GENERAL STANDARD

FOR

GAS CYLINDERS

CONTENTS :

PAGE No.

APPENDICES:

1. SCOPE

This Standard specifies the technical requirements for the design, material, construction and inspection of the portable refillable various gas cylinders, such as Dissolved Acetylene, L.P.G. Nitrogen, Oxygen, Air, Argon, Helium, Hydrogen as specified hereinafter in this Standard. Such cylinders are constructed of welded or seamless steel in various nominal water capacities.

2. REFERENCES

Throughout this Standard the following standards are referred to. The editions of these standards and codes that are in effect at the time of publication of this Standard shall, to the extent specified herein, form a part of this Standard. The applicability of changes in standards and codes that occur after the date of this Standard shall be mutually agreed upon by the Company and the Vendor/Consultant.

BSI (BRITISH STANDARDS INSTITUTION)

BS 349-1973	"Specification for Identification of the Contents of Industrial Gas Containers"
BS 509 Part 1 (1993)	"Specification for Acetone"
BS 1780 (1992)	"Specification for Bourdon Tube Pressure and Vacuum Gages"
BS 5045-1982 Parts 1 and 2	"Transportable Gas Containers"
BS 6061-1981	"Transportable Acetylene Containers"

ISO (INTERNATIONAL ORGANIZATION FOR STANDARDIZATION)

4706-1989	"Refillable Welded Steel Gas Cylinders"
3807-1977	"Dissolved Acetylene Cylinders-Basic Requirements"
5145-1990	"Cylinder Valve Outlets For Gases and Gas Mixture-Selection and Dimensioning"
10462-1994	"Cylinder for Dissolved Acetylene-Periodic Inspection and Maintenance"

ISIRI (INSTITUTE OF STANDARDS AND INDUSTRIAL RESEARCH OF IRAN)

473-1991	"L.P.G. Gas Cylinder"
1526-1991	"High Pressure Gas Cylinders"

DOT (DEPARTMENT OF TRANSPORTATION)

IPS (IRANIAN PETROLEUM STANDARDS)

IPS-M-TP-190	"Coal Tar Epoxy (Polyamide) Paint as Primer, Intermediate and Top Coat (Finish)"
IPS-M-TP-250	"Amine Cured Epoxy as Primer, Intermediate and Top Coat"

3. DEFINITIONS AND TERMINOLOGY

For the purpose of this Standard, the following definitions shall apply:

3.1 L.P.G.* Cylinder

A portable container constructed of specific steel material having water capacity of not less than 0.3 or exceeding more than 100 litters with the design pressure of 17.5 kg/cm² (250 psi).

3.2 Water Capacity

The amount of water, in either kg or liters, at 15°C (60°F) required to fill a container liquid full of water.

3.3 Filling Ratio

The filling ratio is the ratio of the mass of gas introduced into a container to the mass of water at 15°C that fills the container fitted as for use.

3.4 High Pressure Cylinder

A transportable container constructed of specific steel material having maximum water capacity of 450 kg with the design pressure of not less than 130 atmosphere.

3.5 Dissolved Gas

A gas that is dissolved under pressure in a solvent contained in porous substance at ambient temperature and that is released from that solvent without application of heat.

3.6 Dissolved Acetylene Cylinder

A vessel having a valve, and with or without safety devices, containing a porous mass, a solvent for the storage of dissolved acetylene and at least sufficient acetylene to saturate the solvent at atmospheric pressure and at a temperature of 15°C.

3.7 Tare

The mass of the cylinder, having a valve (but excluding a valve cover), containing a porous substance, a solvent for the storage of dissolved acetylene, the acetylene required to saturate the solvent at atmospheric pressure and at a temperature of 15°C and any valve protection permanently fixed directly to the container.

3.8 Yield Stress

Throughout this Standard the term "yield stress" means the upper yield stress ReH, or, for steels that do not exhibit a defined yield, the 0.2% proof stress (non-proportional elongation) Rp 0.2.

3.9 Operating Pressure

The pressure of a cylinder at which it normally operates and shall not exceed the maximum allowable working pressure.

3.10 Maximum Allowable Working Pressure

The maximum allowable working pressure (MAWP) of a cylinder stipulates the design limit of the cylinder, and does not represent the operating point.

