INTERNATIONAL STANDARD

ISO 24431

First edition
2006-09-15

Gas cylinders — Cylinders for compressed and liquefied gases (excluding acetylene) — Inspection at time of filling

Bouteilles à gaz — Bouteilles à gaz comprimés et liquéfiés (à l'exception de l'acétylène) — Contrôle au moment du remplissage

Reference number
ISO 24431:2006(E)

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Published in Switzerland

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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 24431 was prepared by Technical Committee ISO/TC 58, *Gas cylinders*, Subcommittee SC 4, *Operational requirements for gas cylinders*.

This first edition of ISO 24431 cancels and replaces ISO 10463:1993 and ISO 11113:1995, of which it constitutes a technical revision.

Introduction

This International Standard covers requirements that reflect current practice and experience.

Each transportable gas cylinder is inspected at the time of filling in order to establish that:

— it has no defects which render it unsafe for filling or continued use;

— it can be identified and complies with the relevant requirements with regard to marking, labelling, colour coding and completeness of its accessories;

— its valve functions satisfactorily.

The cylinder filling inspection is carried out exclusively by persons who have the appropriate training and competences, so as to ensure that each cylinder is safe for continued use.

Gas cylinders — Cylinders for compressed and liquefied gases (excluding acetylene) — Inspection at time of filling

1 Scope

This International Standard specifies the inspection requirements at the time of filling, and applies to seamless or welded transportable gas cylinders made of steel or aluminium alloy for liquefied or compressed gases (excluding acetylene) of a water capacity of between 0,5 l and 150 l. It also applies to cylinders of less than 0,5 l water capacity, as far as practicable.

This International Standard does not apply to cylinders manifolded in bundles or trailers.

This International Standard applies primarily to industrial gases other than liquefied petroleum gas (LPG), but may also be applied to LPG. For specific LPG applications, refer to ISO 10691.

For cylinders manifolded in bundles, refer to ISO 11755.

NOTE In International Standards, weight is equivalent to a force, expressed in newtons, However, in common parlance (as used in terms defined in this International Standard), the word “weight” continues to be used to mean “mass”, although this practice is deprecated (see ISO 80000-4).

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 6406, *Gas cylinders — Seamless steel gas cylinders — Periodic inspection and testing*

ISO 10460, *Gas cylinders — Welded carbon-steel gas cylinders — Periodic inspection and testing*

ISO 10461, *Gas cylinders — Seamless aluminium-alloy gas cylinders — Periodic inspection and testing*

ISO 11114-1, *Transportable gas cylinders — Compatibility of cylinder and valve materials with gas contents — Part 1: Metallic materials*

ISO 11114-2, *Transportable gas cylinders — Compatibility of cylinder and valve materials with gas contents — Part 2: Non-metallic materials*

3 Terms and definitions

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

3.1
compressed gas
gas which when packaged under pressure for transport is entirely gaseous at −50 °C

NOTE This category includes all gases with a critical temperature less than or equal to −50 °C.

3.2
empty weight
empty mass
mass of the cylinder including all integral parts (e.g. neck ring, foot ring), but excluding the mass of valve, valve cap or valve guard and any coating

3.3
filler
person (or persons) responsible for inspection prior to, during and immediately after filling, who has received an appropriate level of training for the work involved and who has access to all necessary data for the cylinder, valve and all other fittings used

3.4
filling pressure
pressure to which a cylinder is filled at the time of filling

NOTE Filling pressure varies according to the gas temperature in the cylinder, which is dependent on the charging parameters and ambient conditions.

3.5
filling ratio
ratio of the mass of gas to the mass of water at 15 °C that would fill completely a pressure receptacle fitted ready for use

3.6
liquefied gas
gas which, when packaged under pressure for transport, is partially liquid at temperatures above −50 °C

NOTE A distinction is made between:

— high pressure liquefied gas, a gas with a critical temperature between −50 °C and +65 °C, and

— low pressure liquefied gas, a gas with a critical temperature above +65 °C.

