
**Gas cylinders — Periodic inspection
and testing of welded steel pressure
drums — Capacities up to 1 000 l**

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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 of the voluntary nature of standards, 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 www.iso.org/iso/foreword.html.

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

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Introduction

This document provides information and procedures for the periodic inspection and testing of pressure drums and the condition of the test equipment. It addresses requirements that reflect current practice and experience. The principal aim of a periodic inspection and testing procedure is that at the satisfactory completion of the inspection the pressure drums can be reintroduced into service for a further period of time.

This document has been written so that it is suitable to be referenced in the UN *Model Regulations*^[2].

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Gas cylinders — Periodic inspection and testing of welded steel pressure drums — Capacities up to 1 000 l

CAUTION — Some of the tests specified in this document involve the use of processes that could lead to a hazardous situation.

1 Scope

This document specifies the requirements for periodic inspection and testing of welded steel transportable pressure drums of water capacity from 150 l up to 1 000 l and up to 300 bar test pressure intended for compressed and liquefied gases.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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 10286, *Gas cylinders — Terminology*

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

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

ISO 13341, *Gas cylinders — Fitting of valves to gas cylinders*

ISO 13769, *Gas cylinders — Stamp marking*

ISO 21172-1, *Gas cylinders — Welded steel pressure drums up to 3 000 litres capacity for the transport of gases — Design and construction — Part 1: Capacities up to 1 000 litres*

ISO 22434, *Transportable gas cylinders — Inspection and maintenance of cylinder valves*

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 terms and definitions given in ISO 10286 apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- ISO Online browsing platform: available at <https://www.iso.org/obp>
- IEC Electropedia: available at <http://www.electropedia.org/>

3.1

pressure drum

welded transportable pressure receptacle of a water capacity exceeding 150 l and of not more than 1 000 l

EXAMPLE Cylindrical receptacles equipped with rolling hoops, spheres on skids.

[SOURCE: UN *Model Regulations*, as amended]

3.2

rejected pressure drum

pressure drum (3.1) not fit for service without further evaluation

3.3

minimum design wall thickness

thickness of the *pressure drum* (3.1) wall calculated from the design standard, taking into account the material properties and dimensions at time of manufacture

[SOURCE: ISO 18119:2018, 3.4, modified — "cylinder" replaced by "pressure drum".]

4 Intervals between periodic inspections and tests

A pressure drum shall be due for periodic inspection and testing on its first receipt by a filler following the expiry of the established interval or, in the absence of regulations, in accordance with the UN *Model Regulations* (see [Annex A](#)). The expiry date is based on the last test date shown on the pressure drum.

Provided the pressure drum has not been subjected to abusive and abnormal conditions such as being involved in an accident, heat exposure or other severe conditions that would render the pressure drum unsafe, there is no requirement for the user to return a pressure drum before the contents have been used even though the periodic inspection and test interval has lapsed. However, pressure drums, particularly those containing corrosive gases, should be retested within a period not exceeding twice the periodic inspection and test interval of the applicable regulations.

5 List of procedures for periodic inspection and test

Each pressure drum shall be submitted to a periodic inspection and test. The following procedures form the requirements for such inspection and testing, and are explained more fully in later clauses:

- a) identification of pressure drum (see [Clause 6](#));
- b) preparation for inspection and testing (see [Clause 7](#));
- c) depressurization (see [7.2](#));
- d) devalving and flange removal (see [7.3](#));
- e) external visual inspection (see [Clause 8](#));
- f) internal visual inspection (see [Clause 9](#));
- g) supplementary tests (see [Clause 10](#));
- h) inspection of openings and fittings (see [Clause 11](#));
- i) pressure test (see [Clause 12](#));
- j) repair of pressure drums (see [Clause 13](#));
- k) inspection of valves (see [Clause 14](#));
- l) final operations (see [Clause 15](#));
- m) rejection and rendering unserviceable (see [Clause 16](#)).

These procedures should be performed in the sequence listed in order to improve the safety of the operation and to detect potential harmful damage.

