

INTERNATIONAL STANDARD

ISO
11621

First edition
1997-04-15

Gas cylinders — Procedures for change of gas service

iTeh STANDARD PREVIEW

Bouteilles à gaz — Mode opératoire pour le changement de service de gaz
(standards.iteh.ai)

ISO 11621:1997

<https://standards.iteh.ai/catalog/standards/sist/635291af-87ef-4bcc-a0cb-4933db147da6/iso-11621-1997>



Reference number
ISO 11621:1997(E)

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.

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 11621 was prepared by Technical Committee ISO/TC 58, *Gas cylinders*, Subcommittee SC 4, *Operational requirements for gas cylinders*.

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Annex A of this International Standard is for information only.

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Printed in Switzerland

Introduction

It is occasionally desirable to change gas cylinders from one gas service to another. Certain of these service changes can be made quite easily, while others require a careful inspection of the interior and exterior of the cylinder to detect the presence of corrosion products or contaminants, which must be removed for safety reasons or to avoid undesirable contamination of the contained gas.

This International Standard has been prepared to assist those engaged in the filling of gas cylinders for changing cylinders from one gas service to another.

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Gas cylinders — Procedures for change of gas service

1 Scope

This International Standard applies to seamless steel, aluminium alloy and welded steel refillable cylinders of all sizes, including large cylinders (water capacity greater than 150 l).

It provides general requirements and procedures to be considered whenever a cylinder is being transferred from one gas service to another for permanent and liquefied gases.

It does not apply to cylinders for dissolved acetylene, radioactive gases or gases listed in group G of table 1.

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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 indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

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

ISO 6406:1992, *Periodic inspection and testing of seamless steel gas cylinders*.

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

ISO 10460:1993, *Welded carbon steel gas cylinders — Periodic inspection and testing*.

ISO 10461:1993, *Seamless aluminium-alloy gas cylinders — Periodic inspection and testing*.

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

1) To be published.

3 Abbreviations

NDT = Non-destructive testing.

SCT = Stress corrosion testing.

4 General requirements

Cylinders are manufactured in accordance with international and/or national standards and are intended for use with a variety of gases under specified filling conditions. Although some cylinders are restricted to specific gas services, the majority of cylinders can be transferred from one gas service to another, provided applicable regulations are observed and appropriate procedures are followed and material compatibilities are considered (see ISO 11114-1).

Cylinders which have been in service may have been exposed to conditions that render them unsafe during, or when transferred to, a different gas service. These conditions could result in contamination, corrosion or residual gases that may react. Therefore, it is essential that all procedures detailed in clause 5 and displayed in tables 1, 2 and 3 be carefully followed.

Particular attention shall be directed to assuring that purging or cleaning procedures, where specified, remove all residual gas, contaminants or corrosion products and that cleaning agents are removed and cylinders dried and sealed to prevent entry of dirt or moisture after cleaning.

Persons using this International Standard shall be knowledgeable in the handling of compressed gases and be familiar with the chemical and physical properties of the commodities which they charge into cylinders and of the contaminants which are likely to be found therein.

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4.1 Grouping of gases

For the purposes of this International Standard, the gases for which cylinder transfers are most frequently desired have been separated into several groups. This separation has taken into consideration the chemical and physical reactivity of the gases and of the contaminants which are most frequently encountered.

The requirements in this International Standard may not be applicable to gases or mixtures which are not included in the gas groups given in table 3. Recommendations for the cleaning of cylinders which have contained such gases shall be obtained from the manufacturer of the cylinder and/or gas. The values quoted in table 1 for the FTSC code are taken from ISO 5145 or ISO 10156.

4.2 Gases which may affect cylinder condition

Cylinders which have been in certain gas services may be subjected to conditions which could affect the future serviceability of the cylinder or render it unsuitable for use in any other gas service. Cylinders in such services are subject to rigid requalification procedures or may be prohibited from use in other gas services. Examples are:

steel cylinders in carbon monoxide/carbon monoxide mixture service which may be subject to stress corrosion cracking;

steel cylinders which have been in hydrogen service but which were not designed and manufactured for this gas (see ISO 11114-1).

