10463, ISO 11113 and ISO 11372 cover inspection of gas cylinders at the time of filling.

5 Content identification

Cylinders offered for shipment shall have their contents identified as prescribed by relevant national and/or international regulations and standards. Content identification is applied before filling and identification shall be present during the transportation, delivery to user and during use.

The primary and only accurate identifier of cylinder content is the cylinder label. Cylinders may be painted (colour coded) by the gas supplier to permit recognition of the contents or hazard and to permit segregating them more readily in their handling operations. ISO 32 covers colour marking for medical gas cylinders.

The user shall verify by reading the label that the correct gas ordered by him has been supplied. Cylinders which do not bear a legible label to identify the content or bear more than one label in contradictory identification shall not be used. They shall be returned to the supplier unused. See ISO 7225.

6 Safe handling requirements

6.1 General

Gas cylinders shall be handled and used only by properly trained persons. The following rules apply to all gas cylinders.

6.2 User responsibilities

The user is responsible for the safe use of the cylinder and its contents and for returning the cylinder to the gas manufacturer or distributor in the same safe condition as it was received. The following precautions concerning the cylinder and its accessories shall be observed by the user.

6.2.1 Cylinder maintenance. Maintenance of the cylinder and its accessories shall be performed only by qualified persons authorized by the owner and as permitted by the national authorities.

6.2.2 Prescribed markings. The user shall not remove or alter any of the markings on the cylinder. Only the owner may remove or alter any of the markings on a cylinder.

6.2.3 Labels. The user shall not deface or remove the labels applied by the gas manufacturer to identify the cylinder contents. Users shall use only the cylinder label to identify contents. Users shall not repaint gas cylinders. The user shall not add markings or labels.

NOTE — Other means of product identification may be used by the gas manufacturer, such as indelible ink marking of gas mixture and analysis thereof.

6.2.4 Cylinder modifications. The user shall not modify, tamper with, obstruct, remove or repair any part of the cylinder, including the pressure relief device and the cylinder valve, other accessories or a retest ring, if any.

6.2.5 Contamination. Contamination can occur when foreign substances or fluids enter the cylinder through the valve. If this has happened, or is suspected, the user shall identify and clearly mark the cylinder and shall notify the gas supplier of details on the contamination.

6.2.6 Misuse. Gas cylinders shall not be used as rollers, supports or for any purpose other than to deliver the content received (see 3.4).

6.2.7 Electrical circuits. Cylinders SHALL NOT be placed where they become part of an electrical circuit. When gas cylinders are used in conjunction with electric welding, they shall not be earthed (grounded) or used for earthing (grounding). These precautions will prevent the cylinder from being arc burned.

6.2.8 Temperature limits. Gas cylinders SHALL NOT intentionally be exposed to temperatures above 65 °C. NEVER apply a flame or heat directly to any part of a gas cylinder or allow it to come in contact with an electrically energized system. If ice or snow accumulate on a cylinder or related accessories, thaw at room temperature, or with water at a temperature not exceeding 50 °C with permission of the supplier.

Cylinders shall not be subjected to artificially created low temperatures without the approval of the supplier. Cylinders are designed for use under ambient conditions, normally the temperatures for design are -20 °C to 50 °C.

Gas cylinders that have been exposed to fire shall not be shipped if they still contain compressed gas. Consult the gas manufacturer prior to returning such cylinders.

NOTE — Special care should be taken with aluminum cylinders, because elevated temperatures will alter mechanical properties.

6.2.9 Leaking cylinders. DO NOT USE A CYLINDER FOUND TO BE LEAKING. Move the cylinder out-of-doors to a well ventilated area and call the supplier for instructions.

NOTE — If the leaking cylinder contains corrosive, toxic or very toxic gas consider emergency action by placing in a special "coffin" container for disposal (see 7.15).

6.2.10 Corrosion damage. If a cylinder or valve is noticeably damaged or corroded, the gas supplier shall be notified and his instructions followed. Any other damage that might impair the safety of the cylinder during use or transportation shall be called to the attention of the gas supplier before the return of the cylinder.

6.2.11 Discharging gas. The discharge of contents from any gas cylinder shall not be directed toward any person. For corrosive, toxic or very toxic compressed gases such gases shall not be discharged directly to the atmosphere. The user shall return the cylinders containing these materials to the producer or distributor for proper disposal.

NOTE — Discharging gas can cause a variety of injuries to the body especially the eyes. In the event of a release, precautions should be taken to prevent potentially hazardous accumulations, e.g., toxic, asphyixant, inflammable, etc.