When a pressure drum passes the above listed procedures, but the condition of the pressure drum remains in doubt, additional, supplementary tests shall be performed to confirm its suitability for continued service or the pressure drum shall be rejected (see [Clause 16](#)).

Pressure drums that fail an inspection or test shall be rejected (see [Clause 16](#)).

Depending on the reason for rejection, some pressure drums may be returned to service after further evaluation. The requirements for returning a rejected pressure drum to service are provided in [Clause 16](#) and [Annex B](#).

The eyesight acuity of operators is critical and should be checked by an optician on a yearly basis.

6 Identification of pressure drum

The labelling and permanent marks on the pressure drum shall be checked and the information recorded before carrying out any further work. Pressure drums with incorrect or illegible marks shall be set aside for further evaluation.

Pressure drums with contents that are unknown shall also be set aside for further evaluation.

7 Preparation for inspection and testing

7.1 General

Pressure drums shall be made safe before carrying out any further inspections. This can include purging or other operations depending upon the gas service involved. Pressure drums that cannot be safely emptied of product shall be set aside for further evaluation.

Particular attention shall be paid to pressure drums that have contained flammable, oxidizing or toxic gases to eliminate risks during the internal visual inspection. Additionally, as some liquefied products cannot be removed from the pressure drum by only venting, an additional check such as weighing the pressure drum and comparing this value to its tare may be required.

7.2 Depressurization

Before removing the valve, a check shall be performed to ensure that the pressure drum does not contain any gas under pressure.

A check shall be performed to establish that the valve is not obstructed or inoperable in accordance with ISO 25760.

7.3 Devalving and flange removal

WARNING — The uncontrolled opening of the valve and/or the removal of the valve and flange from a pressure drum can lead to injury, death and/or property damage.

The valve may be removed only after the pressure drum has been depressurized and it has been established that there is no obstruction to gas flow in the pressure drum's valve. Devalving shall be performed in accordance with ISO 25760.

The flange(s) shall only be removed after the pressure drum has been devalved in accordance with ISO 25760.

8 External visual inspection

8.1 Preparation

Each pressure drum shall be cleaned and have all labels, loose coatings, corrosion products, tar, oil or other foreign matter removed from its external surface, e.g. by brushing, shot blasting (under controlled conditions), water jet abrasive cleaning, chemical cleaning or other methods. Care shall be taken to ensure that the integrity of the pressure drum is not compromised by the cleaning process.

8.2 Procedure

The external surface of each pressure drum shall undergo a thorough visual inspection for:

- dents, cuts, gouges, bulges, cracks, laminations or excessive wear;
- heat damage, torch or electric arc burns (as identified in [Table B.1](#));
- corrosion (as defined in [Table B.2](#)) — attention shall be given to areas where water can be trapped;
- defects to welds, welded attachments and the areas adjacent to them;
- other defects such as illegible or unauthorized stamp marks, unauthorized additions or modifications;
- integrity of all permanent attachments, e.g. shrouds, lifting points, lifting pockets; and
- damage to rolling bands.

If the results of the external visual inspection are in doubt, see [Clause 10](#).

For rejection criteria, see [Annex B](#). Pressure drums no longer suitable for continued service shall be rendered unserviceable as defined in [Clause 16](#).

9 Internal visual inspection

Once the requirements of [Clause 7](#) have been met, each pressure drum shall be inspected internally to identify defects such as those listed in [8.2](#). Flange(s), if present, shall be removed in accordance with [7.3](#) to facilitate the internal inspection of the pressure drum.

Precautions shall be taken to ensure that the method of illumination used for the internal visual inspection presents no hazard to the person carrying out the inspection. Any internal lining or coating that can prevent a thorough examination shall be removed.

Any pressure drum showing the presence of foreign matter or signs of corrosion shall be cleaned under closely controlled conditions by a method such as shot blasting, water jet abrasive cleaning, flailing, steam jet, hot water jet, chemical cleaning or other approved method. Care shall be taken to avoid damage to the pressure drum. The pressure drum shall be re-inspected after the cleaning process.