3.7
maximum permissible filling weight
maximum permissible filling mass
product of the water capacity of the cylinder and the **filling ratio** (3.5) of the gas

3.8
pallet
device for handling several cylinders at the same time

3.9
pressure relief device
device fitted to the cylinder or its valve, which is designed to open to prevent a rise of pressure in excess of a specified value, due to excess temperature and/or pressure

3.10
tare
sum of the **empty weight** (3.2) plus the mass of the valve, including dip tube where fitted, any fixed valve guard and all other parts that are permanently attached (e.g. by clamping or bolted fixing) to the cylinder when presented for filling

3.11
total weight
total mass
tare (3.10) of the cylinder plus the **maximum permissible filling weight** (3.7)

3.12
working pressure
settled pressure of a **compressed gas** (3.1) at a reference temperature of 15 °C in a pressure receptacle

4 Filling inspection

Each cylinder shall be subjected to an inspection prior to, during and immediately after filling. The following items shall be covered by a filling inspection:

a) verification of serviceable condition (see 5.1),

b) identification of cylinder owner, if required (see 5.2),

c) for cylinders filled by weight, verification of tare and calculation of weight of gas to be charged (see 5.3),

d) verification of internal cylinder condition (see 5.4),

e) verification of integrity of neck ring/threaded boss (see 5.5),

f) verification of valve integrity and suitability (see 5.6),

g) verification of correct filling pressure as applicable (see 5.7),

h) verification of correct filling weight as applicable (see 5.8), and

i) verification of the valve protection (see 5.9).

Cylinders which do not satisfy the criteria listed above shall be handled in accordance with the relevant procedures of the filling company before any further action is taken.

5 Description of inspection items

5.1 Verification of serviceable condition

5.1.1 General criteria

Before filling a cylinder, it shall be established that:

a) the cylinder has not exceeded its due date for periodic inspection and testing,

b) the cylinder is compatible with the intended gas content and filling pressure,

c) the cylinder is permitted for filling in the country of the filling station,

d) the intended gas contents correspond to any identification label and shoulder or body colour on the cylinder (e.g. through verification of the cylinder's markings or by questioning the owner of the cylinder), and

e) each cylinder, whether individual or palletized, is in a serviceable condition.

Cylinders judged to be unserviceable shall be clearly marked and separated for further treatment, in accordance with the written procedures of the filling company.

5.1.2 Individual cylinder

Before a cylinder is filled it shall be established that the external surface of the cylinder is clean and free of foreign material (i.e. such that the cylinder can be assessed for mechanical damage that would prevent it from being filled safely) and that it does not exhibit any abnormalities that could render it unsafe, such as arc burns, bulging, severe corrosion, heat/fire damage or significant mechanical damage. In case of doubt, rejection criteria described in ISO 6406, ISO 10461 or ISO 10460, as appropriate, shall be applied.

Cylinders exhibiting evidence of excessive corrosion or rusting shall not be filled until properly evacuated, cleaned and evaluated, in accordance with the rejection criteria described in ISO 6406, ISO 10461 or ISO 10460, and painted.

5.1.3 Palletized cylinder

A filler may only submit a pallet for filling without unloading the cylinders if an internal, written procedure is respected by the filling company and its representatives which ensures that only cylinders in a serviceable condition are collected in a pallet (see 5.1.2).

5.2 Identification of cylinder owner

If required, before filling, the identity of the cylinder's owner shall be established and authorization obtained from him to fill the cylinder.

5.3 Verification of tare and calculation of weight of gas to be charged

The validity of the tare shall be checked for cylinders that will be filled by weight.

The validity of the tare does not need to be checked if special valves are used that prevent ingress of contamination (e.g. non-return/positive pressure valves), or if it can be guaranteed by appropriate checks at the time of filling that no liquid or other detrimental contamination exists in the cylinder.

If the above conditions cannot be met, the validity of the tare shall be verified at the start of the filling process, when the cylinder is placed on the filling scale. The tare stamped on the cylinder shall be verified by the actual scale weight readings within the tolerances given in Table 1.

Cylinders to be filled by weight shall not be filled until the correct tare is determined and stamped onto the cylinder. The tare shall be deemed incorrect if it is not stamped on the cylinders or if there are doubts about their validity.