6.2.12 Non-refillable cylinders. Non-refillable cylinders shall not be refilled after use of original contents. After usage such cylinders shall be disposed of in accordance with the cylinder manufacturer's recommendations and national regulations.

6.2.13 Valve protection device. Cylinder valves shall normally be protected by a cap or a guard/shroud. The user shall keep caps on cylinders at all times except when cylinders are connected to dispensing equipment. Replace the cap before returning to the manufacturer. Valve guards/shrouds shall not be removed by the user. For complete description of valve protection devices see ISO 11117.

6.2.14 Valve outlet caps and/or plugs. Where valve outlet caps and/or plugs are provided by the cylinder manufacturer, the user shall keep the device on the valve outlet at all times except when cylinders are connected to dispensing equipment.

Gas tight valve outlet caps and plugs are required by regulations for some harmful gases. When the valve outlet cap/plug is supplied, it shall be tightened securely, immediately after use.

6.2.15 Handling of cylinder. Users shall not roll or drag cylinders in the horizontal position in order to move them. A suitable hand truck, forklift truck or similar material handling device shall be used with the cylinder securely held by the device, especially for large or heavy cylinders. Caution shall be used to guard against dropping or permitting cylinders to violently strike against each other or other surfaces.

Do not lift cylinders having a water capacity over 12 l by using the valve protection device or magnets. See ISO 11117.

Do not use ropes, chains or slings to suspend cylinders unless the manufacturer has installed appropriate lifting attachments such as lugs. Suitable cradles, platforms or pallets to hold the cylinders may be used for lifting.

NOTES

1 Some smaller cylinders are designed to have a carrying handle which also serves as the valve protection device. It is safe to carry such cylinders by such handles/shrouds.

2 It is recommended that personnel handling cylinders wear safety shoes, gloves and safety glasses.

6.2.16 Transfilling. The user shall not transfer gases from one cylinder to another cylinder, except where the system has been designed to safely permit transfill and with authorization of the owner of the receiving cylinder or gas supplier, and if the local authority allows it.

EXCEPTION: Never transfill acetylene from one cylinder into another cylinder.

7 Use of gas

The following rules apply when withdrawing content from gas cylinders.

7.1 Connecting cylinders and withdrawing content

Cylinder valve connections that do not fit shall not be forced. Threads on regulator connections or other auxiliary equipment shall match the cylinder valve outlet. The valve outlet connection should conform to a recognized standard. See ISO/TR 7470 and ISO 5145.

7.2 Cylinder Valve

— The cylinder valve shall be kept closed at all times (charged or empty) except when the cylinder is in use.
NOTE — For acetylene bundles, the cylinder valve many be opened during transport or storage.
— Valve outlets shall be pointed away from all personnel when the valve is being opened.
— Valves shall be closed during the shut-down procedures.
— The cylinder valve shall be opened slowly.

— Valves without hand wheels have wrenches (keys) provided and only those shall be used; that wrench (key) shall remain on the valve while the cylinder is in use.
— For valves with hand wheels: wrenches, hammers, or other tools shall not be used to open or close the valve.
— DO NOT APPLY EXCESSIVE FORCE TO OPERATE A CYLINDER VALVE.
— Torque wrenches designed for use with cylinder valves are acceptable, but shall be set to deliver only the recommended torque.
— Contact the gas manufacturer if the valve is difficult to operate. Never lubricate cylinder valves.
— Automatically operated valves shall be operated in accordance with instructions.

7.3 Non-return valves

Gas cylinders SHALL not be attached directly to a process where the cylinder may be contaminated by the backflow of other process material. Design of process equipment shall include the use of non-return valves and/or traps to prevent back-flow. Non-return valves and/or traps shall be checked and maintained on a regular schedule to ensure proper operation.

7.4 Flame arrestor

Acetylene cylinder manifolds shall be equipped with an appropriate flame arrestor.

7.5 Manifolds

Where gas cylinders are connected to a manifold, the manifold and its related equipment, such as regulators, non-return valves, etc. shall be of correct design for the product(s) they are to contain at the appropriate temperatures, pressures and flows, and properly tested for leakage and pressure rating.

7.6 Gas tight connections

Piping, regulators and other equipment shall be gas-tight to prevent leakage. This can be confirmed by the use of a compatible leak test solution, or an appropriate leak-detection instrument. Always leak test the cylinder connection when first installed.