5 Actions for change of service

5.1 General

Because of the potential safety problems (e.g. corrosion, contamination, compatibility), specific actions are required when transferring a cylinder from one gas service to another. The steps (set of actions), denoted by a number, are

listed in table 3. Table 2 shows in tabular form all the steps to be taken for each transfer. It is important that each step be taken. The gas groups are shown by name and letter in table 1. The actions given in table 3 are described in detail in 5.3.1 to 5.3.10 inclusive.

5.2 Use of tables 1, 2 and 3

EXAMPLE 1

A nitrogen cylinder is to be transferred to hydrogen service. Determine the gas groups from table 1 (nitrogen = A; hydrogen = E). Using table 2, find A in the left-hand column and proceed across the table to column E where you will find the numbers 1, 4, 6. Go to table 3, which shows what actions are required by steps 1, 4 and 6 (for details, see 5.3.1, 5.3.4 and 5.3.6).

EXAMPLE 2

An oxygen cylinder is to be transferred to 50 % oxygen and 50 % nitrous oxide. Determine the gas groups from table 1 (oxygen and nitrous oxide = C). Using table 2, find C in the left-hand column and proceed across the table to column C where you will find the number 1. Go to table 3, which shows what actions are required by step 1 (for details, see 5.3.1).

Table 1 — Gas groups for change of service

Group	Description	Gases
A	Inert ¹⁾	Nitrogen, argon, helium, neon, krypton, xenon and all gases and gas mixtures having FTSC code 01X ²⁾ 0 (but excluding gases in group B).
B	Inert/active ³⁾	Carbon dioxide, carbon dioxide mixtures and oxygen mixtures containing less than 21% oxygen having FTSC code 01X0 or 11X0.
C	Oxidizing	Oxygen, nitrous oxide, air and mixtures containing at least 21 % oxygen or more than 60 % nitrous oxide having FTSC code 41X0.
D	Flammable	Ethylene, methane, cyclopropane, other hydrocarbons, liquefied petroleum gases, etc., and all gases and gas mixtures having FTSC code 21X0 (but excluding flammable gases of groups E and F).
E	Embrittling	Hydrogen and all non-toxic gases of group 2 of ISO 11114-1 having FTSC code 21X0.
F	SCC ⁴⁾	Carbon monoxide and carbon monoxide mixtures.
G	Toxic Corrosive Pyrophoric	Very toxic (X3XX), toxic (X2XX), corrosive (XXXY ⁵⁾) and pyrophoric (3XXX) gases (but excluding group F). CAUTION — Some of these gases are also embrittling (see ISO 11114-1).

1) Inert in terms of fire potential (see ISO 10156).
 2) X equals any digit.
 3) Inert in terms of fire potential, but corrosive in presence of moisture.
 4) Stress corrosion cracking.
 5) Y ≠ 0

Table 2 — Actions to be taken when transferring cylinders from one gas service to another

From ↓	To →	A Inert	B Inert/active	C Oxidizing	D Flammable	E Embrittling	F Carbon monoxide	G Toxic, etc.
A	Inert	1	1, 2	1, 3	1	1, 4, 6	1, 5	1, 4, 3
B	Inert/active	1, 7	1	1, 3	1, 7	1, 4, 6, 7	1, 5, 7	1, 3, 4, 6
C	Oxidizing	1, 7	1	1	1, 8, 7	1, 4, 6, 7, 8	1, 5, 7, 8	1, 3, 4, 7, 8
D	Flammable	1, 8	1, 8	1, 8, 3	1, 8*	1, 4, 6, 8*	1, 5, 8*	1, 4, 5, 8
E	Embrittling	1, 8*, 9	1, 8, 9	1, 3, 8, 9	1, 8, 9	1, 6, 8*, 9	1, 5, 8, 9	1, 3, 4, 8, 9
F	Carbon monoxide	1, 8, 10	1, 8, 10	1, 8, 3, 10	1, 8, 10	1, 6, 8, 10	1, 5, 8*, 10	1, 3, 4, 8, 10
G	Toxic, etc.	Not covered by this International Standard. Only to be performed under tightly controlled conditions using special procedures.						