10 Supplementary tests

Where there is doubt concerning the type and severity of a defect found on visual inspection (see [Clauses 8](#) and [9](#)), or when the cleaning processes might have reduced the wall thickness, additional tests or methods of examination may be performed. These additional tests or methods of examination include ultrasonic examination (UT), checking the weight of the pressure drum or other non-destructive testing such as x-ray or dye-penetrant to investigate the presence of surface imperfections.

Only when doubt is eliminated may the drum be further processed (see [Annex B](#)).

11 Inspection of openings and fittings

11.1 Internal threads

The internal threaded openings shall be visually examined to ensure they are:

- clean and of full form;
- free of damage;
- free of burrs;

- free of cracks; and
- free of other imperfections.

Where there is any doubt as to the condition of the threaded openings and the threads of the fittings of pressure drums, the threads shall be checked using a thread gauge.

Threaded openings and the threads of the fittings of pressure drums used in toxic, flammable or corrosive service shall be examined using an appropriate thread gauge or gauges.

For examples on the use of thread gauges, see ISO 11363-2. In all cases, the threads shall be checked by a person trained in gauging threads.

11.2 Damaged internal threads

When necessary, threads may be re-tapped to clean and rectify the appropriate number of effective threads. After re-tapping, the threads shall be checked using the applicable thread gauge (e.g. ISO 11363-2).

11.3 Flanged openings and retaining assemblies

If the pressure drum is fitted with flanged openings, they shall be inspected to ensure that they are:

- clean faced;
- free of damage to the mating surfaces; and
- free of cuts or gouges.

For retaining assemblies, including bolts/studs, ensure that:

- the profile conforms to the required specification;
- is free from all surface defects; and
- the materials are compatible with the intended gas service, even those that are not in the gas stream (see ISO 11114-1).

11.4 Damaged flanged openings and/or retaining assemblies

If the design permits, damaged flange faces on both the pressure drum and the flange may be re-machined to enable a pressure seal to be made on re-assembly.

When retaining assemblies have been replaced, ensure that they are compatible with the intended gas service (see ISO 11114-1 or ISO 11114-2, as applicable).

12 Pressure test

12.1 General

Each pressure drum shall be subjected to a proof pressure test (see 12.2).

12.2 Proof pressure test

WARNING — Appropriate measures shall be taken to ensure safe operation and to contain any energy that might be released. It should be noted that pneumatic proof pressure tests require more precautions than hydraulic proof pressure tests, regardless of the size of the pressure drum. Any error in carrying out this test is highly likely to lead to a rupture under gas pressure. Therefore, these tests shall be carried out only after ensuring that the safety measures adopted satisfy the safety requirements.

The hydraulic proof pressure test shall use a fluid, usually water, as the test medium. The test procedure shall be performed in accordance with 12.3 as appropriate to the design of the pressure drum. The test pressure shall be in accordance with the stamp mark of the pressure drum.

A pneumatic pressure test may be substituted for the hydraulic proof pressure test provided that a risk assessment has been carried out. Personnel using pneumatic testing need to ensure that precautions are taken to contain any energy released if a pressure drum fails. The energy required to conduct a pneumatic pressure test is considerably more than that required for a hydraulic pressure test and can cause extensive damage in the event of failure if adequate precautions have not been taken.

When using air as the medium for the pneumatic pressure test, care shall be taken due to the oxidizing potential of high pressure air. At 300 bar, the partial pressure of oxygen is approximately 60 bar. Pressure drums that have internal flammable materials (e.g. coatings containing hydrocarbons) shall not undergo a pneumatic pressure test that uses high pressure air.

Care shall be taken during the periodic inspection and testing of pressure drums that have been used in flammable gas service.

12.3 Test procedures

12.3.1 Hydraulic test

12.3.1.1 General

The pressure in the pressure drum shall be increased gradually until the test pressure is reached. The pressure shall be held for a minimum of 10 min with the pressure drum isolated from the pressure source. During the test period, there shall be no decrease in the recorded pressure or evidence of any leakage. Safety precautions shall be taken, even for a hydraulic test, due to the considerable stored energy in a pressure drum.

