

S.I. 15 of 2005

SEYCHELLES BUREAU OF STANDARDS ACT

(Cap 212)

Seychelles Bureau of Standards (Standard Specification for Periodic Inspection and Testing of Refillable Gas Cylinders) Notice, 2005

In exercise of the powers conferred by section 16(1) of the Seychelles Bureau of Standards Act, the Minister of Economic Planning hereby makes the following Notice –

1. This Notice may be cited as the Seychelles Bureau of Standards (Standards Specification for Periodic Inspection and Testing of Refillable Gas Cylinders) Notice, 2005.

Citation

2. The Minister of Economic Planning declares the standard specification set out in the Schedule to be the mandatory standard specification for periodic inspection and testing of refillable gas cylinders.

Mandatory standard specification for periodic inspection and testing of refillable gas cylinder

3. The Seychelles Bureau of Standards (Standard Specification for Refillable Gas Cylinders) Notice is hereby repealed.

Repeal of Cap 212 Sub. Leg. P1

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SECTION ONE : GENERAL

1.1 Scope

This standard specification specifies requirements for the periodic inspection and testing of refillable, transportable aluminium alloy and steel gas cylinders of water capacity 0.5 litre up to 150 litres.

This standard does not apply for the periodic inspection and testing of acetylene cylinders or composite (full wrapped or hoop-wrapped) steel or aluminium alloy cylinders and it does not cover the inspection and maintenance of cylinder valves.

1.2 Definition

For the purpose of this standard the following definitions apply:

- 1.2.1 **Corrosion** shall mean a chemical reaction on material that result in the removal of the surface of the material.

Note Corrosion may exist in many forms, such as:

- (a) chemical attack where the metal is dissolved by the reagents and which may be general over the complete surface, localised (causing pitting), or a combination of the two;
- (b) rusting caused by the combined action of moisture and air.

- 1.2.2 **Competent person** shall mean a person who, through training, qualification, skills and/or practical experience is able to verify compliance with this standard.

- 1.2.3 **Expansion** shall mean the increase in the cylinder volume due to the application of pressure.

- 1.2.4 **Gas cylinder** shall mean a vessel of cylindrical shape having a water capacity of 0.5 litre up to 150 litres used for the storage and conveyance of liquefied or compressed gases.

- 1.2.5 **High pressure liquefied gas** shall mean gas that has a critical temperature between -10°C and 70°C inclusive.

- 1.2.6 **Hydraulic pressure test** shall mean a cylinder qualification procedure consisting of the application of internal pressure with the measurement of the cylinder expansion, generally performed with water, but other liquid or gas pressure may be used.
- 1.2.7 **Inspection** shall mean visual examination of gas cylinders by a competent person, using appropriate equipment.
- 1.2.8 **Liquefied gas** shall mean gas that is liquefiable by pressure at -10°C or higher.
- 1.2.9 **Low pressure liquefied gas** shall mean gas that has critical temperature above 70°C .
- 1.2.10 **Mark** shall mean an identification made by a stamp or a sticker as evidence of visual inspection and/or hydraulic pressure test.
- 1.2.11 **Permanent expansion** shall mean the increase in cylinder volume due to the application of pressure, which is not recovered when the pressure is released.
- 1.2.12 **Permanent gas** shall mean gas that has critical temperature below -10°C .
- 1.2.12 **Refillable gas cylinder** shall mean a gas cylinder meeting the requirements of this standard capable of being refilled with the same type of gas (compressed or liquefied) after having satisfactorily completed the inspection and/or hydraulic pressure test specified in this standard.
- 1.2.13 **Test pressure** shall mean the required pressure applied during a pressure test.
- 1.2.14 **Testing station** shall mean suitably equipped authorised premises, staffed by competent persons to undertake the

periodic inspection and/or testing of refillable gas cylinders, in accordance with this standard.

SECTION TWO : GENERAL REQUIREMENTS

- 2.1 Refillable gas cylinders shall be subjected to periodic inspection and testing in accordance with the schedule specified in Table 1 and in accordance with the test methods specified in this standard.
- 2.2 Testing stations shall have the responsibility to verify compliance with this standard.
- 2.3 Filler of refillable gas cylinders shall be responsible to ensure that all gas cylinders have been inspected and tested prior to filling.
- 2.4 Refillable gas cylinders not in use shall be properly stored and labelled accordingly.
- 2.5 Owner, user and filler of gas cylinders shall ensure at all times that cylinders in their possession are not damaged or corroded and shall refer all those suspected of damage or corroded for further inspection and testing regardless of the prescribed inspection and test intervals.
- 2.6 Refillable gas cylinders due for periodic inspection and testing shall be identified primarily from the date of manufacture of the cylinder or the last periodic test date marked on the gas cylinders.
- 2.7 Equipment used for inspection and testing of refillable gas cylinders shall be properly maintained and calibrated at appropriate intervals and maintenance and calibration record properly kept.
- 2.8 Testing stations shall ensure the necessary safety measures required for inspection and testing of refillable gas cylinders.