*** L.P.G. = Liquefied Petroleum Gas.**

3.11 Design Pressure

The pressure used in determining the minimum permissible thickness or physical characteristics of the different parts of the cylinders.

3.12 Reference Temperature for Filling Ratio

The temperature at which the liquid density is to be evaluated for calculating the filling ratio.

3.13 Authorized Body

The authority having jurisdiction is the organization, office or individual responsible for approving equipment, an installation or a procedure.

4. UNITS

This Standard is based on International System of Units (SI), except where otherwise specified.

5. REQUIREMENTS

5.1 Requirements for Transportable Acetylene Cylinders

5.1.1 Material

5.1.1.1 The material used for the cylinders shall be free of crack, breakage, mill-spot, lamination or any other defects.

5.1.1.2 The chemical composition and mechanical properties of materials used for the cylinders shall comply with Table 2 of BS 5045 Part 2 and the permissible deviations on product analysis shall comply with Table 3 of above-mentioned standard.

5.1.2 Design

5.1.2.1 Different parts of cylinders shall be designed in accordance with BS 5045 Part 2. The reference temperature for calculation shall be 85°C.

5.1.2.2 Circumference

The external circumference of the cylindrical shell of the completed cylinder shall not depart by more than ±0.25% from the circumference calculated from the nominal outside diameter (equal to the nominal internal diameter plus twice the actual plate thickness).

5.1.2.3 Cylinderically

The maximum deviation of the cylindrical part of the shell from a straight line shall not exceed 0.3% of the cylindrical length.

5.1.2.4 Circularity

The difference between the maximum and minimum external diameters measured at any cross section of the completed cylinder shall not exceed 1% of the specified internal diameter.

5.1.3 Cylinders shall be equipped with a suitable fusible plug which shall be externally marked to indicate the temperature at which they are designed to relative pressure.

5.1.4 Welding and heat treatment of cylinders shall be done in accordance with BS 5045 Part 2.

5.1.5 Valve

Cylinders shall be equipped with a valve. The valve shall be in accordance with BS 341. Where the valve body is manufactured from an alloy containing copper, the alloy shall not form dangerous acetylides and the copper content shall not exceed 70%.

The manufacturer of the valve shall not employ any process that will result in surface enrichment of copper. The valve shall be protected by a cap. The construction of the cap shall be such that it is nowhere in contact with any part of the valve. The valve cap shall be provided with a side vent(s) of such size as to prevent any gas pressure accumulating inside the cap, unless the cap and its fixing are designed to withstand the pressure that could be developed in the cylinder by the contents at the reference temperature.

5.1.6 New cylinders shall withstand all the tests specified in BS 5045 Part 2.

5.1.7 Porous substance

The porous substance in the container shall be of such quality that it enables the charged container to pass the safety tests included in Appendix A of BS 6061 or Appendix A of ISO 3807.

Note:

It should be considered that the reference temperature for tests shall be 85°C instead of 65°C.

There shall be no deleterious reaction between the porous substance, the acetylene, the solvent and any materials in contact with acetylene.

5.1.8 Solvent

5.1.8.1 The quantity of solvent charged into the cylinder shall be such that the container can meet the requirements of the tests included in Appendix A of BS 6061 or ISO 3807.

Note:

It should be considered that the reference temperature for tests shall be 85°C instead of 65°C.

5.1.8.2 When acetone is used as the solvent it shall comply with the requirements of BS 509.

Note:

Acetone is the preferred solvent.

5.1.8.3 The total mass of acetylene to be charged into a cylinder shall not exceed the amount authorized by the manufacturer or any other authorized body.

5.1.8.4 When the container has been charged with acetylene and the pressure has reached equilibrium, the gage pressure in the container at 15°C shall not exceed the maximum permitted pressure.

5.1.9 Color identification

Each cylinder shall be painted maroon in accordance with BS 349.

5.1.10 Marking and identification

5.1.10.1 Each container shall be stamped on the shoulder or on a reinforced part of the container or on the collar or neck ring with the following marks:

a) the name of the gas 'Acetylene';
b) identification of the manufacturer together with the serial number of the completed container;
c) identification of porous substance;
d) identification mark of owner;
e) tare (see 3.7) i.e. a number and an indication of the units used;
f) maximum mass of acetylene to be charged into the container, excluding saturation mass of acetylene;
g) identification of the solvent when not acetone;
h) maximum permissible pressure at 15°C.