12.3.1.2 Test equipment

12.3.1.2.1 All rigid pipe work, flexible tubing, valves, fittings and components forming the pressure system of the test equipment shall be designed to withstand a pressure 1,5 times the maximum test pressure of the pressure drum that is to be tested. Flexible tubing shall have sufficient wall thickness to prevent kinking.

12.3.1.2.2 Two pressure gauges (also known as pressure indicating devices) shall be used. They shall be at least to an Industrial Class 1 (± 1 % deviation from the end value) with a scale appropriate to the test pressure (e.g. EN 837-1 or EN 837-3).

They shall be checked for accuracy against a calibrated master gauge at regular intervals (e.g. at least once a month).

When an analogue pressure gauge is used, the full-scale rating shall be 1,5 to 2 times the value to be measured. For example, when a test pressure of 100 bar is required, the analogue pressure gauge shall have a full-scale rating of 150 bar to 200 bar.

12.3.1.2.3 The design and installation of the equipment, the connection of the drums and the operating procedures shall avoid trapping air in the system when a liquid medium is used.

12.3.1.2.4 All joints within the system shall be visibly leak tight.

12.3.1.2.5 A control device shall be fitted to the test equipment to ensure that the pressure drum is not subjected to a pressure in excess of its test pressure by more than the tolerances given in [12.3.1.3.3](#).

In addition, a pressure relief device shall be fitted to the system to prevent overpressurization. Its set pressure shall not exceed the upper tolerance shown in [12.3.1.3.3](#) plus 10 %.

12.3.1.3 Test method

12.3.1.3.1 Only one pressure drum may be tested at a time.

12.3.1.3.2 Before applying pressure, the external surface of the pressure drum shall be dry.

12.3.1.3.3 The pressure applied shall not be below the test pressure and shall not exceed the test pressure by 3 % or 10 bar, whichever is lower.

12.3.1.3.4 On attaining the test pressure, the pressure drum shall be isolated from the pump and the pressure held for a minimum period of 10 min.

12.3.2 Pneumatic test

The pneumatic test method follows the hydraulic test method outlined in [12.3.1](#) with the following exception to [12.3.1.3.4](#).

The pressure in the pressure drum shall be increased gradually until the test pressure is reached. The increase in pressure shall be controlled to minimize the effects of an increase in temperature due to the heat of compression. The test pressure shall be maintained for at least 10 min to compensate for the temperature effects. The test pressure shall then be held for a minimum of an additional 20 min with the pressure drum isolated from the pressure source.

During the test period, there shall be no decrease in the recorded pressure or any evidence of leakage.

12.4 Acceptance criteria

If there is a leakage in the pressure system, it shall be corrected and the pressure drum retested.

While the pressure is being held (10 min for the hydraulic test, 20 min for the pneumatic test), the pressure registered on the pressure gauge shall remain constant.

There shall be an absence of visible leakage (liquid when the test is hydraulic) on any part of the external surface of the pressure drum. This check shall be made during the hold period if safe to do so (e.g. by

using a remotely operated camera) or, in the case of the hydraulic pressure test, immediately after the pressure has been released.

There shall be no permanent deformation on the entire surface of the pressure drum. This check shall be made during the hold period if safe to do so or immediately after the pressure has been released.

Any pressure drum failing to conform to the requirements of either of these tests shall be rejected and treated in accordance with [Clause 16](#). Leaks from any mechanical joints, e.g. flanges, may be repaired and the pressure drum shall be retested.

13 Repair of pressure drums

13.1 Welds

If, during the pressure test or external visual inspection, pinhole leaks are detected in a weld, the pressure drum shall be rendered unserviceable in accordance with [Clause 16](#). Pressure-containing welds shall not be repaired.

13.2 Other repairs

Any other repairs, including de-denting and replacement of fittings, may be carried out, provided this repair work will not compromise the integrity of the pressure drum.

All corrosion products shall be removed prior to repair.