- 2.9 All methods used for the inspection and testing of refillable gas cylinders shall be in accordance with those specified in this standard.

SECTION THREE: INSPECTION AND TESTING OF REFILLABLE GAS CYLINDERS

3.1 General

Refillable gas cylinder shall be submitted to inspection and hydraulic pressure test in accordance with the schedule specified in Table 1 of this standard.

Cylinders due for hydraulic pressure test shall undergo visual inspection regardless of the prescribed visual inspection interval specified in Table 1 of this standard.

Refurbished cylinders shall undergo both visual inspection and hydraulic pressure test regardless of the prescribed visual inspection and hydraulic pressure test intervals specified in Table 1 of this standard.

Hydraulic pressure test shall take the form of either a proof pressure test or a volumetric expansion test. However, volumetric expansion test shall be carried out in the following circumstances:

- (a) where the cylinder is employed on a duty known to cause a significantly high risk of corrosion;
- (b) at the discretion of the testing station, from its knowledge and experience of the history of the cylinders used in a particular service;
- (c) at the discretion of the testing station, in order to resolve any doubt arising from the inspection of a gas cylinder;

- (d) when testing aluminium cylinders; and,
- (e) for all diving cylinders.

Table 1 : Intervals between periodic inspection and hydraulic pressure tests

Gas cylinders for :	Hydraulic Pressure Test	Visual Inspection	
		External Inspection	Internal Inspection
Permanent and high pressure liquefiable gases including carbon dioxide, oxygen, argon, nitrogen, helium, air, hydrogen.	4 years	1 year	4 years
All gases and gas mixtures used in self-contained breathing apparatus, to include self-contained breathing apparatus for fire fighters.	2 years	1 year	1 year
Compressed air for diving (Steel).	2 years	1 year	1 year
Compressed air for diving (Aluminium)	4 years	1 year	1 year
Low pressure liquefiable gases including ammonia, butane, refrigerant gases, propane	4 years	2 years	2 years
Pressurized fire extinguishers	4 years	1 year	4 years

3.2 Preparation of refillable gas cylinders for inspection and testing

The following shall be undertaken in the preparation of gas cylinders for inspection and/or testing:

- (a) Record all markings on each cylinder;
- (b) Each cylinder and its content shall be identified;

- (c) Each cylinder shall be depressurised to atmospheric pressure and the contents shall be discharged in a safe manner and the release of pressure shall be controlled;
- (d) Each cylinder shall be weighed on a weighing machine that has been checked for accuracy to determine the difference between the actual mass and the original mass stamped on the cylinder. (Refer to Appendix D);
- (e) Where a cylinder has contained a toxic gas, the cylinder shall be purged with an inert gas, air or steam as appropriate. Where the cylinder has contained a flammable non-toxic gas, the cylinder shall be either purged or evacuated so that the percentage of flammable gas remaining is less than the lower flammability limit of the particular gas;
- (f) Each cylinder shall be cleaned and have all loose coating and corrosion products and foreign matter removed from its external surface by a suitable method, e.g. by brushing, shot blasting (under close controlled conditions), water jet abrasive cleaning, chemical cleaning or other suitable methods. Care shall be taken to avoid damaging the cylinder or removing excessive amounts of the cylinder wall;
- (g) Provided that the requirements given above have been complied with, the cylinder valve shall be removed for internal inspection and hydraulic pressure test.

3.3 Visual inspections

3.3.1 General

Visual inspections shall include external and/or internal inspection of gas cylinder for sign of physical and material defects, corrosion and damage.

Visual inspections shall be carried out by a competent person using appropriate inspection equipment.

Appendix A shall be used to assess the degree of defects, corrosion and damage and the rejection limit for both external and internal inspection of refillable gas cylinders.

3.3.2 External inspection

Each cylinder shall be inspected externally for:

- (a) dents, cuts, gouges, bulges, cracks, laminations and base wear;
- (b) corrosion, special attention shall be given to the junction between the cylinder base and the footing;
- (c) other defects such as misaligned neck ring or collar, damaged shroud or other fittings, illegible or unauthorised markings, fire damage, electric arc or torch burn, unauthorised additions or modifications.

Sound test shall be done by lightly striking on the body of the cylinder with a suitable object. A muffled ring may indicate corrosion or a defect in the metal, which should be subjected to further examination.

The cylinder which fails to meet the requirements of Appendix A shall be rejected in accordance with clause 3.7 of this standard.

3.3.3 Internal inspection

3.3.3.1 Each cylinder shall be inspected over its whole internal surface using an appropriate device (e.g. a light source of sufficient intensity) to identify any sign of physical and material defects, or corrosion.