EXAMPLE Doubts about validity can be raised by illegible stamp markings, a suspected change (or absence) of guard, a suspected change of valve, etc.

Annex A provides an example of a procedure to establish a correct tare.

However, when a tare needs to be altered, a diagonal line shall be drawn through the obsolete tare, if present, in such a way that it remains legible for future reference. If more than one obsolete tare exists, only the original tare (with a diagonal line drawn through it) shall be retained for reference alongside the new tare. The other obsolete tare(s) shall be removed from the cylinder, whilst taking care not to damage its integrity.

Only a clean, empty cylinder, with one paint coat and valve, shall be weighed accurately, as shown in Table 1. The cylinder shall be empty of all product prior to weighing.

The amount of liquefied gas charged into a cylinder shall be determined by weight or, if charged at a pressure lower than the vapour pressure, by pressure shown on a vapour pressure/temperature chart for the specific gas. The weight of gas to be charged into a cylinder shall be determined from the water capacity and the filling ratio for the specific gas, or by the maximum permissible filling weight, if indicated.

Table 1 — Maximum permissible deviation in tare

Cylinder water capacity (V) l	**Maximum permissible deviation in tare** g
$0{,}5 \leqslant V < 5{,}0$	$\pm$ 50
$5{,}0 \leqslant V \leqslant 20$	$\pm$ 200
$V > 20$	$\pm$ 400

5.4 Verification of internal cylinder condition

In the case of liquid ingress for some gas/cylinder material combinations, internal corrosion can occur (see ISO 11114-1). For such gases (e.g. CO mixtures, CO_2 mixtures), filling stations shall follow a written procedure based on experience and dependent on service conditions.

Cylinders without special valves to prevent ingress of contamination (e.g. non-return/positive pressure valves), or cylinders where there is a risk of internal corrosion of the cylinder material, are checked for liquid ingress when there are doubts about their internal condition.

This check shall be carried out by means of a residual pressure check, by check weighing, by moisture analysis or by another method that can confirm the presence of liquid contamination.

If liquid is detected, or whenever the valve is removed, a visual internal inspection shall be performed by a competent person, in accordance with ISO 6406, ISO 10461 or ISO 10460, as appropriate.

5.5 Verification of the integrity of permanent attachments

Before filling a cylinder, it shall be established whether the neck ring/threaded boss and guard (if fitted) are fit for the intended purposes, and whether the neck ring, if one exists, is securely affixed to the cylinder. If there is a permanent valve guard or a welded-on shroud, this shall be checked to ensure that it is properly attached. Similarly, the integrity of the foot ring, if fitted, shall be checked to ensure that it is fit for its intended purpose.

5.6 Verification of valve integrity and suitability

5.6.1 Prior to each fill, it shall be established whether the installed valve is suitable for the intended gas, in accordance with ISO 11114-1 or ISO 11114-2, as appropriate, and whether it is in a satisfactory condition. As a minimum, it shall be established that:

a) the valve is easy to operate,

b) the valve is free from contaminants,

c) the handwheel, or key-operated spindle, is operable,

d) the safety device (e.g. pressure-relief device or residual-pressure device), if present, is undamaged,

e) the outlet thread and body are undamaged, and

f) the valve attaches correctly to the filling connector.

5.6.2 During the filling cycle of a cylinder, the filler shall determine that:

a) the valve is not blocked (see Annex B) and that the operation is progressing satisfactorily (e.g. by checking the increase in weight), and

b) the valve does not leak in the open position (e.g. by means of a gas-compatible leak test fluid).

If leakage is suspected, the bonnet or the gland nut should be checked.

5.6.3 After filling a cylinder, the filler shall ensure that the valve and the pressure relief device do not leak when the valve is closed and disconnected from the filling connection. If leakage is suspected, check for seat leakage at the valve outlet. In addition, the interface between the valve and the cylinder shall be checked to ensure that it is leak-tight. For welded cylinders, attention shall be paid to the welds to ensure that the cylinder is free from leaks.