Caution: Do not tighten connections or leaking fittings or attempt other repairs or servicing while the system is under pressure.

7.7 Residual cylinder pressure

The residual pressure of a gas cylinder shall not be reduced below the operating pressure of the system or below a minimum residual pressure in order to prevent the backflow of atmospheric air or other contaminants into the cylinder. The cylinder valve shall be closed to retain a residual pressure. The minimum residual pressure recommended ranges from 0,5 bar to 2 bar gauge.

7.8 Removing pressure regulator

Before a regulator is removed from a cylinder, the cylinder valve shall be closed and the regulator relieved of gas pressure.

7.9 Changing equipment service

Regulators, gauges, hoses and other equipment provided for use with a particular gas or group of gases, shall not be used on cylinders for gases having different chemical properties. Information can be obtained from the gas manufacturer concerning gas compatibility. As an example, only pressure regulating devices approved for use with oxygen shall be used in oxygen service.

7.10 Ventilation

Gas cylinders shall be used only in ventilated areas.

7.11 Securing cylinders

Where appropriate, all gas cylinders in service at locations shall be secured to prevent falling.

7.12 Cleaning for oxidizer service

It is important that equipment used for oxygen and nitrous oxide be cleaned with oxygen compatible materials free from oils, greases and other contaminants. Any material used in contact with highly oxidizing gases shall be suitable for this type of service. Valves, piping, fittings, regulators and other equipment used in oxygen service shall be of a material and pressure rating compatible with oxygen.

7.13 Oxygen concentration in work areas

The oxygen concentration in work areas, other than hyperbaric chambers, shall not exceed a volume fraction of 25 % (*V*/*V*). A detection and alarm system should be considered for detection of oxygen leakage or of concentration increase.

Where oxygen concentration is found to exceed 25 % and an uncontrolled leak is present, personnel shall be evacuated from the area immediately. Where clothing has become saturated with oxygen, personnel shall be removed from the oxygen source and from potential ignition sources and the clothing removed.

7.14 Suffocation by inert gases

Inert gases may cause suffocation by displacing the ambient oxygen necessary to sustain life. Self-contained breathing apparatus or airline masks shall be worn in areas containing an oxygen deficient atmosphere (less than 19,5 % oxygen). All gases except oxygen and compressed air are suffocating.

7.15 Hazards due to corrosive, toxic or very toxic gases

Some gases create additional hazards other than those of fire, asphyxiation or oxygen enrichment. Exposure to these gases may present serious hazards to unprotected personnel. Before using a corrosive, toxic or very toxic gas read the label and safety data sheet information associated with the specific gas. Personnel working in the immediate storage area where exposure to these gases could occur shall be instructed as to the hazards of the gases. Exposure to these gases shall be kept as low as possible but in no case should concentrations exceed the exposure levels established by national regulations.

7.16 Emergency precaution and required equipment

Personal protection equipment shall be made available to avoid contacting the skin or eyes or inhaling any of the corrosive, toxic or very toxic gases. Areas where corrosive gases are stored or used shall be equipped with emergency showers and eyewash fountains. The capability for prompt emergency medical treatment, including first aid, shall be provided.

Only trained and qualified personnel shall be allowed to handle, process or utilize corrosive and very toxic gases. Training shall include the associated hazards of the materials, necessary precautions, protective equipment and emergency response procedures.

8 Storage

Gas cylinders shall be stored according to hazard class. The following rules are for storage/handling of the gas cylinder.

8.1 Hazard class. Gases are classified based upon their chemical and physical hazards. Personnel using gases shall have a thorough knowledge of their properties in order to maintain a safe, controlled operation. Annex A of ISO 5145:1990 gives an example of classifications. In all cases follow national regulations.

8.1.1 Gases may represent a hazard because they are:

— flammable
— asphyxiant (inerts)
— highly oxidizing
— corrosive
— toxic
— very toxic
— under high pressure, e.g., greater than 100 bar

8.1.2 Some gases may combine several of the above hazards. For example, a cylinder of hydrogen gas combines high pressure with the flammable hazard; chlorine is at the same time very toxic, corrosive and highly oxidizing (see 8.1.1).