The requirements given in [13.3](#) shall be followed.

13.3 Requirements for repair

13.3.1 Major repairs (e.g. de-denting, replacement of fittings such as a complete rolling ring) shall be performed in accordance with an approved procedure, taking into account the requirements of ISO 21172-1. After such repairs, which could involve a high temperature (i.e. greater than 300 °C), a stress relieving or normalizing heat treatment shall be performed. This treatment shall be performed in a controlled manner under the supervision of a competent person.

After any major repair, the pressure drum shall again be tested in accordance with [Clause 12](#).

13.3.2 Minor repairs (e.g. reforming damaged fittings such part of a rolling ring) not involving welding or hotwork on pressure-containing parts may be carried out provided this repair work will not compromise the integrity of the pressure drum. At all times, material compatibility shall be maintained (see ISO 11114-1).

14 Inspection of valves

If valves are to be reused, they shall be inspected and refurbished as required in accordance with ISO 22434.

15 Final operations

15.1 Drying and cleaning

When required, the interior of each pressure drum shall be thoroughly dried immediately after pressure testing to remove all traces of free water. Particular attention shall be paid to the areas of any joggle joints where free water can accumulate. In no case shall the temperature of the pressure drum exceed 300 °C since overheating could change the mechanical properties of the pressure drum.

The interior of the pressure drum shall be inspected to ensure that it is dry and free from other contaminants.

15.2 Painting

If required, pressure drums shall be repainted. Particular attention shall be paid to crevices to ensure that they are fully covered.

Marks stamped on the pressure drum shall remain legible after painting.

15.3 Fitting valves

Valves shall be fitted to the pressure drum in accordance with ISO 13341.

When the use of lubricants or a sealing material is permitted, only those approved for the pressure drum's gas service shall be used in accordance with ISO 11114-2.

15.4 Fitting of flanges

Flanges shall be refitted to pressure drums and the pressure drum shall be subjected to a pneumatic leak test at a minimum pressure of 6 bar. The joints shall be tested for leaks by either using a leak detection fluid or by a method of equal sensitivity. The leak detection fluid shall be compatible with the valve material, e.g. brass exhibits stress corrosion cracking in solutions that include ammonia, and with the gas service.

Damaged retaining assemblies, which includes flanges, bolts, studs and gaskets, shall be replaced in accordance with ISO 21172-1.

Both gasket materials and bolts/studs shall be compatible with the intended gas service in accordance with ISO 11114-1 and ISO 11114-2, as applicable.

15.5 Verification of tare

The verification of the pressure drum's tare shall only apply to pressure drums that contain liquefied gases. The tare shall be obtained by weighing the pressure drums on a scale calibrated with traceability to national or international standards. The scale shall be checked for accuracy at the beginning of each shift. The capacity of the scale shall be suitable for the weight of the pressure drum to be weighed.

The tare shall include the mass of the drum, its valve(s) and its nonremovable fittings. If the tare of the drum differs from the stamped tare by more than $\pm 2\%$ and is not due to reasons of damage, the original tare shall be cancelled. The correct tare shall be marked in a durable and legible fashion in accordance with ISO 13769. Particular attention shall be paid to the tare when replacing any valves, dip tubes, guards, shrouds and footrings.

15.6 Retest marking

After satisfactory completion of the periodic inspection and test, each pressure drum shall be permanently marked, in accordance with the relevant standard, e.g. ISO 13769, with:

- a) the character(s) identifying the country that authorizes the body performing the periodic inspection and testing, as indicated by the distinguishing signs of motor vehicles in international traffic specified in the UN *Model Regulations*;
- b) the stamp or symbol of the authorized inspection body or testing facility; followed by
- c) the present test date (as either YY/MM or YYYY/MM).

This mark may be applied by means other than stamp marking.

This information is provided on the nameplate of the pressure drum.

15.7 Reference to the next test date

The next periodic inspection and test date shall be shown in a clearly visible manner, such as by a label, by stencilling or by a disc fitted between the valve and the pressure drum indicating the year (and the month, when required) of the next periodic inspection test date.