5.7 Check for correct filling pressure

For cylinders filled by pressure, the filler shall ensure that the filling pressure is consistent with the intended working pressure. Finally, the cylinder shall be checked to ensure that it is correctly identified and labelled.

5.8 Check for correct filling weight

For cylinders filled by weight, the weight shall be checked immediately after disconnection from the filling line, by means of a scale capable of determining the weight of gas in the cylinder, within the tolerances shown in Table 1, according to the cylinder water capacity. The weight of the full cylinder shall not exceed the total weight allowed for that cylinder and gas combination.

Finally, the cylinder shall be checked to ensure that it is correctly identified and labelled.

5.9 Check of the valve protection

If a valve guard or valve cap is fitted prior to dispatch, a check shall be made of the guard or cap-fitting connection.

Annex A
(informative)

Example of a procedure to establish a correct tare

A correct tare may be determined by proceeding as follows.

a) If the cylinder is valved, perform all necessary purges and evacuations in order to de-valve safely.

b) Remove the valve (see Annex B).

c) Visually check the interior and exterior of the cylinder for corrosion, the exterior for excess paint, and the interior for contamination or build-up. If necessary, clean (e.g. by means of shotblast) and requalify.

NOTE Evidence of excess corrosion indicates that periodic inspection and testing is required.

d) Weigh cylinder on a calibrated scale:

   1) place on the scale the empty cylinder, together with the intended valve, including dip tube (where fitted), any fixed-valve guard and all other parts that are permanently attached to the cylinder (e.g. by clamping or bolted fixing), and weigh;

   2) From this reading, establish the correct tare for the cylinder, valve and any permanently-attached parts.

e) Stamp onto the cylinder the tare, in kilograms, expressed to three significant figures rounded down to the last digit (see ISO 13769).

Annex B
(informative)

Procedures to be adopted when de-valving and/or when it is suspected that a cylinder valve is obstructed

B.1 Check for obstructed valve

The following procedures should be carried out exclusively by trained personnel. In view of the potential hazards in cylinders, this operation can lead to injury from stored energy release, fire and toxic hazards. Personnel shall therefore take such precautions as deemed necessary for the work to be performed. When the gas, if any, has been released and the pressure within the cylinder reduced to atmospheric pressure - and, in the case of liquefied gases, when there is no frost or dew on the outside of the cylinder - the valve may be removed after an additional check has been made to establish that there is free passage through the valve.

As indicated in 5.6, a systematic check shall be made to establish that the passage through the valve is unobstructed. The method adopted should be a recognized procedure, such as one of the following, or one that provides equivalent safeguards. The check can be carried out:

— by introducing gas, non-reactive to the gas stored in the cylinder, at a pressure up to 5 bar (0,5 MPa) and by checking its discharge;

— by using the device shown in Figure B.1 to hand-pump air into the cylinder;

— for a cylinder of liquefied gases, by first verifying that the total weight of the cylinder is the same as the tare stamped on the cylinder: if there is a positive difference, the cylinder may contain either liquefied gas under pressure or contaminants;

NOTE The absence of a positive difference does not rule out the possibility of the presence of a gas under pressure.

— for a valve incorporating a residual pressure device (see ISO 15996), by using a specific adapter to release the remaining pressure, and by verifying the absence of pressure by means of one of the methods described previously.

B.2 Valve unobstructed

Only when it is established that there is no obstruction to gas flow in the cylinder valve may the valve be removed. Personal protection during de-valving shall be assessed.

B.3 Valve obstructed

B.3.1 The following methods are applicable for cylinders of non-toxic, non-flammable and non-chlorofluorocarbon (non-CFC) gases. Appropriate safety precautions should be taken to ensure that no hazard results from the uncontrolled discharge of any residual gas. When a cylinder is found to have an obstructed gas passage in the valve, the cylinder shall be set aside and handled by personnel specially trained in this task, by one of the two following methods.

a) Saw or drill the valve body until interception is made with the gas passage between the valve body stem and valve spindle seat. The operation shall be properly cooled, particularly when handling oxidizing gases.

b) Loosen or pierce the pressure relief device in a controlled manner.