8.2 Storage areas

8.2.1 Storage areas shall be designed to accommodate the various gases required by the user. Adequate spacing or segregation by partitioning in accordance with applicable codes, shall be provided so that cylinders can be grouped together by the hazard class of the gas. Separate storage of full and empty cylinders should be provided. The area shall be dry, well-ventilated and preferably of fire-resistant construction. Storage area temperatures shall not exceed 65 °C. Storage in subsurface locations should be avoided. Users must ensure that there is adequate separation from combustibles as specified by national regulations. Cylinders shall not be stored near readily ignitable substances, such as petroleum products, or exposed to corrosive chemicals or fumes. Corrosion may damage the containers and may cause the container valve protection caps to stick.

8.2.2 The maximum quantity of gases to be stored is specified by various national regulations. Some regulations specify safe distances for storage in restricted areas.

8.2.3 Cylinder storage areas shall be posted with signs readily visible showing the hazard class or the name of the gases to be stored and with “NO SMOKING” signs where oxidizing or flammable gases are stored.

8.2.4 Cylinders shall be stored in protected areas to prevent chemical attack or other mechanical damage such as cuts or other abrasion on the surface of the cylinder. Cylinders shall not be stored in locations where heavy moving objects may strike or fall on them.

8.2.5 Cylinders are usually stored out of doors. However, to prevent corrosion, prolonged exposure to a damp or corrosive environment should be avoided. To reduce corrosion to the base, cylinders shall, where practical, be stored on paved surfaces, such as concrete or asphalt which has been sloped to prevent accumulation of water.

8.2.6 Cylinders, when stored, shall not obstruct exit routes or other areas normally used or intended for the safe exit of people.

8.2.7 Where appropriate, all gas cylinders in storage at user locations shall be secured to prevent falling.

8.3 Storage by hazard class

The following are recommended procedures meant to enhance safety for storage of various hazard classes.

8.3.1 Gas cylinders for flammable gases

Flammable gases shall not be stored near open flames, sources of heat, adjacent to oxidizers and non-explosion proof electric systems, or near unearthed electrical equipment.

— Fire extinguishers (of carbon dioxide or dry chemical types) shall be available for fire emergencies at storage installations.

— "NO SMOKING" signs shall be posted around the storage area of buildings or at entrance(s) to special storage rooms.

— A flame shall not be used for detection of flammable gas leaks; either a flammable-gas leak detector or compatible leak detection solution shall be used.

— Electrical equipment shall comply with the applicable electrical code, i.e., explosion proof, etc.

— Heating of storage areas shall be by steam, hot water or other indirect means. Direct heating by flames or fire shall be PROHIBITED.

— Storage areas, buildings and rooms shall be in compliance with applicable regulations.

— Showers should be installed in the vicinity of the cylinders in use.

— LPG cylinders shall not be stored underground.

NOTE — In the event of an emergency situation involving a flammable gas, whether a gas leak, fire or explosion, personnel should immediately evacuate the area. No attempt should be made to extinguish burning gas if the flow of product cannot be shut off immediately. Rescue or other emergency response activities should only be attempted by trained and qualified personnel.

In the specific case of acetylene, care shall be taken to protect oneself against possible cylinder explosion; then abundantly spraying at a distance any acetylene cylinder which has become hot either due to internal heating or through exposure to a fire. Evacuate personnel and only stop spraying if, after having ceased spraying for a few moments, the cylinder remains moist. Then immerse it for 24 h in water prior to transportation.

Facilities utilizing these gases in quantities exceeding the exempt amounts stipulated in applicable regulations shall have prepared an emergency response plan defining procedures and outlining responsibilities necessary to address emergency situations involving flammable gases.

8.3.2 Gas cylinders for highly oxidizing gases

Highly oxidizing gases, including oxygen, are nonflammable gases, but in the presence of an ignition source and a fuel, they can support and vigorously accelerate combustion. Common highly oxidizing gases include chlorine, fluorine and nitrous oxide. Materials which normally will not burn in air may burn in an oxygen-enriched atmosphere. Materials which do burn in air will burn more vigorously and at a higher temperature in an oxygen-enriched atmosphere. Oxygen is extremely reactive with organic materials such as oil grease or tar if ignited by flame, impact or some other energy source.

8.3.2.1 It is important that equipment used for oxygen and nitrous oxide be cleaned with oxygen-compatible materials free from oils, greases and other contaminants. Any material used in contact with highly oxidizing gases shall be suitable for this type of service. Valves, piping, fittings, regulators and other equipment used in oxygen service shall be of a material and pressure rating compatible with oxygen.

8.3.2.2 The oxygen concentration in work areas, other than in hyperbaric chambers, shall not exceed a volume fraction of 25 % (*V*/*V*). If it is suspected of exceeding 25 % proceed as follows: