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Gas cylinders — Seamless, welded and composite cylinders for compressed and liquefied gases (excluding acetylene) — Inspection at time of filling (ISO 24431:2016)

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National foreword

This British Standard is the UK implementation of EN ISO 24431:2016. It supersedes BS ISO 24431:2006 which is withdrawn.

The UK participation in its preparation was entrusted to Technical Committee PVE/3/7, Gas containers - Gas cylinder (receptacle) operations.

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.

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Gas cylinders - Seamless, welded and composite cylinders for compressed and liquefied gases (excluding acetylene) - Inspection at time of filling (ISO 24431:2016)

Bouteilles à gaz - Bouteilles à gaz comprimés et liquéfiés (à l'exception de l'acétylène) sans soudure, soudées et composites - Contrôle au moment du remplissage (ISO 24431:2016)

Gasflaschen - Nahtlose, geschweißte und Composite-Flaschen für verdichtete und verflüssigte Gase (ausgenommen Acetylen) - Inspektion zum Zeitpunkt des Füllens (ISO 24431:2016)

This European Standard was approved by CEN on 13 September 2016.

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 24431:2016) has been prepared by Technical Committee ISO/TC 58 “Gas cylinders” in collaboration with Technical Committee CEN/TC 23 “Transportable gas cylinders” the secretariat of which is held by BSI.

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of an identical text or by endorsement, at the latest by May 2017, and conflicting national standards shall be withdrawn at the latest by May 2017.

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 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 24431:2016 has been approved by CEN as EN ISO 24431:2016 without any modification.

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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.

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 World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT) see the following URL: www.iso.org/iso/foreword.html.

The committee responsible for this document is ISO/TC 58, *Gas cylinders*, Subcommittee SC 4, *Operational requirements for gas cylinders*.

This second edition cancels and replaces the first edition (ISO 24431:2006), which has been technically revised with the following changes.

— This edition has been restructured and includes additional provisions for the inspection before, during and after filling of composite cylinders (Types 2 to 5 inclusive).

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 (e.g. within test period, labelling, colour coding and completeness of its accessories), and

— its valve functions satisfactorily.

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

Guidance and requirements provided in this International Standard allow fillers to determine when cylinders should be rejected for filling. This International Standard is intended to be used as a basis for developing specific operating procedures for a filling operation.

CAUTION — Some of the tests specified in this International Standard involve the use of processes which could lead to a hazardous situation.

This International Standard is intended to be used under a variety of national regulatory regimes, but has been written so that it is suitable for the application of the UN Model Regulations.[1] Attention is drawn to requirements in the relevant national regulations of the country (countries) where the cylinders are intended to be used that might override the requirements given in this International Standard. Where there is any conflict between this International Standard and any applicable regulation, the regulation always takes precedence.

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).

Gas cylinders — Seamless, welded and composite 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 (Type 1), and for composite transportable gas cylinders (Types 2 to 5 inclusive) for liquefied or compressed gases of a water capacity up to 150 l. It may be applicable to cylinders and tubes with a water capacity between 150 l and 450 l, provided they are inspected and filled as individual cylinders and tubes.

This International Standard does not apply to acetylene cylinders, bundles of cylinders, tubes, multiple-element gas container (MEGCs) or battery vehicles.

This International Standard may also be applicable to LPG. For specific LPG applications, refer to ISO 10691.

For cylinders manifolded in bundles, refer to ISO 11755.

2 Normative references

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

ISO 7225, *Gas cylinders — Precautionary labels*

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 11623, *Gas cylinders — Composite construction — Periodic inspection and testing*

ISO 13769, *Gas cylinders — Stamp marking*

ISO 25760, *Gas cylinders — Operational procedures for the safe removal of valves from gas cylinders*

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 1 to entry: This category includes all gases with a critical temperature less than or equal to –50 °C.

3.2
covering
protective or non-protective, transparent or non-transparent, device or attachment that can interfere with an external visual inspection

3.3
cylinder marking
permanent and durable information on the cylinder required by the relevant design standard and/or ISO 13769 and the regulations in the country(ies) of use

3.4
empty weight
mass of the cylinder including all permanent attachments (e.g. neckring, footring), but excluding the mass of valve, valve cap or valve guard and any coating

Note 1 to entry: See Introduction for terminology regarding weight and mass.

3.5
examination
process having the object of determining a condition by judgement

Note 1 to entry: The examination results in a pass or fail or further measurement, testing or gauging.

[SOURCE: ISO 10286:2015]

3.6
fibre
continuous filament of glass, aramid, carbon or other material

3.7
filler
person (or persons) responsible for *inspection* (3.10) prior to, during and immediately after filling, who has received an appropriate level of training for the work involved

3.8
filling pressure
pressure to which a cylinder is filled at the time of filling

Note 1 to entry: Filling pressure varies according to the gas temperature in the cylinder, which is dependent on the charging parameters and ambient conditions. It is normally higher than the *working pressure* (3.27) (because of the heat of compression) and always less than the test pressure.

3.9
filling ratio
ratio of the mass of gas to the mass of water at 15 °C that would fill completely a cylinder fitted ready for use

Note 1 to entry: Synonyms are filling factor and filling degree, often expressed in kg/l or similar.

[SOURCE: ISO 10286:2015]

3.10
inspection
evaluation of conformity by observation and judgment accompanied as appropriate by measurement, *examination* (3.5), testing or gauging

[SOURCE: ISO 10286:2015]

3.11
liner
inner portion of the composite cylinder comprising a metallic or non-metallic vessel, whose purpose is to both contain the gas and transmit the gas pressure to the composite overwrap

3.12
liquefied gas
gas which, when packaged under pressure, is partially liquid at temperatures above –50 °C

Note 1 to entry: 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.

3.13
maximum permissible filling weight
maximum permissible filling mass
maximum mass of gas in kg which is allowed in a filled cylinder

Note 1 to entry: This term applies to *liquefied gas* (3.12).

3.14
pallet
device for handling several cylinders at the same time

3.15
pressure relief device
device that protects the cylinder against overpressurization

Note 1 to entry: This is a collective term that includes a bursting disk, fusible plug or pressure relief valve.

3.16
protective attachments
component (or components) connected to the cylinder that prevents or resists damage to the cylinder and/or valve

Note 1 to entry: Some protective attachments are designed to be removed at the time of requalification or prefill *inspection* (3.10).

3.17
service life
number of years a cylinder is permitted to be in service

Note 1 to entry: Usually applied to composite designs, and when required, the service life is marked in accordance with an applicable standard or regulation (e.g. “FINAL 2019/10” in ISO 13769).

3.18
sleeve
thin *covering* (3.2) fitted to the outside surface of the cylinder such as by stretching or heat shrinking

Note 1 to entry: Some sleeves are designed to be removed at the time of prefill *inspection* (3.10).

3.19
rejected cylinder
cylinder not fit for filling in its present condition

3.20
tare
weight of the cylinder when empty, including accessories fitted and coatings as presented for filling

3.21
total weight
total mass
tare (3.20) of the cylinder plus the *maximum permissible filling weight* (3.13)

3.22
Type 1 cylinder
all metal cylinder

3.23
Type 2 cylinder
hoop wrapped cylinder with a load sharing metal *liner* (3.11) and composite reinforcement only on the cylindrical (sidewall) part

3.24
Type 3 cylinder
fully wrapped cylinder with a load sharing metal *liner* (3.11) and composite reinforcement on both the cylindrical part and dome ends

3.25
Type 4 cylinder
fully wrapped cylinder with a non-load sharing *liner* (3.11) and composite reinforcement on both the cylindrical portion and the dome ends

[SOURCE: ISO 11119-3:2013]

3.26
Type 5 cylinder
fully wrapped cylinder without a *liner* (3.11) and with composite reinforcement on both the cylindrical portion and dome ends

[SOURCE: ISO 11119-3:2013]

3.27
working pressure
settled pressure of a *compressed gas* (3.1) at a reference temperature of 15 °C in a full gas cylinder

Note 1 to entry: In North America, service pressure is often used to indicate a similar condition, usually at 21,1 °C (70 °F).

Note 2 to entry: In East Asia, service pressure is often used to indicate a similar condition.

3.28
verification
confirmation, by *examination* (3.5) of objective evidence, that specified requirements have been fulfilled

[SOURCE: ISO 10286:2015]

4 Identification of cylinder owner

Some country's regulations and filling organizations require verification of ownership of the cylinder before filling and forbid to fill cylinders that are not owned by the filling organization except if the owner has authorized filling.

The filler may request technical information from the cylinder owner to verify that the cylinder is safe to fill.

In all cases, if the owner cannot be identified, or if the owner or owner's representative does not authorize the filling of the cylinder, the cylinder shall not be accepted for filling.

5 Filling inspection

5.1 General

Each cylinder shall be inspected by the filler before, during and immediately after filling, as indicated in this Clause.

5.2 Verification of serviceable condition of individual cylinders before filling

5.2.1 General criteria

The filler shall establish that

a) the information required for filling (e.g. next requalification date, filling pressure, gas identification) is present on the cylinder,

b) the cylinder and/or valve are not on a prohibited fill list,

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

d) the cylinder has not exceeded its service life (if applicable),

e) the cylinder and valve (such as valve outlet, material of construction and specification) are compatible with the intended gas content and the condition (pressure or weight as applicable) to which the cylinder is to be filled,

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

g) the cylinder has not been subject to unauthorized modifications, and

h) the intended gas contents correspond to any identification label and shoulder or body colour on the cylinder through verification of the cylinder's markings and the colour coding (e.g. by reference to ISO 7225 and ISO 32) or by questioning the owner of the cylinder.

NOTE Not all countries require standardized colours.

Cylinders not meeting these criteria shall be rejected for filling and handled in accordance with Clause 6.

5.2.2 Exterior condition

5.2.2.1 General requirements

Before an individual cylinder can be filled, the filler shall establish that

a) the cylinder does not show any signs of having undergone any unauthorized modifications, such as but not limited to, welding of attachments to the cylinder or additional stamp markings,

b) the external surface of the cylinder is clean and free of foreign material (i.e. such that the cylinder can be assessed for physical damage that would prevent it from being filled safely). Possible variations to this are those cylinders fitted with a covering or protective attachment, in which case, the requirements of 5.2.6 shall first be considered, and

c) the cylinder is free from abnormalities as described in ISO 6406, ISO 10460, ISO 10461 or ISO 11623. Typical abnormalities include, but are not limited to

   — arc burns,

   — bulging,

   — cracks,

— dents,

— deep cuts,

— gouges,

— severe corrosion,

— unauthorized stamp markings,

— heat/fire damage (e.g. discoloration of coating, charred or burnt paint and/or labelling, melted or distorted plastic valve handwheel or other attachments), or

— mechanical damage.

In addition, cylinders of composite design (Types 2 to 5) shall include an inspection of the composite material for these abnormalities, as well as those described in 5.2.2.2. In particular, composite cylinders with coverings that exhibit exterior impact damage shall be handled in accordance with 5.2.6.

Cylinders not meeting these criteria shall be rejected for filling and handled in accordance with Clause 6. In case of doubt or obvious abnormalities, the cylinder shall be rejected for filling and handled in accordance with Clause 6.

5.2.2.2 Additional provisions for composite cylinders (Types 2 to 5)

5.2.2.2.1 Composite overwrap

Composite cylinders can exhibit unique damage of their composite overwrap and thus shall be inspected for the following.

a) **Abrasion damage**. Abrasion damage is caused by wearing, grinding or rubbing away by friction of the overwrap material. “Flat spots” evident on the surface could indicate excessive loss of composite overwrap thickness.

b) **Damage from cuts**. Cuts or gouges are caused by contact with sharp objects in such a way as to cut into the composite overwrap, reducing its thickness at that point.

c) **Impact damage**. Impact damage can appear as hairline cracks in the resin, or delamination or cuts of the composite overwrap. The resin can have a frosted or smashed appearance.

d) **Delamination**. Delamination is a separation of layers of strands, or of the strands themselves, of the composite overwrap. It also can appear as a whitish patch, like a blister or an air space beneath the surface.

e) **Heat or fire damage**. Heat or fire damage can be evident by discolouration, charring, loss of resin or burning of the composite overwrap, labels, paint or non-metallic components of the valve.

f) **Chemical attack**. Chemical attack would appear as the dissolution of the resin matrix surrounding the fibres. The resulting cylinder surface can be pitted, feel soft/sticky, discoloured, etc.

When it is suspected that a composite cylinder has undergone a chemical attack, care should be taken in handling the cylinder to ensure protection of personnel.

Rejection criteria shall be established for composite cylinders in a written procedure of the filling station or the rejection criteria given in ISO 11623 shall be followed. The rejection criteria established by the filling station shall be based on those in ISO 11623.

5.2.2.2.2 Metallic liner external corrosion

Under certain conditions, some metallic liners (or metallic end bosses) can corrode externally under the composite material. Such corrosion can appear as brownish, reddish or white discoloration or blistering.

Cylinders with metallic liners that show evidence of corrosion or are suspected to be corroded shall be rejected for filling and handled in accordance with Clause 6.

5.2.2.2.3 Neck inspection for Types 3, 4 and 5 cylinders

The necks of Types 3, 4 and 5 cylinders shall be inspected for deformation and damage.

Type 4 and Type 5 cylinders have a metallic boss attached to the liner (Type 4) or a metallic boss attached to the composite material (Types 4 and 5). Inspect the boss for looseness, signs of deformation, misalignment and damage.

Cylinders with any evidence of neck or boss damage, deformation, looseness or misalignment shall be rejected for filling and handled in accordance with Clause 6.

5.2.3 Interior condition

Before filling, the presence of liquid that could have caused internal corrosion shall be established. The presence of liquid can be established, for example, by

— verification of residual pressure (see Annex A for guidance),

— verification of weight,

— performing a moisture analysis,

— inverting the cylinder with the valve open,

— performing a hammer test on Type 1 steel cylinders, or

— any other method that can verify the presence of liquid.

Ingress of liquid combined with particular gas/cylinder material combinations (e.g. CO or CO_2 mixtures and steel) can cause corrosion and/or damage to the cylinder's internal surface. See also ISO 11114-1 and ISO 11114-2 for additional examples of gas interactions with cylinder materials.

Filling stations shall develop and comply with a written procedure to address liquid ingress.

A visual internal inspection of the cylinder shall be performed if liquid is detected or whenever the valve is removed.

The requirements of ISO 25760 shall be followed to remove the valve.

WARNING — Failing to follow ISO 25760 requirements can cause loss of life, injury and/or property damage.

5.2.4 Cylinder tare

5.2.4.1 General

Only a clean cylinder empty of product and including its accessories fitted and coatings as presented for filling shall be weighed, as shown in Table 1.

When a tare is required for filling, the cylinders shall not be filled until the correct tare is determined and marked on the cylinder. The tare shall be deemed incorrect if it is not marked on the cylinder or if there are doubts about its validity. Doubts about validity can be raised by an illegible stamp marking, a suspected change (or absence) of guard, a suspected change of valve, etc.

5.2.4.2 Verification

The validity of the tare shall be verified for cylinders that are required by regulation to be filled by weight. Care shall be taken not to confuse tare weight with empty weight.

The validity of the tare does not need to be verified if

— special valves are used that prevent ingress of contamination (e.g. non-return/positive pressure valves), provided it has been verified that the special valve is functioning as intended,

— LPG cylinders are fitted with special valves that prevent overfilling, or

— it can be guaranteed by appropriate verifications (e.g. inversion of cylinder) at the time of filling that no liquid or other detrimental contamination exists in the cylinder.

If these conditions cannot be met, the validity of the tare shall be verified at the start of the filling process, when the fully depressurized cylinder is placed on the filling scale. The tare marked on the cylinder shall be verified by the scale weight reading within the tolerances given in Table 1.

The tare of the cylinders shall be obtained using a scale that is regularly calibrated (e.g. every year) and checked (e.g. every day) for accuracy. The capacity of the scale shall be suitable for the weight of the cylinder. The scale shall allow a determination of the tare to three significant figures.

Table 1 — Maximum difference between scale weight reading to marked tare weight

Cylinder water capacity (V) l	**Maximum weight deviation** g
$0{,}5 \leq V < 1{,}0$[a]	±25
$1{,}0 \leq V < 5{,}0$	±50
$5{,}0 \leq V \leq 20$	±200
$V > 20$	±400
[a] For cylinders with less than 0,5 l of water capacity, the maximum weight deviation should be reduced to a value less than 25 g.	

5.2.4.3 Alteration

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, while taking care not to damage its integrity.

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

5.2.5 Calculation of weight of gas to be filled into the cylinder

The amount of liquefied gas filled into a cylinder shall be determined by weight or, if filled 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 filled 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.

5.2.6 Provisions for visually inspecting cylinders fitted with coverings

Many cylinders, especially those of composite construction, are fitted with coverings such as

— sleeves,

— casings,

— netting,

— decals and labels that have been applied during service,

— footring,

— shroud, or

— shock absorbers.

Prior to carrying out a visual inspection, clean the covering, if necessary, using a suitable cleaning agent and:

a) If the covering is transparent and allows the filler to make a direct visual inspection, a visual external inspection may be performed without removing the covering.

b) If the covering is opaque or translucent or interferes with a direct visual inspection, procedures shall be provided to either evaluate the surface condition without removing the covering or to remove the covering if so permitted. This procedure shall define which coverings shall be removed and provide directions to evaluate cylinders when the cover cannot be removed. The procedure shall be based on manufacturer instructions regarding the removal of the cover.

Some coverings are an integral part of the cylinder design and shall not be removed. In these cases, the cylinder manufacturer shall provide the rejection criteria of these cylinders for filling and the rejection criteria shall be specified in the inspection procedures. In cases of doubt, these cylinders shall be rejected for filling.

5.2.7 Verification of the integrity of permanent attachments

Before filling a cylinder, the filler shall establish whether the neckring/threaded boss and guard (if fitted) are fit for the intended purposes, and whether the neckring, if one exists, is securely affixed to the cylinder. If there is a permanent valve guard or a welded-on shroud, it shall be checked to ensure that it is securely attached. Similarly, the integrity of the footring, if fitted, shall be verified to ensure that it is fit for its intended purpose. If the condition is in doubt or known to render the cylinder unsafe for service, reject the cylinder.

5.2.8 Verification of valve integrity and suitability

The filler shall establish that the valve and the valve outlet connection comply with the intended gas service and that the valve is suitable for the intended filling pressure.

As a minimum, the filler shall establish that the valve is undamaged by verifying that:

a) the valve is free from contaminants and signs of leakage;

b) the valve shows no signs of looseness as installed in the cylinder;

c) the handwheel or operating mechanism functions as intended;

CAUTION — If this action involves opening the valve, then precautions shall be taken. This operation could lead to the release of gases under pressure that are harmful to the operator and/or the environment. Hazards include toxicity, flammability, oxidizing potential, asphyxiation and reaction forces due to high pressure gas release. Consequently, this process shall follow a written procedure that has considered the potential hazards.

d) the pressure relief device, if required, is present, undamaged and suitable for the intended gas service;

e) the residual pressure device, if present, is undamaged and the cylinder has residual pressure;

f) for valves fitted with a dedicated filling port, that the filling port thread is undamaged;

g) the outlet thread and body are undamaged; and

h) the valve attaches correctly to the filling connector.

If any of these conditions are not met, the cylinder shall be rejected for filling and handled in accordance with Clause 6.

5.2.9 Provisions for palletized cylinders

Palletized cylinders may only be filled without unloading the cylinders from the pallet if written procedures that ensure that these cylinders have been inspected individually in accordance with 5.2 are in place.

5.2.10 Rejected cylinders

Those cylinders found to be in a doubtful or unserviceable condition or are found unsuitable shall be rejected for filling. These cylinders shall be identified and handled in accordance with Clause 6.

5.3 Verification during filling

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

a) the operation is progressing satisfactorily (e.g. by verifying that the filling pressure is increasing and that either the cylinder's weight or its temperature is increasing as appropriate), and

b) the valve does not leak when connected and in the open position (e.g. by means of a leak test fluid compatible with the gas service, the cylinder and the valve).

If the filling process is not proceeding satisfactorily, the filling should be stopped and investigated and rectifications made. Factors that can cause the filling process not to proceed satisfactorily include blockage in the fill system, a valve malfunction or human error. This can result into a case where one cylinder out of a filling charge remains unfilled. If this is detected during or at the end of the filling process, then the opening of the valve of the unfilled cylinder can lead to adiabatic compression and subsequent flash fire (oxygen) or rupture (other gases).

NOTE For valves with additional features, such as integrated regulation of pressure, further verifications might be required at the time of filling.

Special attention is drawn to the fast filling of high pressure composite cylinders (Types 3, 4 and 5) as the composite material used in the manufacture of the cylinders is a good insulator and so the heat generated in the filling process takes longer to dissipate than with traditional metal cylinders. Consequently, a Type 3, 4 or 5 cylinder filled to normal filling pressure, particularly if filled quickly, can reach excessive temperatures during filling, which could lead to damage to the plastic liner. Cylinder manufacturer's recommendations should be followed.

5.4 Verification after filling

5.4.1 General

The filler shall ensure that valve plugs and other ancillaries are fitted as required.

5.4.2 Verification of gas tightness

The filler shall ensure that the cylinder's valve and pressure relief device do not leak when the valve is closed and disconnected from the fill connection. If leakage is suspected, verify for seat leakage at the valve outlet. In addition, the interface between the valve and the cylinder shall be inspected to ensure that there is no leakage.

For welded cylinders, attention shall be paid to the welds to ensure that the cylinder is free from leaks.

For Type 4 and Type 5 composite cylinders, the filler shall also ensure that the cylinder is free from leaks at the boss-composite interface and around the dome of the cylinder.

5.4.3 Verification of correct filling pressure

For cylinders filled with compressed gas, the filler shall ensure that the filled pressure is consistent with the intended working pressure according to the reference temperature.

If the filled pressure is not correct, it shall be rectified.

5.4.4 Verification of correct filling weight

For liquefied gases, the filling weight shall be verified after disconnecting from the fill connection to ensure that the cylinder is not overfilled.

For compressed gases filled by weight, a verification of the filling pressure shall be carried out in accordance with 5.4.3.

NOTE There are gases such as boron trifluoride, silane and silicon tetrafluoride that, although defined as liquefied, are completely gaseous at normal fill or transport temperatures. Some competent authorities consider them non-liquefied compressed gases.

If the cylinder is under- or overfilled, it shall be rectified.

5.4.5 Verification of valve protection

If valve protection is fitted prior to dispatch, it shall be verified that the protection device is securely affixed to the cylinder and not damaged or deformed in such a manner that affects its integrity.

5.4.6 Verification of correct product labelling

The cylinder shall be checked to ensure that it is labelled in accordance with the applicable requirements for the product contained in the cylinder. In the absence of regulatory requirements, cylinders shall be labelled in accordance with ISO 7225.

6 Cylinders rejected for filling

Cylinders rejected for filling shall be clearly identified as having been rejected and shall not be filled.

These cylinders shall be handled in accordance with the relevant procedures of the filling station. These procedures shall include at least one of the following:

— sending the cylinders to an inspection facility for further evaluation;

— repairing the cylinders by qualified personnel;

— returning the cylinders to the owner.

If it is not possible to recover a rejected cylinder, it shall be condemned by rendering it unserviceable as described in and in accordance with the relevant periodic inspection and testing standards.

Annex A
(informative)

Residual pressure check

A.1 General

A residual pressure check may be carried out using the following procedure.

CAUTION — Carrying out residual pressure checks could lead to the release of gases under pressure that are harmful to the operator and/or the environment. These hazards include toxicity, flammability, oxidizing potential, asphyxiation and reaction forces due to high pressure gas release. Consequently, this process shall follow a written procedure that has considered the potential hazards.

A.2 Pressure check with gas emitted

Open the cylinder valve to check for residual pressure. If gas is emitted, the cylinder may be filled.

A.3 Pressure check with no gas emitted

A.3.1 General

Open the cylinder valve to check for residual pressure. If no gas is emitted, the following steps shall be taken.

A.3.2 Case 1 — Valves fitted with a residual pressure device

The functioning of the residual pressure device shall be verified. This could require the use of a special tool.

If the check shows that the residual pressure device has retained pressure, the cylinder may be filled.

If the check shows that the residual pressure device has not retained pressure, the internal condition of the cylinder shall be checked for contamination.

— If no contamination is detected, the cylinder may be filled following repair or replacement of the residual pressure device if necessary.

— If contamination is detected, corrective action shall be carried out prior to filling.

A.3.3 Case 2 — Valve without residual pressure function

The internal condition of the cylinder shall be checked for contamination.

— If no contamination is detected, the cylinder may be filled.

— If contamination is detected, a corrective action shall be carried out prior to filling.

Annex B
(informative)

Example of a procedure to establish a correct tare

A correct tare may be determined by using the following procedure.

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

b) Remove the valve (see ISO 25760).

c) Visually inspect the interior and exterior of the cylinder for corrosion, the exterior for excess paint and the interior for contamination. If necessary, clean (e.g. for Type 1 cylinders, by means of shotblast). If excessive corrosion has been observed, the cylinder shall be subjected to a full periodic inspection and test before returned to service.

d) Weigh cylinder on a calibrated scale.

    1) Place on the scale the empty cylinder with all required paint and or coatings 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) Obliterate the old tare weight.

    1) For cylinders with a stamped tare weight, this shall be carried out by stamping a diagonal line through the old tare.

    2) For cylinders where the tare weight is indicated on a label under the composite, the old tare weight shall be covered with a new label instead of being stamped out.

f) Mark the new tare weight.

    1) For cylinders with a stamped tare weight, the new tare shall be expressed in kg to three significant figures rounded down to the last digit (see ISO 13769).

    2) For cylinders where the tare weight is indicated on a label, the new tare shall be marked on a label and the label affixed to the cylinder by a durable means.

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