3.3.3.2 Any internal liner or coating which can obstruct optimum internal visual inspection shall be removed.

- 3.3.3.3 Any cylinder showing presence of foreign matter or signs of more than light surface corrosion shall be cleaned internally under closely controlled conditions such as shot blasting, water jet abrasive cleaning, flailing, steam jet, hot water jet, rumbling, cleaning chemical or other suitable method. Care shall be taken to avoid damage to the cylinder during cleaning.
- 3.3.3.4 Chemical cleaning of aluminium alloy cylinder shall be done in accordance with Appendix E.
- 3.3.3.5 Where a cylinder is to be used for a gas which may be ingested, care shall be taken to ensure that the cleaning method is such that the cylinder is free from any residual toxicity and loose material before it is returned into service.
- 3.3.3.6 All cylinders shall be inspected again after cleaning.
- 3.3.3.7 Internal inspection shall also include inspection of the cylinder neck thread in accordance with clause 3.4 of this standard.
- 3.3.3.8 The cylinder which fails to meet the requirements of Appendix A shall be rejected in accordance with clause 3.7 of this standard.

3.4 Inspection of the cylinder neck threads

- 3.4.1 The internal neck thread of each cylinder shall be examined to ensure that it is clean, of full form, and free from damage, burrs, cracks and other imperfections. Common thread defects are galled, worn or corroded crest, and broken or nicked threads.
- 3.4.2 Where necessary, and where the design of the neck permits, taper threads may be rectify to ensure that there is the required number of effective threads for the safe

fitting of the valve. After re-tapping, the thread shall be checked by the appropriate thread gauge.

- 3.4.3 When a neck ring exists, examinations for secureness and correct thread shall be carried out. If it is found that any damage has been caused to the cylinder when replacing the neck ring, or if the neck ring has been attached by welding, brazing or soldering, the cylinder shall be removed from further service.

3.5 Hydraulic test

3.5.1 General

- 3.5.1.1 Each cylinder shall be subjected to a hydraulic pressure test by a competent person in accordance with the schedule specified in Table 1 of this standard. Hydraulic pressure testing shall take the form of a proof pressure test or the volumetric expansion test specified in Appendix C of this standard.

- 3.5.1.2 The cylinder which fails the hydraulic tests shall be rejected in accordance with clause 3.7 of this standard.

3.5.2 Proof pressure test

- 3.5.2.1 Hydraulic proof pressure test shall be carried out in accordance with the test method specified in Appendix B of this standard.

- 3.5.2.2 The test pressure shall be established from the marking on the cylinder or as stipulated by the manufacturer.

- 3.5.2.3 During test, the cylinder test pressure shall be held for a minimum period of 1 minute during which time there shall be no visible leakage or deformation.

3.5.3 Volumetric expansion test

3.5.3.1 Volumetric expansion test shall take the form of the water jacket volumetric expansion tests specified in Appendix C of this standard.

3.5.3.2 The test pressure for volumetric expansion test shall be established from the marking on the cylinder or as stipulated by the manufacturer, or $5/3$ of the working pressure.

3.5.3.3 The permanent volumetric expansion of the cylinder expressed as a percentage of the total expansion at test pressure shall not exceed 10% or as stipulated by the manufacturer.

3.5.3.4 Where it can be clearly established that apparent excessive permanent volumetric expansion of a cylinder is the result of a fault in the test equipment, the cylinder shall be re-tested. Where the cylinder may have been over-pressurised, the test shall be carried out only after re-heat treatment.

3.6 Drying of cylinders

The interior of each cylinder shall be thoroughly dried by a suitable method immediately after hydraulic pressure testing. The interior of the cylinder shall be inspected to ensure that there is no trace of free water and that it is free from contamination.

3.7 Rejected cylinders

Any cylinder that fails to comply with the requirements of clause 3.3 for visual inspections, or any of the hydraulic tests specified in clause 3.5, shall be rejected. If it is not possible to recover a rejected cylinder, it shall be rendered unserviceable and destroyed in accordance with clause 3.8 of this standard.

3.8 Destruction of unserviceable cylinders

Cylinders that have been deemed unserviceable shall be impounded and handed over to the Seychelles Bureau of Standards where they shall be retained for three (3) months during which time the owner may appeal, failing which, it shall be destroyed by the Seychelles Bureau of Standards.

Before any cylinder is destroyed it shall be depressurised in accordance to clause 3.2 (c) of this standard.

Cylinder shall be destroyed by any one of the following methods:

- (a) The cylinder shall be crushed by mechanical means;
- (b) An irregular hole shall be burned in the top dome of the cylinder, equivalent to 10% or more of the area of the top dome;
- (c) In the case of thin-walled cylinder, the cylinder shall be pierced in at least three places;
- (d) The cylinder, including its shoulder shall be cut into two or more irregular pieces;
- (e) Any other alternative method approved by the Seychelles Bureau of Standards.

Drilling a hole in a cylinder shall not be considered as satisfying the requirements of this clause unless it meets the requirement of (b) above.

3.9 Records

3.9.1 Inspection/Test certificate

An inspection/test certificate shall be supplied by the testing station for each cylinder tested. This certificate shall be retained by the testing station and the owner of the cylinder for not less than the intervals between the periodic inspections and hydraulic tests laid down in Table 1 of this standard, and shall include the following information:

- (a) name and address of owner;
- (b) serial number of cylinder;
- (c) manufacturing specification;
- (d) water capacity;
- (e) tare or empty weight,
- (f) test pressure;
- (g) method of test i.e. volumetric or proof pressure test;
- (h) inspection/test date;
- (i) result of inspection/test i.e. pass/fail;
- (j) name and signature of inspector;
- (k) details of any modification made to the cylinder;
- (l) name of gas contained;
- (m) name and address of the testing station;
- (n) due date of the next inspection/test.

For cylinder that fails to comply with any of the inspections and/or tests required by this standard, the certificate issued to the owner of the cylinder shall identify the cause(s) of failure.

3.9.2 Maintenance of calibration, inspection and test records

3.9.2.1 All inspection and test equipment shall be properly maintained and/or calibrated as necessary at the appropriate intervals. Records of such maintenance and calibration shall be kept accordingly.

3.9.2.2 All records of inspection and test shall be maintained by the testing station for traceability purpose.

SECTION FOUR: MARKING OF TESTED GAS CYLINDERS

After satisfactory completion of the periodic inspection and/or test, each cylinder shall be permanently and legibly marked with a stamp or a sticker with the following information:

- (a) the name and address of the testing station;
- (b) the test date which shall be indicated by the two numerical digits or abbreviation of the month and the year of test or the last two numerical

digits of the year of test; e.g. SBS -04-01 or SBS-APR-01 where SBS stands for **Seychelles Bureau of Standards**.

- (c) the due date of periodic inspection and/or testing.

Stamped marking made onto the cylinder shall be confined to the shoulder of the cylinder where the thickness of the metal is greater than the wall. The marking shall not be less than 6mm in height.

APPENDIX A : DESCRIPTION AND EVALUATION OF DEFECTS AND CONDITIONS FOR THE REJECTION OF GAS CYLINDERS

A.1 General

Gas cylinder defects can be physical, material or due to corrosion as a result of environmental or service conditions to which the cylinder has been subjected during its life.

This appendix provides limits for assessing the defects and conditions for rejection of cylinder based on field experience and judgement in order to ensure that it is safe and suitable prior to return to service.

When applying the criteria given in Table 2 and Table 3 of this standard, the conditions of use of the cylinders, the severity of the defect and the safety factors in the design shall be taken into consideration.

The pictorial figures specified in BS EN 1802, BS EN 1803 and BS EN 1968 may be used as guidelines when assessing gas cylinder defects.

A.2 Physical or material defects

The evaluation of physical and material defects in the cylinder shall be carried out in accordance with Table 2 of this standard.

A.3 Corrosion

Extensive experience and judgement are required in evaluating whether cylinders that have been 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 cylinder.

The evaluation of corrosion of the cylinder wall shall be carried out in accordance with Table 3 of this standard.

If the defect is borderline, or gives rise to uncertainty, the cylinder shall be put aside for more detailed examination, using appropriate equipment if necessary.

Where the bottom of the defect cannot be seen and where its extent cannot be evaluated using appropriate equipment, the cylinder shall be destroyed in accordance with clause 3.8 of this standard.

Table 2 : Rejection limits relating to physical and material defects in the cylinder shell

Type of defect	Definition	Rejection limits
Bulge	Visible swelling of the cylinder	Any bulge
Dent	A depression in the cylinder that has neither penetrated nor removed metal and is greater in depth than 1% of the outside diameter.	When the depth of the dent exceeds 3% of the external diameter of the cylinder; or When the diameter of the dent is less than 15 times its depth.
Cut or Gouge	A sharp impression where metal has been removed or redistributed and whose depth exceeds 5% of the cylinder wall thickness.	When the depth of the cut or gouge exceeds 10% of the wall thickness; or When the length exceeds 25% of the outside diameter of the cylinder; or When the wall thickness is less than the minimum designed thickness.
Crack	A split or rift in the metal.	Any crack.
Fire damage	Excessive general or localised heating of a cylinder usually indicated by: (a) partial melting of the cylinder; (b) distortion of the cylinder; (c) charring or burning of paint; (d) fire damage to valve parts.	All cylinders in categories (a) and (b). All cylinders in categories (c) and (d). see Note 1.
Plug or neck inserts	Additional inserts fitted in the cylinder neck, wall or base.	All cylinders unless it can be clearly established that addition is part of the approved design.
Stamp marking	Marking by means of a metal punch	All cylinders with illegible, modified or incorrect or incorrectly modified markings. see Note 2.
Arc or torch burns	Partial melting of the cylinder, the addition of weld metal or the removal of metal by scarfing or cratering.	All cylinders with such defects.
Suspicious marks	Introduced other than by the cylinder manufacturing process or approved testing station.	All cylinders with such defects.
Vertical stability	Deviation from verticality which may present a risk during service (especially if fitted with foot ring)	All cylinders with such defects

Note 1 If paint is only charred, a cylinder may be accepted, but if paint has been removed by heat, or if metallic parts of a valve have been melted, the decision to accept, refurbish or reject shall be made the responsibility of a competent person.