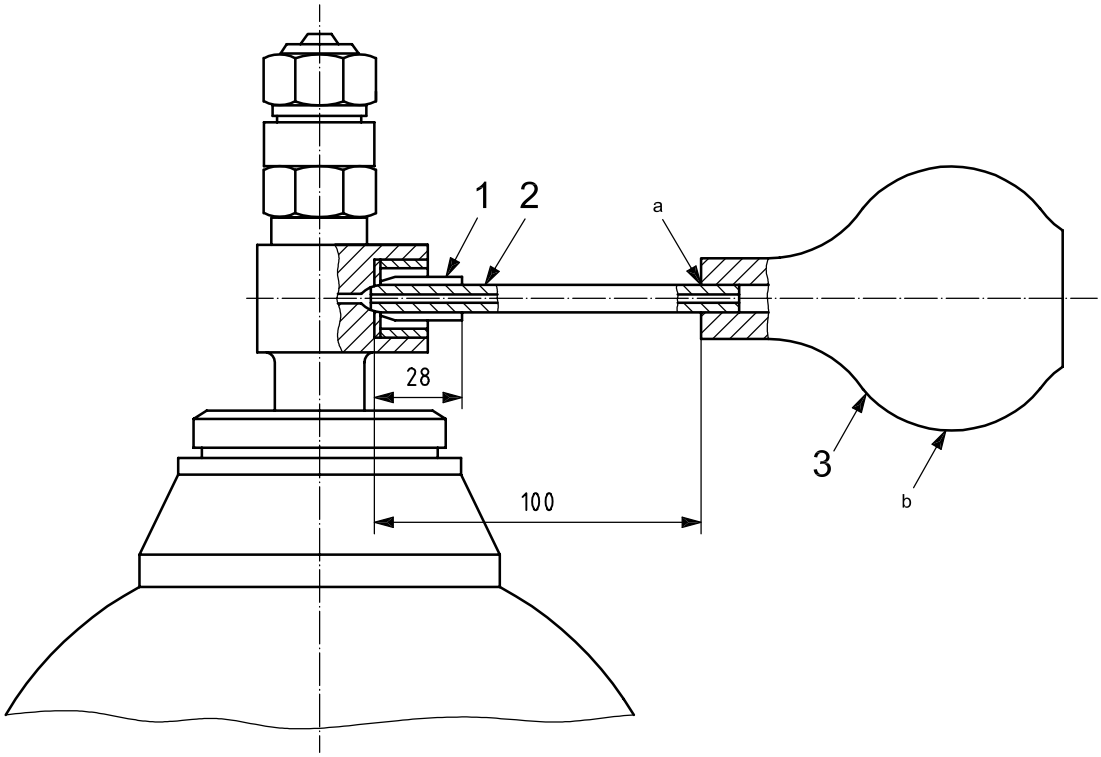
B.3.2 The following methods are applicable to cylinders of toxic, flammable, air-reactive, water-reactive, oxidizing and CFC gases. After release, containment and subsequent disposal shall be carried out safely and without impact to the environment by one of the three following methods.

a) Partially unscrew the valve within a glanded cap, secured and joined to the cylinder and vented to a safe discharge point (an example of a suitable device is illustrated in Figure B.2). This procedure shall be performed in a controlled manner, in such a way as to avoid personal injury.

b) Mechanically remove the valve in an enclosed, automatic device that contains the release of gas and release of energy.

c) Place the cylinder in a suitable container to contain the release of gas and release of energy, and crush or puncture the cylinder to release the material and pressure.

Dimensions in millimetres

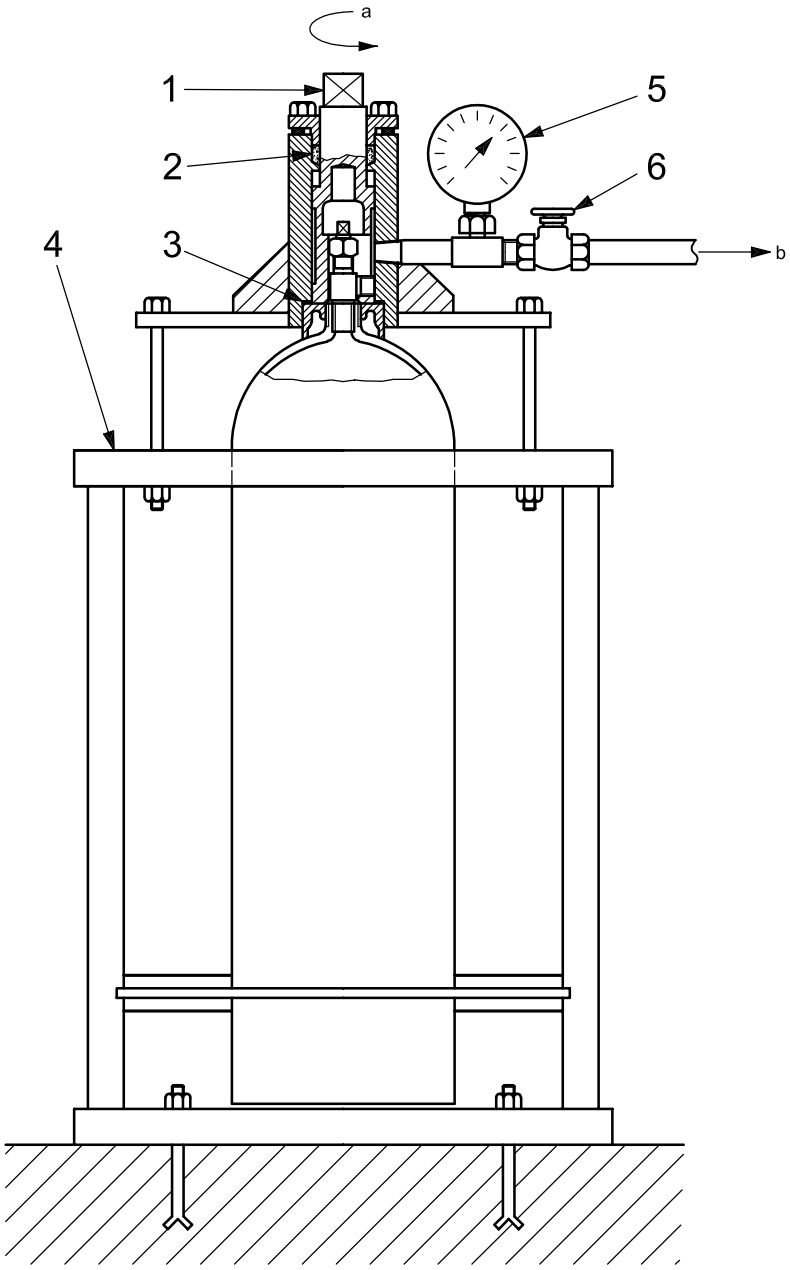


Key

1 rubber tube (internal diameter 8 mm, external diameter 13 mm) ground to olive shape and bonded
2 tube (internal diameter 3 mm, external diameter 8 mm)
3 rubber bulb

a Bonded.
b Hand pressure.

Figure B.1 — Typical device for detecting obstructed cylinder valve



Key

1 drive for de-valving machine
2 gas-tight gland
3 gas-tight seal
4 cylinder frame and clamping device
5 pressure gauge
6 vent valve

a Direction of rotation.
b To gas disposal.

Figure B.2 — Typical device for the removal of an obstructed gas cylinder valve

Bibliography

[1] ISO 32, *Gas cylinders — Colour coding*

[2] ISO 7225, *Gas cylinders — Precautionary labels*

[3] ISO 10691, *Gas cylinders — Refillable welded steel cylinders for liquefied petroleum gas (LPG) — Procedures for checking before, during and after filling*

[4] ISO 11755, *Gas cylinders — Cylinder bundles for compressed and liquefied gases (excluding acetylene) — Inspection at time of filling*

[5] ISO 13769, *Gas cylinders — Stamp marking*

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[7] ISO 80000-4, *Quantities and units — Part 4: Mechanics*

[8] EN 1919, *Transportable gas cylinders — Cylinders for liquefied gases (excluding acetylene and LPG) — Inspection at time of filling*

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