5.1.10.2 In addition to the above markings, other markings such as the last date on which the porous substance was examined and found to be satisfactory, may also be included provided that these are made in such a way that they are separate from the above markings.

5.1.11 Information to be available from the manufacturer

The manufacturer shall always be able to provide the following information concerning the completed container:

a) identification of approving authority;
b) specification to which the shell is made;
c) test pressure and date of test;
d) date of manufacture of the container;
e) type of solvent;
f) tare and make-up of tare (i.e. mass of shell and fittings, mass of porous substance, mass of solvent and saturation gas allowance).

5.1.12 Information to be available from the owner

A record shall be kept by the owner for the lifetime of the container and shall include the items specified in (a) to (f) of Clause 5.1.11 together with the following information:

a) the dates upon which visual examination was carried out;
b) the name of the company and the address of the works where this was done;
c) identification of the examiner.

In addition a record of each gas charge and solvent addition shall be retained by the filler for three months from the date of charging.

5.1.13 Periodic inspection and maintenance of dissolved acetylene cylinders shall be done in accordance with ISO 10462 (1994).

5.2 Requirements for L.P.G Cylinders

L.P.G cylinders with a water capacity of 0.3 up to 100 liters shall be designed, manufactured, tested and inspected in accordance with ISIRI 473.

5.3 Requirements for High Pressure Seamless Cylinders for Nitrogen, Air, Argon, Helium, Hydrogen and Oxygen

5.3.1 General

This clause covers the specification of high pressure seamless cylinders with a water capacity of up to 450 kg and maximum allowable working pressure of 130 atmosphere.

The material used for design requirements for high pressure seamless cylinder shall be free of cracks, mill-spots, breakage, lamination or other defects, and tested according to the procedures specified in this Standard.

The following specification shall be considered in the design and manufacturing of cylinders.

5.3.1.1 The maximum percentage of the carbon, phosphorous and sulfur on ladle analysis for steel used on manufacturing of high pressure cylinders shall be as below, but the most recommended material is given in 5.3.5.

- Maximum percentage of carbon 0.55%.
- Maximum percentage of phosphorous 0.045%
- Maximum percentage of sulfur 0.05%

For the steel with the above mentioned analysis the following formula shall be used for calculating the wall thickness of high pressure seamless cylinders:

$$S = \frac{P\left(\frac{1}{3}D^2 + 0.4\,d^2\right)}{D^2 - d^2}$$

Where:

S = Shell stress in kg/cm²
P = Minimum hydrostatic test pressure in kg/cm²
D = External diameter in cm
d = Internal diameter in cm

In addition, the following shall be considered:

a) The minimum wall thickness of cylindrical shell of cylinders with external diameter of more than 12.7 cm shall not be less than 2.5 mm.

b) The thickness of cylinders in general shall be such that the value of wall stress calculated by formula given in 5.3.1.1 not exceed 3750 kg/cm² or 67% of the tensile strength of the cylinder metal.

c) The thickness of the bottom of the cylinder in any condition shall not be less than twice the minimum thickness of cylindrical part of the cylinder.

5.3.2 Fabrication method

5.3.2.1 Inner and outer surface of cylinder shall be smooth and uniform.

5.3.2.2 All threaded opening for (valves, plugs, safety valves, etc.) shall be clean, uniform and in a sound condition. The engaged threads of valves, plugs, etc. with cylinder shall be at least 6. The calculated shear strength for threads shall be at least 10 times of test pressure.

5.3.3 Welding

5.3.3.1 Electrical arc welding and brazing shall not be used during fabrication.

5.3.4 Heat treatment

5.3.4.1 Each cylinder, after the completion, shall be uniformly heat treated so that to withstand all required tests (See 5.3.8).

The operations involving heating shall be carried out carefully in furnaces equipped to control temperatures accurately, and the cylinders shall be maintained at the stipulated temperatures for the length of time necessary to ensure that all parts have reached the required temperature and all necessary metallurgical changes have been effected.