Note 2 When it can be clearly established from record or otherwise that the cylinder fully complies with the requirements of the appropriate specification for the relevant gas service, an altered marking may be accepted and illegible or inadequate markings may be corrected by a competent person from an approved testing station.

Table 3 - Rejection criteria for corrosion of the cylinder wall

Type of corrosion	Definition	Rejection limits
General corrosion	Loss of wall thickness over an area of more than 20% of the total surface area of the cylinder.	If the original surface of the metal is no longer recognizable; or If the depth of penetration exceeds 10% of original thickness of wall; or If the wall thickness is less than the design minimum wall thickness.
Local corrosion	Loss of wall thickness over an area of less than 20% of the total surface area of the cylinder except for the other types of local corrosion described below.	If the depth of penetration exceeds 20% of the original thickness of the cylinder wall thickness or if the wall thickness is less than design thickness.
Chain pitting and line corrosion	Corrosion forming a narrow longitudinal or circumferential line or strip or isolated craters or pits which are almost connected.	If the total length of corrosion in any direction exceeds the diameter of the cylinder and the depth exceeds 10% of the original wall thickness.
Isolated pits	Corrosion forming isolated craters, without significant alignment.	If the diameter of the pits is greater than 5mm, refer to "local corrosion", see above; If the diameter of the pits is less than 5mm, the pits shall be assessed as carefully as possible in order to check that the remaining thickness of the wall or base is adequate for the intended use for the cylinder.
Crevice corrosion	Corrosion taking place in, or immediately around, an aperture.	If, after thorough cleaning, the depth of penetration exceeds 20% of the original wall thickness.

APPENDIX B : HYDRAULIC PROOF PRESSURE TEST**B.1 General**

- B.1.1 This appendix describes the method for carrying out the hydraulic proof pressure test as specified in sub clause 3.5.2 of this standard.

B.2 Test equipment

- B.2.1 All rigid pipe work, flexible tubing, valves, fittings and components forming the pressure system of the test equipment shall be capable to withstand a pressure of 1.5 times the maximum test pressure of any cylinder that will be tested. Flexible tubing shall have sufficient wall thickness to prevent kinking. The design and installation of the equipment and the cylinders connected to it shall be such as to avoid the trapping of air in the system when a liquid medium is used.
- B. 2.2 All joints within the system shall be leak-tight.
- B.2.3 A suitable device shall be fitted to the test equipment to ensure that no cylinder is subjected to a pressure in excess of its test pressure by more than the tolerances in B.3.4.
- B.2.4 Pressure gauges shall be to an accuracy of class 1 with a scale appropriate to the test pressure. They shall be chosen such that the test pressure is approximately between $S!$ and $T!$ of the value capable of being measured on the pressure gauge.
- B.2.5 Pressure gauges shall be calibrated against a calibrated gauge at regular intervals, not exceeding one year. They shall also be calibrated after each repair and servicing regardless of the validity of calibration.

B.3 Test method

- B.3.1 More than one cylinder may be tested at a time, as shown in Figure 1, provided that they all have the same test pressure and that each individual cylinder is capable of being isolated in case of leakage or any other defect.
- B.3.2 The test pressure shall be established from the marking on the cylinder or as stipulated by the manufacturer.
- B.3.3 The external surface of the cylinder(s) shall be completely dry before applying pressure.
- B.3.4 The pressure applied shall not be below the test pressure and shall not exceed the test pressure by 3% or 10 bars, whichever is the lower.
- B.3.5 Apply pressure until the test pressure is reached. On attaining the test pressure, the cylinder(s) shall be isolated from the pump and the pressure shall be held for a minimum period of 1 minute during which time the pressure as registered on the test gauge reading shall remain constant.
- B.3.6 The cylinder(s) shall not show any sign of leakage, visible deformation or defect during test.
- B.3.7 If there is a leakage in the pressure system, it shall be corrected and the cylinder(s) re-tested.