Table 3 — List of actions for change of gas service

Step No.	Action
1	<p>External examination and preparation:</p> <p>Verify contents/identification</p> <p>Cylinder external surface</p> <p>Valve outlet and operation</p> <p>Check working pressure/specification</p> <p>Ownership</p> <p>Test date — retest if required resulting from change of service</p> <p>Reduce pressure (blow down) to atmospheric pressure using appropriate discharge</p> <p>Remove all existing labels, stencils, etc., after cylinder has been emptied</p> <p>Re-mark with service markings: label, paint, stamp, etc. (after gas has been removed from the cylinder)</p> <p>If the valve is removed do an internal visual inspection</p>
2	Check for moisture contamination
3	Internal inspection for liquid and/or hydrocarbons. If suspected, clean for oxygen service
4	Check materials compatibility in accordance with ISO 11114-1
5	Check moisture level for steel cylinders. Use moisture requirements of ISO 11114-1
6	Check for internal surface defects
7	Check for internal corrosion
8	Cylinder content evacuation
8*	Pull vacuum or purge (only if valve is removed)
9	Check previous service against ISO 11114-1. If not compatible, perform appropriate NDT and hydrotest
10	If suspected that cylinder has been exposed to water, perform appropriate NDT and hydrotest

5.3 Details of actions for change of service

The following gives details and/or explanations of the actions listed in table 3.

5.3.1 External examination and preparation (step 1)

This step is required for each cylinder transferred to any other gas service. Each action listed in this subclause shall be taken for each cylinder. Prior to the following actions, the cylinder contents (gas or gas group) shall be verified to determine actions required from table 2. The actions below do not necessarily have to be performed in the order indicated. At all times, safety considerations shall be observed.

- Carry out an external visual inspection of the cylinder and valve to verify suitability for service. For guidance, see ISO 6406, ISO 10460 and ISO 10461. Note that external contamination of the cylinder and especially the valve may indicate internal contamination.
- Check that the cylinder is equipped with a valve having an outlet connection conforming to ISO 5145 or national standards for the new service. If not, see table 2 to determine if step 8 or step 8* is required, before replacing the valve. Also, check that the valve operates satisfactorily.
- Determine that the pressure relief device, if present, is of an approved type for the intended gas and the working/test pressure of the cylinder.
- Check the working pressure/cylinder design specification and applicable regulations to verify that the cylinder is satisfactory and authorized for the new gas service.
- Check the cylinder ownership to verify that the owner has authorized the transfer to another gas service.
- Check the test date and determine whether or not it is within the specified test frequency for the old and new gas service. Retest, if necessary.
- Reduce the pressure (blow down) to atmospheric pressure using appropriate equipment and discharge to be safe and meet environmental requirements.
- Remove all means of identification concerning the former gas content, such as labels, colour coding and other relevant identification. Stamp markings of the former gas content shall be either removed or crossed out.
- Identify for the new gas service: this includes painting, labelling, stencilling and possibly stamp marking of the cylinder.
- If a valve is removed for any reason, the opportunity should be taken to perform an internal visual inspection. The valve may not require replacement for transfers within the same gas group, but a valve may be replaced because of damage or improper operation. An internal inspection shall always observe for defects, corrosion and contamination. Only acceptable cylinders shall be kept in service. Contaminated cylinders may be cleaned (see annex A). Internal inspection of cylinders having contained oxidizing gases can be performed without evacuation provided that a safety lamp is used. However, evacuation/purging shall be carried out prior to probing or working on the interior surface.

5.3.2 Check for moisture contamination (step 2)

When step 2 is required, it is not mandatory that the valve be removed. The point of concern is the presence of moisture in the cylinder. The absence of liquid water and other aqueous substances can be verified either by a visual examination or by a moisture test for dew point. If visual internal inspection is used, a dry surface appearance is acceptable proof of satisfactory condition. If liquid is found, the cylinder shall be dried, and/or washed and dried, prior to transfer. This step is not required for aluminium-alloy and stainless-steel gas cylinders, other than for gas quality reasons.

5.3.3 Internal inspection for liquid and/or hydrocarbons (step 3)

Before any cylinder is transferred into oxygen or oxidizing-gas service, the valve shall be removed and the cylinder given a visual internal inspection for any evidence of a liquid or a hydrocarbon. Liquids may show as pools on the cylinder bottom or as droplets on the wall. Hydrocarbons may show as liquids or by an oily appearance. If either condition is observed or if there are any other doubts when the internal inspection is being made, the cylinder shall be cleaned for oxygen service (see annex A). After this cleaning, the internal inspection shall be repeated to ensure that the observed contamination and the cleaning solution have been removed.

5.3.4 Check for materials compatibility (step 4)

When step 4 is required, determine that all materials which will come in contact with the intended gas, including the cylinder, internal lining (if present), valve components, pressure relief devices, thread compounds and valve lubricants, are compatible with the intended gas under normal conditions of storage, transportation and use (see ISO 11114-1).

5.3.5 Check of moisture level (step 5)

This step is intended to be more demanding than step 2. When step 5 is required, it shall be verified that each cylinder being transferred is sufficiently dry so that liquid water will not form within the cylinder at the pressure/temperature ranges of use. This shall be verified by a moisture test for dew point. The presence of excessive moisture can be rectified by drying the cylinder. For acceptable moisture levels, see ISO 11114-1. This step is not required for aluminium-alloy and stainless-steel cylinders.

5.3.6 Check for internal surface defects (step 6)

When step 6 is required, it shall be verified that the inside surface is free of surface defects such as laminations, laps, cuts, gouges or cracks. Certain defects can be detected by visual inspection. However, detection of cracks and small defects requires an NDT (non-destructive testing) test such as an angle-beam ultrasonic test or acoustic-emission test. Cylinders exhibiting an unacceptable level of defects shall be removed from service. For rejection criteria, see ISO 6406, ISO 10460 and ISO 10461. [ISO 11621:1997](https://standards.iteh.ai/catalog/standards/sist/635291af-87ef-4bcc-a0cb-4933db147da6/iso-11621-1997)

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5.3.7 Check for internal corrosion (step 7)

When this step is required, an internal visual inspection shall be performed to determine whether internal corrosion due to the previous gas service has taken place. Additionally, since it is known that existing corrosion may initiate cracking, only cylinders free from harmful internal corrosion (to be checked by appropriate NDT) may be transferred into group E or group F gas service. This step is not required for aluminium-alloy or stainless-steel cylinders.

5.3.8 Cylinder content evacuation (step 8)

When step 8 is required, it is necessary that the oxidizing or flammable gas in the cylinder being transferred be safely evacuated. Adequate removal of a flammable gas to below its lower flammable limit can be achieved by evacuation, by purging or by filling with water and subsequent emptying and drying. The cylinder contents shall be removed before an internal inspection light or other source of ignition is used in a cylinder.

When step 8* is required, the evacuation or purge is required only if the valve is removed during the transfer.

5.3.9 Check of previous services against compatibility using ISO 11114-1 (step 9)

Cylinders may be in gas service today which current technology would not permit, e.g. a cylinder with too high a strength may be in hydrogen service. If the cylinder is not compatible with its existing gas service (see ISO 11114-1), the cylinder shall be withdrawn from the gas service. However, it may be used in another gas service provided it passes appropriate NDT evaluation (e.g. shear-wave ultrasonic or acoustic-emission testing) and hydrotesting.

5.3.10 Suspected exposure to internal liquid water (step 10)

When step 10 is required (transfer from group E), determine whether or not the cylinder was likely to have been exposed to liquid water internally. If this is likely, then carry out an appropriate NDT evaluation (e.g. shear-wave ultrasonic or acoustic-emission testing). Those cylinders passing these tests may be transferred to the new gas service. This step is not required for aluminium-alloy or stainless-steel cylinders.

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