5.3.4.2 Heat treatment shall be accomplished after all forming and welding operations.

5.3.5 Materials

Open-hearth, basic oxygen, or electric steel of uniform quality shall be used. The chemical analysis of steel shall comply with code CM of Table 2 of BS 5045 Part 1 or with 4130X DOT § 178.37-8. Any equivalent material is acceptable. The mechanical properties of steel in finished cylinder shall comply with Table 3 of BS 5045 for pertinent code.

5.3.6 Cylinder valve

The valve body shall not be manufactured from materials that are subject to porosity or brittleness. Screw-threaded valve outlet connections shall be right-hand on cylinders used for non-flammable gases and left-hand on cylinders used for flammable gases.

5.3.7 Valve protection

5.3.7.1 Containers intended for the transport of toxic and/or flammable gases shall have their valves protected against damage, either by the design of cylinder or by the provision of suitable cap or shroud securely attached to the body of the cylinder.

5.3.7.2 Construction of the cap or shroud shall be such that it is nowhere in contact with any part of the valve.

5.3.7.3 The valve cap or shroud shall be provided with a side vent of such size as to prevent any gas and/or liquid accumulating inside the cap or shroud.

5.3.8 Pressure relief device

5.3.8.1 No pressure relief device shall be fitted to cylinder intended for the conveyance of toxic gases.

5.3.8.2 Material of construction for all pressure relief devices shall be compatible with the gas to be conveyed and other service conditions.

5.3.8.3 All pressure relief devices shall be so designed and fitted as to ensure that the cooling effect of the contents of the cylinder during discharge shall not prevent the effective operation of the devices.

5.3.8.4 The outlets from all pressure relief devices shall be so sited that free discharge from the devices is not impaired.

5.3.9 Painting

Coal tar epoxy paint (IPS-M-TP-190) shall be applied in thickness of 300 micron to the finished external surface of cylinders as a primer. For top coat amine cured epoxy conforming to IPS-M-TP-250 shall be applied with a thickness of 100 micron. The shade of final coat shall conform to BS 349.

5.3.10 Testing

5.3.10.1 Hydrostatic pressure test

All manufactured cylinders, after heat treatment operations and before any coating or valve attachments shall be subjected to water jacket test. The pressure test for each cylinder shall be $^{5}/_{3}$ of working pressure of the cylinders.

After this test no sign of leakage or crack, lumps penetration or corrosion shall be seen and also the permanent expansion of cylinder shall be less than 10% of its volume.

5.3.10.1.1 For pressure test the method described in Appendix A, shall comply and thus for expansion test the method described in Appendix B shall comply.

5.3.10.1.2 Number of cylinder to be tested

The hydrostatic pressure test for each lot shall be based on the randomly selected number of cylinders as indicated in the Table below:

RANDOM CYLINDER SELECTING FOR HYDROSTATIC TEST

No. of Cylinder in Each Group (lot)	No. of Cylinder to be Tested
200 or less From 200 up to 1000 From 1000 and more	1 Each 200 one 6

5.3.10.2 Physical tests

Physical test shall be required to determine yield strength, tensile strength, elongation, and reduction of area of material. The test procedure shall conform to Clause 178.51-15 DOT. Regulations or in accordance with "ISIRI" Standard No. 1526.

5.3.10.3 Flattening test

For this test the specimen cylinder shall be placed at 60° angle between knife edges such that the bending radius at its edge is 12.7 mm (½") and applied enough force so as to maintain distance between two inner edges of specimen, 6 times that of cylinder wall thickness. The specimen shall be taken at random from each lot of 200 cylinders or less after hydraulic test.

The acceptable result of physical and flattening tests are as follows:

a) In physical test, the minimum relative elongation shall be 40% of the 50 mm effective length or 20% for 200 mm effective length and the yield strength shall not exceed 73% of tensile strength of the material. In such a case the flattening test is not necessary.

b) In physical test, the minimum relative elongation shall be 20% of the 50 mm effective length or 10% for 200 mm effective length and the yield strength shall not exceed 73% of tensile strength of the material. In this case the flattening test shall be applied, and the result shall be as below:

While the level of internal distance between two specimen from each other is equal 6 times the thickness of the cylinder, crack or breakage shall not be seen.

5.3.10.4 Leakage test

All cylinders shall be tested for leakage by gas or air pressure after the bottom has been cleaned and is free from all moisture. Pressure, approximately the same as but no less than service pressure, shall be applied to one side of the finished bottom over an area of at least $^{1}/_{16}$ of the total area of the bottom but not less than 20 mm in diameter, including the closure, for at least 1 minute, during which time the other side of the bottom exposed to pressure must be covered with water and closely examined for indication of leakage. Leakes shall be rejected.