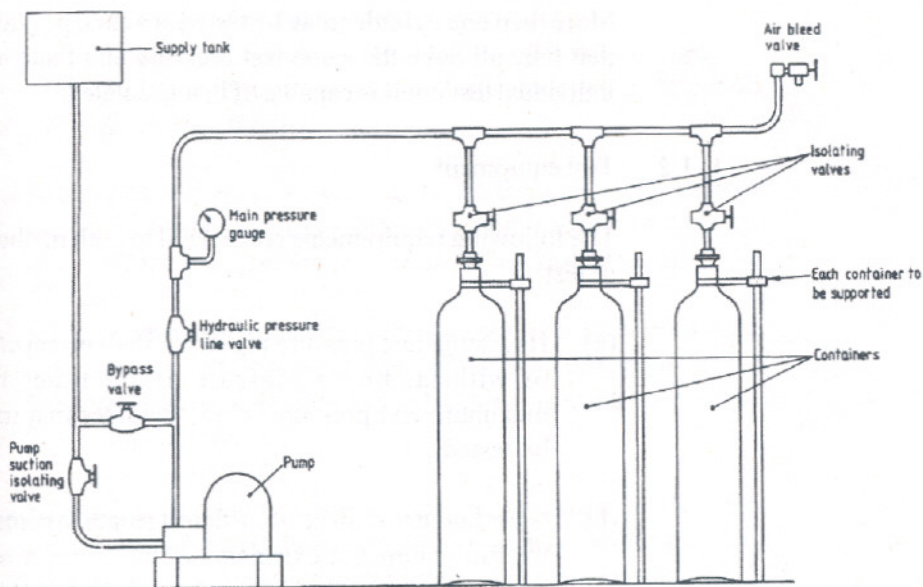


Figure 1 : Example of hydraulic proof pressure test equipment

APPENDIX C : HYDRAULIC VOLUMETRIC EXPANSION TEST

C.1 General

C.1.1 This appendix describes the water jacket method for determining the volumetric expansion of gas cylinders as specified by sub clause 3.5.3 of this standard. Water jacket volumetric expansion test can be done using one of the following methods:-

1. Levelling burette method
2. Fixed burette method

More than one cylinder may be tested at a time provided that they all have the same test pressure and that each individual test point is capable of being isolated.

C.1.2 Test equipment

The following requirements are general to both methods of test:

- (a) Hydraulic test pressure pipelines shall be capable of withstanding a pressure of 1.5 times the maximum test pressure of any cylinder that may be tested.
- (b) Glass burettes shall be of sufficient length to contain the full volumetric expansion of the cylinder and shall have bores of uniform diameter such that the expansion can be read to an accuracy of 1% or 0,1 ml, whichever is the greater.
- (c) Pressure gauges shall be of accuracy class 1 with a scale appropriate to the test pressure. They shall be calibrated at regular intervals, not exceeding one year. Pressure gauges shall also be calibrated after repair and servicing regardless of validity of calibration.
- (d) A suitable device shall be employed to ensure that no cylinder is subjected to a pressure in excess of its test pressure.
- (e) Pipework should utilize long bends in preference to elbow fittings and pressure pipes should be as short as possible. Flexible tubing should be capable of withstanding 1.5 times the maximum test pressure in the equipment and should have sufficient wall thickness to prevent kinking.

- (f) All joints should be leak-tight.
- (g) When installing equipment, care should be taken to avoid the trapping of air in the system.

C.2 Water jacket volumetric expansion test

C.2.1 General

The water jacket volumetric expansion test necessitates enclosing the water-filled cylinder(s) in a jacket also filled with water. The total and any permanent volumetric expansions of the cylinder(s) are measured in relation to the amount of water displaced by the expansion of the cylinder(s) when under pressure and after the pressure is released.

C.2.2 Water jacket volumetric expansion test (levelling burette method)

An example of the test equipment is shown in Figure 2.

This method is used to avoid errors due to parallax or effect of hydrostatic head.

The procedure is as follows:

- (a) Fill the cylinder(s) with water and attach to the water jacket cover.
- (b) Seal the cylinder(s) in the jacket and fill the jacket with water, allowing the air to bleed off through the air bleed valve.
- (c) Connect the cylinder(s) to the hydraulic pressure line. Adjust the burette to zero level by manipulation of the jacket filling valve and drain valve. Raise

the pressure in the cylinder(s) to T! of the test pressure, stop pumping and close the hydraulic pressure line valve. Check that the burette reading remains constant.

- (d) A rise in water level may indicate either a leaking joint between the cylinder(s) and the jacket or a faulty cylinder.
- (e) Restart the pump and open the hydraulic pressure line valve until the cylinder(s) test pressure is reached. Close the hydraulic pressure line valve and stop pumping. Check that the burette reading remains constant.
- (f) Lower the burette until the water level is at zero mark on the burette support. Note the water level reading on the burette scale. This is a measure of the total expansion and shall be recorded.
- (g) Open the hydraulic line drain valve to release pressure from the cylinder(s). Raise the burette until the water level is at zero mark on the burette support. Check that the pressure is at zero and that the water level is constant.
- (h) Note the water level reading on the burette scale. This is a measure of the permanent expansion, if any, and shall be recorded.
- (i) Calculate the permanent expansion as a percentage of the total expansion from the following formula (see 3.5.3)

$$\frac{\text{Permanent expansion}}{\text{Total expansion}} \times 100\% = \% \text{ Permanent expansion}$$

- (j) The permanent volumetric expansion of the cylinder expressed as a percentage of the total expansion at test pressure shall not exceed 10% or as stipulated by the manufacturer.