In all cases, the next periodic inspection and test date shall be shown as YYYY (or YYYY/MM, when the month is required).

15.8 Records

After the periodic inspection, the following shall be recorded on the test certificate:

- owner's name;
- serial number of the pressure drum;
- name of manufacturer;
- pressure drum manufacturer's identification;
- date of manufacture;
- manufacturing specification;
- pressure drum weight (empty), or tare, when applicable;
- water capacity/size;
- type of inspection and test performed;
- test pressure;
- present test date shown as YYYY/MM/DD;
- identification symbol of the retest body or the testing facility;
- identification of retester;
- details of any repairs made to defects as described in [Annex B](#) (see [Clause 13](#));
- specification or regulation according to which the periodic inspection and test was performed; and
- result of inspection and test (pass or fail).

In case of failure, the reason(s) should be recorded.

Records shall be retained by the retester for at least 15 years or until the next periodic inspection.

16 Rejection and rendering unserviceable

The decision to reject a pressure drum may be taken at any stage during the inspection and testing procedure.

If a rejected pressure drum cannot be recovered, the owner shall be notified and the pressure drum shall be rendered unserviceable. If the owner agrees, the testing facility shall render the pressure drum unserviceable for holding gas under pressure by one or more of the methods listed below so that it is impossible for any part of the pressure drum to be reintroduced into service. If the owner does not agree with this disposition, at the very least, the mark (e.g. UN mark) that allows the pressure drum for legal transport in the country where it is periodically inspected and tested shall be made illegible. In case of any disagreement, ensure that the legal implication of the contemplated action is fully understood.

In some cases, it might be necessary to transport pressure drums that have been rendered unserviceable to a place where they can be scrapped. If there are no specific regulations, a pressure drum that has been rendered unserviceable shall be identified.

One or a combination of the following methods may be used to render the pressure drum unserviceable, after ensuring that the drum is empty and free of product and pressure:

- crush the pressure drum, paying particular attention to crushing both ends;
- burn an irregular hole that is at least 10 % of the surface area of the pressure drum in each of its ends and in two other locations equally spaced along its axis;
- cut the pressure drum into two or more irregular pieces.

The nameplate of the drum shall be removed from the drum and returned to the pressure drum owner.

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Annex A (informative)

Periodic inspection and test periods

The information shown in [Table A.1](#) includes intervals for periodic inspection and test periods as outlined in the UN *Model Regulations*^[7].

Table A.1 — Intervals for periodic inspections and tests

Gas type	Examples	UN recommended period years
Compressed gases	Ar, N ₂ , He, etc.	10
	H ₂ ^a	10
	Air, O ₂	10
	CO ^b	5
Liquefied gases	Refrigerants, CO ₂	10
Corrosive gases	c	5
Toxic/very toxic gases that are non-corrosive ^c	Sulfuryl fluoride (SO ₂ F ₂), Arsine (AsH ₃), Phosphine (PH ₃), etc.	5
Gas mixtures	All mixtures	5 years or 10 years, according to dangerous properties. Generally, toxic or corrosive ^c mixtures have a 5-year interval while other mixtures have a 10-year interval.

These test periods may be used provided that the dryness of the product and the dryness of the filled cylinder are such that there is no freestanding water. This condition shall be proven and documented within a quality system of the filler. If this condition cannot be fulfilled, alternative or more frequent testing may be appropriate.

NOTE At all times, certain requirements can necessitate a shorter time interval, e.g. the dew point of the gas, polymerization reactions and decomposition reactions, cylinder design specifications, change of gas service.

^a Particular attention shall be paid to the tensile strength and surface condition of such cylinders. Cylinders not in conformance with the special hydrogen requirements shall be withdrawn from hydrogen service. See ISO 11621 for possible additional testing.

^b This product requires very dry gas. See ISO 11114-1.

^c Corrosiveness is with reference to human tissue (see ISO 13338) and NOT cylinder material.

Annex B (normative)

Description, evaluation of defects and conditions for rejection of pressure drums at the time of visual inspection

B.1 General

Pressure drum defects can be physical, material or due to corrosion as a result of environmental or service conditions to which the drum has been subjected during its life. This annex provides general guidelines to the users of pressure drums as to the application of rejection criteria. This annex applies to all pressure drums, but those that contain gases with special characteristics could require modified controls.

Any defect in the form of a sharp notch may be removed by mechanical means (e.g. machining or other approved methods) and blended smooth in accordance with [Clause 13](#). Following repair, the wall thickness shall be checked (e.g. by ultrasonic examination) to verify whether the remaining wall thickness is not less than the design wall thickness in accordance with ISO 21172-1.

B.2 Physical or material defects

Evaluation of physical or material defects shall be in accordance with [Table B.1](#).

B.3 Corrosion

B.3.1 General

A pressure drum can be subjected to environmental conditions that could cause external corrosion of the metal. Internal corrosion of the metal can also occur due to service conditions.

There is difficulty in presenting definite rejection limits in tabular form for all sizes and types of pressure drums and their service conditions. The rejection criteria shown in [Tables B.1](#) and [B.2](#) have been established following considerable field experience.

Extensive experience and judgement are required in evaluating whether drums that have corroded internally are safe and suitable for return to service. It is important that the surface of the metal is cleaned of corrosion products prior to the inspection of the drum.

B.3.2 Types of corrosion

The types of corrosion may be classified generally as shown in [Table B.2](#).

Table B.1 — Rejection criteria relating to physical and material defects in the pressure drum

Type of defect	Definition	Rejection criteria in accordance with Clause 8 ^a	Repair or render unserviceable
Bulge	Visible swelling of the drum.	All drums with such a defect.	Render unserviceable.
Dent	A depression in the drum that has neither penetrated nor removed metal and is greater in depth than 1 % of the external diameter.	When the depth of the dent exceeds 3 % of the external diameter of the drum, OR when the diameter of the dent is less than 15 times its depth.	Render unserviceable. Render unserviceable.
Cut or gouge	A sharp impression where metal has been removed, displaced or redistributed and whose depth exceeds 5 % of the drum's minimum design wall thickness (see Figure B.1).	When the depth of the cut or gouge exceeds 10 % of the minimum design wall thickness, OR when the length exceeds 25 % of the outside diameter of the drum, OR when the remaining wall thickness is less than the minimum design wall thickness.	Repair possible ^a . Repair possible ^b . Render unserviceable.
Crack	A split or separation in the metal typically appearing as a line on the surface (see Figure B.2).	All drums with such defects.	Render unserviceable.
Fire/excessive heat damage	Excessive general or localized heating of a drum usually indicated by: a) partial melting of the drum; b) distortion of drum; c) charring or burning of paint; d) fire damage to valve, melting of plastic date ring.	All drums in categories a) and b).	Render unserviceable.
		All drums in categories c) and d) may be acceptable after inspection and/or testing.	Repair possible. In case of doubt, render unserviceable.
Plug or neck inserts	Additional inserts fitted in the drum end, base or wall.	All drums unless it can be clearly established that the additional inserts are part of approved design.	Repair possible.
Damage to rolling bands, shrouds, lifting points, etc.	Any defect that affects the integrity of the rolling band, shroud or lifting point.	All drums with such a defect.	Repair possible.
Stamp marking	Marking by means of a metal punch.	All drums with illegible, modified or incorrect marks.	Render unserviceable ^c .
Arc or torch burns	Partial melting of the drum, the addition of weld metal or the removal of metal by scarfing or cratering (see Figure B.3).	All drums with such defects.	Repair possible.

^a When applying the rejection criteria given in this table, the conditions of use of the drums, the severity of the defect and safety factors in the design shall be taken into consideration.

^b Provided that after repair by a suitable metal removal technique, the remaining wall thickness is at least equal to the minimum design wall thickness.

^c If it can be clearly established that the drum fully conforms to the appropriate specifications, altered operational and modified marks may be acceptable and inadequate marks may be corrected, provided there is no possibility of confusion.