5.3.11 Marking

The following information shall be permanently and legibly marked at the shoulder of the high pressure cylinders.

a) The chemical abbreviation formula of the gas it contains as specified in Table below:

CHEMICAL FORMULA

NAME OF GAS	FORMULA
Argon	Ar
Air	*
Acetylene	C_2H_2
Helium	He
Hydrogen	H_2
Nitrogen	N_2
Oxygen	O_2

*** Abbreviation formula not marked on cylinder in this case.**

b) Name or trade mark of manufacturer.
c) The water capacity of the cylinder in litre.
d) The net weight of the cylinder (excluding valve and cap) in kg.
e) Serial number of cylinder.
f) Testing pressure in kg/cm².
g) Date of pressure test (year and month).
h) Maximum allowable working pressure (kg/cm³).
i) The name of gas to be filled in cylinder.

6. INSPECTION

6.1 The purchaser's inspector, or his authorized representative shall have free access to the manufacturing plant engaged in the manufacture of the cylinder, to carry out necessary inspection at any stage of work.

6.2 Inspection may include visit to quality control laboratories, workshops, testing bay etc.

6.3 All materials supplied under this Standard shall subject to timely inspection by the Purchaser or his authorized representative.

6.4 The Purchaser shall have the right to reject any material(s) supplied which is (are) found to be defective under this Standard Specification.

6.5 Inspection of the cylinder shall be made at the manufacturer's plant, point of shipment or at the place of delivery as agreed upon between the manufacturer and the customer.

6.6 Inspection procedure for weldings shall be approved by the Purchaser.

6.7 The cylinder may be rejected if inspection reveal any discrepancies between quoted figures and purchase order.

6.8 The supplier shall maintain appropriate inspection and test records to substantiate conformance with specified requirements and made available on request by purchaser.

6.9 Approval by the Purchaser's inspector or assigned representative shall not relieve the Vendor of his commitments under the terms of this specification or any associated order.

6.10 All repairs shall meet the inspection requirements and acceptance standards for the original material. After weld repair, cylinder shall be suitably heat-treated. Details of the weld repairs, and of the heat-treatment where applicable, shall be recorded and reported to the Purchasers.

6.11 The supplier shall make available technical data, test facilities and samples that the Purchaser's representative may require for verification in conjunction with pertinent product.

7. DRAWINGS AND TECHNICAL DOCUMENTS

7.1 At Quotation Stage

Documents to be submitted by manufacturer/supplier shall give the following as complete:

a) Report of experience.
b) Drawings and documents which define the technical data of required commodity (ies).
c) List of tests which may be made on his work.
d) Complaint and compensation polices.
e) Declaration of any certificate from any impartial laboratory "if any".

7.2 At Ordering Stage

a) A copy of test certificate.
b) Quality assurance certificate.

8. CONFLICTING REQUIREMENTS

In case of conflict between documents relating to the inquiry or purchase order the following priority of documents shall apply:

- First priority : purchaser order (including attachments) and variations thereon.
- Second priority : data sheets and drawing.
- Third priority : this specification.

All conflicting requirements shall be referred to the Purchaser in writing. the purchaser will issue confirmation document if needed for clarification.

9. GUARANTEE AND WARRANTY

Unless exception is recorded by the Vendor in his proposal, it shall be understood that the Vendor shall, with all possible speed and without cost to the Purchaser, replace or repair the cylinder or any part thereof found to be defective due to faulty martial, workmanship or to any act or omission of the Vendor, in particular the Vendor shall reimburse any transportation and other charges incurred by the Purchaser in effecting such replacement or repair.

10. PACKING

10.1 Cylinders must be carefully packed to provide necessary protection during transit to destination.

10.2 Special attention must be given to protection against corrosion damages or defects which may occur during handling, sea shipment to the port and rough road.

10.3 The supplier shall provide methods of handling to prevent damage and/or deterioration during transit.

11. LANGUAGES

11.1 All correspondence, drawings, documents, certificates, including testing, operation, maintenance and repairs manuals, etc. shall be in English.