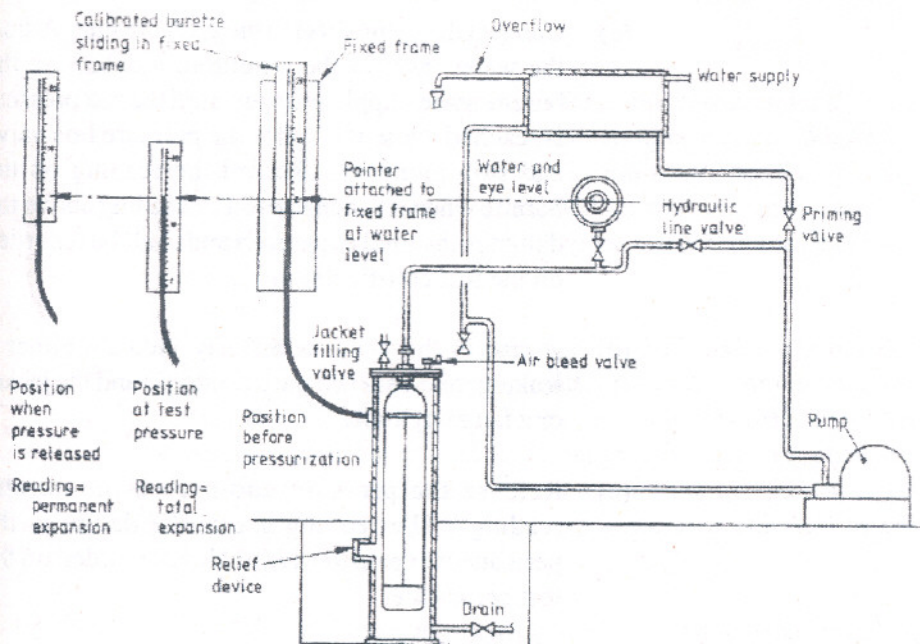


Figure 2 : Example of water jacket volumetric expansion test equipment (levelling burette method)

C.2.3 Water jacket volumetric expansion test (fixed burette method)

An example of the test equipment is shown in Figure 3.

The procedure is as follows:

- (a) Fill the cylinder(s) with water and attach to the water jacket cover.
- (b) Seal the cylinder(s) in the jacket and fill the jacket with water, allowing the air to bleed off through the air bleed valve.
- (c) Connect the cylinder(s) to the pressure line. Adjust the water level in the burette to a datum on the burette scale. Apply pressure until the test pressure is reached, close the hydraulic pressure line valve and stop pumping. Record the reading on the burette when it is constant. The reading above the datum is the total expansion and shall be recorded on the test certificate.
- (d) A rise in the water level may indicate either a leaking joint between the cylinder(s) and the jacket or a faulty cylinder.
- (e) Release the pressure and record the burette reading. The reading above the datum is the permanent expansion and shall be recorded on the test certificate.
- (f) Calculate the permanent volumetric expansion as a percentage of the total expansion from the following equation:

$$\frac{\text{Permanent expansion}}{\text{Total expansion}} \times 100\% = \% \text{ Permanent expansion}$$

- (g) The permanent expansion of the cylinder expressed as a percentage of the total expansion at test pressure shall not exceed 10% or as stipulated by the manufacturer.

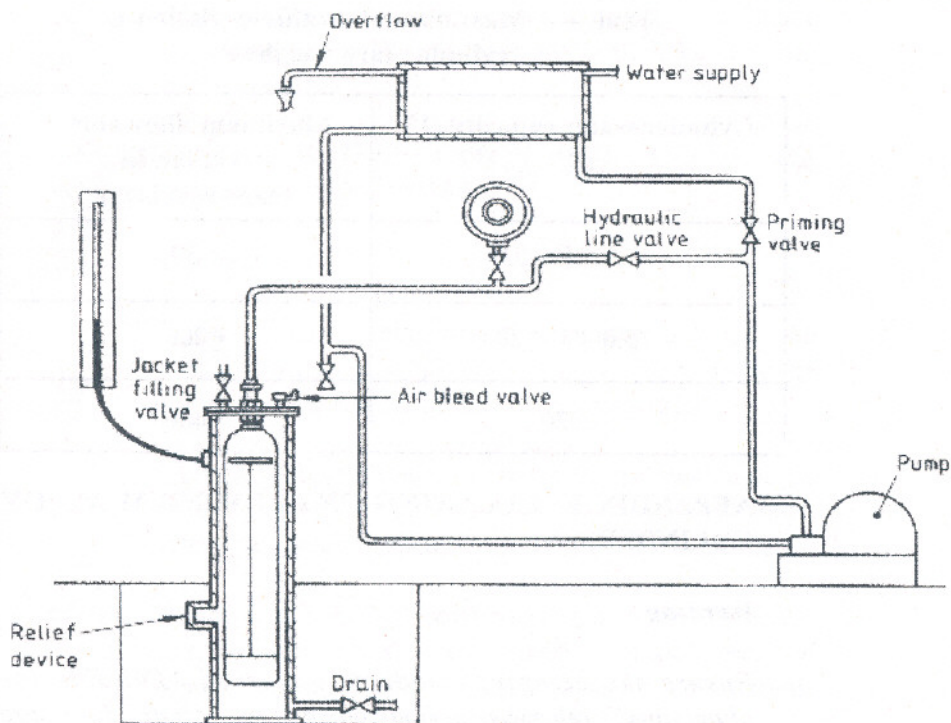


Figure 3 : Example of the water jacket volumetric expansion test equipment (fixed burette method)

APPENDIX D : TARE/EMPTY WEIGHT

The tare/empty weight of cylinders used for permanent gases shall exclude removable fittings.

The tare/empty weight of cylinders used for liquefiable gases shall include the mass of the cylinder, valve(s) and all permanent fittings.

If the tare/empty weight of the cylinder differs from the stamped tare by more than the value shown in Table 4 and it is not due to reasons of damage, the original tare shall be cancelled and the correct tare shall be marked in a permanent and legibly fashion.

Table 4 – Maximum allowable deviation in cylinder tare weight

Cylinder water capacity (<i>V</i>) (l)	Maximum allowable deviation in tare weight(g)
$0,5 \leq V < 5,0$	± 50
$5,0 \leq V \leq 20$	± 200
> 20	± 400

APPENDIX E: CLEANING OF ALUMINIUM ALLOY CYLINDERS

Warning

Ensure the cleaning product is marked "Suitable for aluminium"; otherwise serious damage will occur. To ensure gas compatibility completely remove the cleaning agent, or check that the final cleansing operation is compatible with the intended gas service.

Internal

Aluminium alloy cylinders in normal service can accumulate internal contamination which may detrimentally affect use. Table 5 illustrates procedures for cleaning the interior of aluminium alloy cylinders.

Table 5 – Procedures for cleaning the interior of aluminium alloy cylinders

Contamination	Cleaning method
Moisture or loose particles	Steam clean and blow dry
Oil and grease	Degrease with suitable solvent , steam clean and blow dry
Odour	Rinse with solution of sodium bicarbonate, then rinse with solution of acetic acid, steam clean and blow dry
Corrosion	Tumble with aluminium oxide chips or pellets, or glass beads, steam clean and blow dry
NOTE Ensure all traces of cleaning agent have been removed.	

External

The following procedures are examples for cleaning external surfaces:

- (a) Soap and water;
- (b) Solvent wipe;
- (c) A scouring pad and water.

REFERENCES

- IS 5430 Part 1:1990 Periodic inspection, testing and maintenance of transportable gas containers (excluding dissolved acetylene containers). Part 1- Specification for seamless steel containers of water capacity 0.5 litre and above.

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|----------------------------|--|
| BS 5430 Part 2 1990 | Periodic inspection, testing and maintenance of transportable gas containers (excluding dissolved acetylene containers). - Part 2. Specification for welded steel containers of water capacity 0.5 litre up to 150L. |
| BS 5430 Part 3 1990 | Periodic inspection, testing and maintenance of transportable gas containers (excluding dissolved acetylene containers). - Part 3. Specification for seamless aluminium alloy containers of water capacity 0.5 litre and above. |
| BS 5045 Part 1 1982 | Transportable gas containers. - Part 1. Specification for seamless steel containers above 0.5 litre water capacity. |
| BS 5045 Part 2 1989 | Transportable gas containers. - Part 2. Specification for steel containers of 0.5 L up to 450L water capacity with welded seams. |
| BS 5045 Part 5 1986 | Transportable gas containers. - Part 5. Specification for aluminium alloy containers above 0.5 litre up to 130 litres water capacity. |
| BS 5045 Part 7 2000 | Transportable gas containers. - Part 7. Specification for seamless steel gas containers of water capacity 0.5 litre up to 15 litres for special portable applications. |
| BS 5045 Part 8 2000 | Transportable gas containers. - Part 8. Specification for seamless aluminium alloy gas containers of water capacity 0.5 litre up to 15 litres and up to 300 bar charged pressure at 15°C for special portable applications. |
| BS EN 1440:1997 | Transportable refillable welded steel cylinders for liquefied petroleum gas (LPG) – Periodic requalification. |

BS EN 1802:2002	Transportable gas cylinders – Periodic Inspection and testing of seamless aluminium alloy gas cylinders.
BS EN 1803:2002	Transportable gas cylinders – Periodic Inspection and testing of welded carbon steel gas cylinders.
BS EN 1968:2002	Transportable gas cylinders – Periodic inspection and testing of seamless steel gas cylinders.
ISO 6406 1992	Periodic inspection and testing of seamless steel gas cylinders.
ISO 10286 1992	Gas cylinders – Terminology.
SS11 Rev 1 1996	Standard Specification for periodic inspection and testing of refillable gas cylinders.

Acknowledgement is made for the use of information from the above publications.

MADE this 21st day of February., 2005.

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