11.2 Offers in other languages will not be considered.

APPENDICES

APPENDIX A
HYDRAULIC PRESSURE TEST

A.1 General

This Appendix describes an example of a method for carrying out the hydraulic pressure test.

Containers if tested in batches shall be of the same test pressure, established as described in section three BS 5045: Part 2: 1989 which shall not be exceeded by 3% or 10 bar, whichever is the lower.

A.2 Equipment

A.2.1 All rigid pipework, flexible tubing, valves, fittings and components forming the pressure test equipment should be capable of withstanding a pressure 1.5 times the maximum test pressure of any container that may be tested. Flexible tubing should have sufficient wall thickness to prevent kinking.

A.2.2 Pressure gages should comply with the requirements of the industrial class of BS 1780 and have a scale range appropriate to the container test pressure. They should be tested and recalibrated as necessary, at regular intervals and in any case not less frequently than once per month against a dead weight tester.

A.2.3 A device should be fitted to the test equipment to ensure that no container is subjected to a pressure in excess of its test pressure by more than the tolerances in A.1.

A.2.4 All joints shall be leak tight.

A.2.5 The design and installation of the equipment and of the containers connected to it should be such as to avoid trapping air in the system.

Note:

An example of the equipment required is shown in Fig. 1.

A.3 Procedure

Carry out the following procedures:

a) Completely fill all container(s) with water.

b) Connect the container(s) to the test equipment as shown in Fig. 1, leaving all valves open.

c) Fill the pump and pipework system with water and close the air bleed valve when water appears. Close the bypass valve.

d) Remove any excess water from the outside of the container(s).

e) Operate the pump until the test pressure is reached. Stop the pump and close the hydraulic line valve.

f) Check that the test pressure remains constant for a minimum period of 1 min.

g) Inspect the container(s) visually. The presence of water is an indication of either:

1) A leaking connection to a container, or
2) a leak in a test container.
In case (1): The system is depressurized, the connection made good and the test repeated on the batch.
In case (2): The faulty container(s) is isolated and the test continued on the remainder of the batch.

h) If at the end of the test period the pressure in the system has fallen, this may indicate that one or more of the containers has failed under pressure.

In this event the whole test batch is retested, individually if necessary, to identify the faulty container(s).

APPENDIX B
HYDRAULIC EXPANSION TEST

B.1 General

This Appendix gives details of the water jacket method for determining the expansion of welded steel gas containers.

The water jacket expansion test may be carried out using equipment with a levelling burette or with a fixed burette.

B.2 Equipment

B.2.1 Hydraulic test pressure pipelines should be capable of withstanding a pressure twice the maximum test pressure of any container that may be tested.

B.2.2 Glass burettes should be of sufficient length to receive water equivalent to the full volumetric expansion of the container and capable of being read to an accuracy of 1 mL.

B.2.3 Pressure gages should comply with the requirements of the Industrial Class of BS 1780. They should be tested at regular intervals and in any case not less frequently than once per month.

B.2.4 A device should be fitted to ensure than no container is subjected to a pressure in excess of its test pressure.

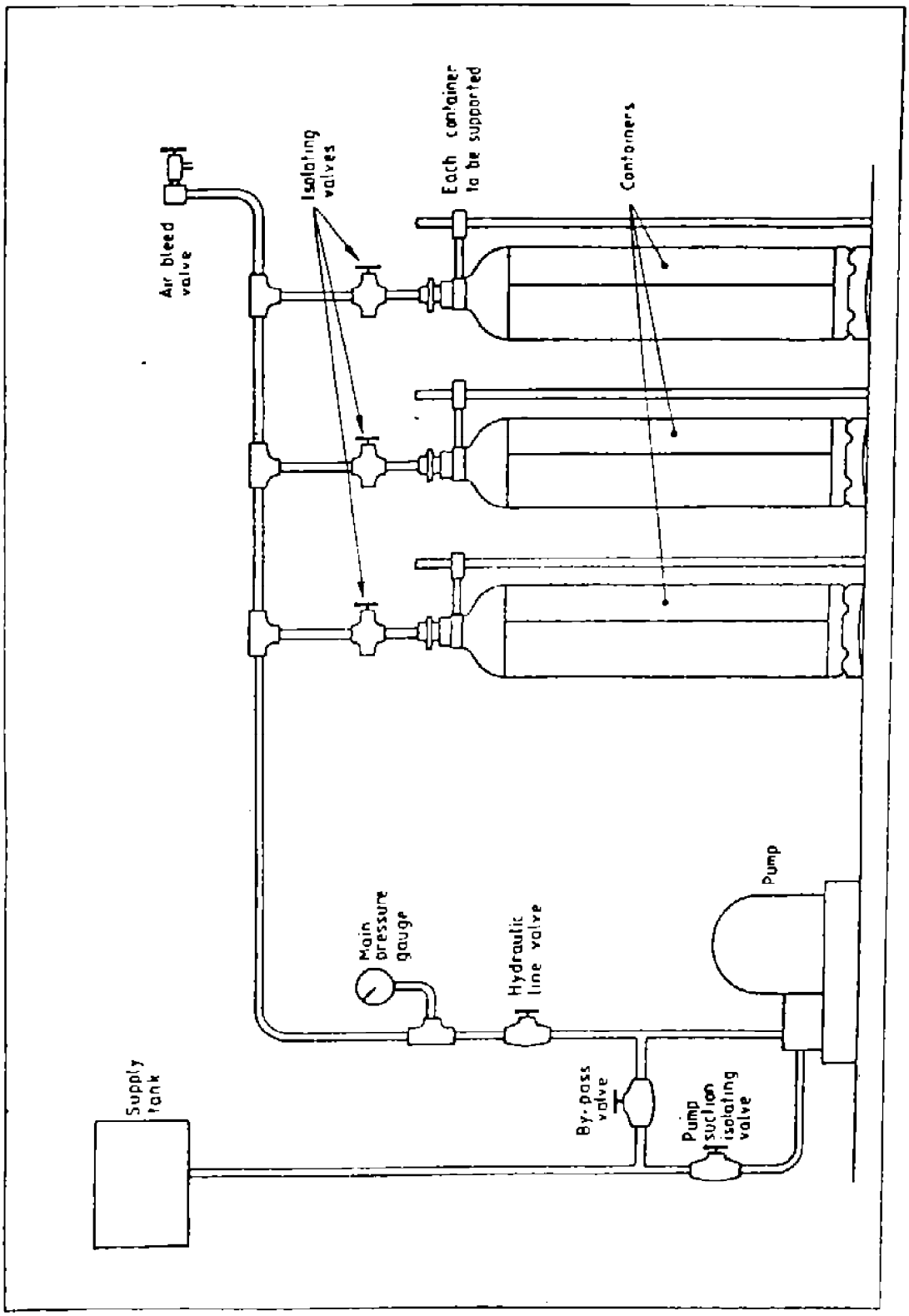
B.2.5 Pipework should use long bends in preference to elbow fittings, and pressure pipes should be as short as possible. Flexible tubing should be capable of withstanding twice the maximum test pressure in the equipment and have sufficient wall thickness to prevent kinking.

B.2.6 All joints shall be leak tight.

B.2.7 The installation of the equipment should be such as to avoid trapping air in the system.

Note:

B.2.1 to B.2.7 are general to both methods of test.



EXAMPLE OF HYDRAULIC PROOF PRESSURE TEST EQUIPMENT
Fig. 1

B.3 Water Jacket Expansion Test

B.3.1 Principle

This method of test necessitates enclosing the water-filled container in a jacket also filled with water. The total volumetric expansion of the container is measured by the amount of water displaced from the jacket when the container has been pressurized. The permanent volumetric expansion of the container is measured by the amount of water which continues to be displaced from the jacket when the pressure has been released.

B.3.2 Additional equipment

The water jacket should be fitted with a safety device capable of releasing the energy from any container that may burst at the test pressure. An air bleed valve should be fitted to the highest point of the jacket.

B.3.3 Procedure

B.3.3.1 General

Two methods of performing this test are described in B.3.3.2 and B.3.3.3. Other methods are acceptable provided that they are capable of measuring the total and, if any, the permanent volumetric expansions of the container.

B.3.3.2 Water jacket expansion test

Levelling burette method. An example of the equipment required is shown in Fig. 2 but other types of installation may be acceptable.

Carry out the following procedures:

a) Fill the container with water and attach the water jacket cover to it.

b) Seal the container in the jacket and attach the pressure line to the container.

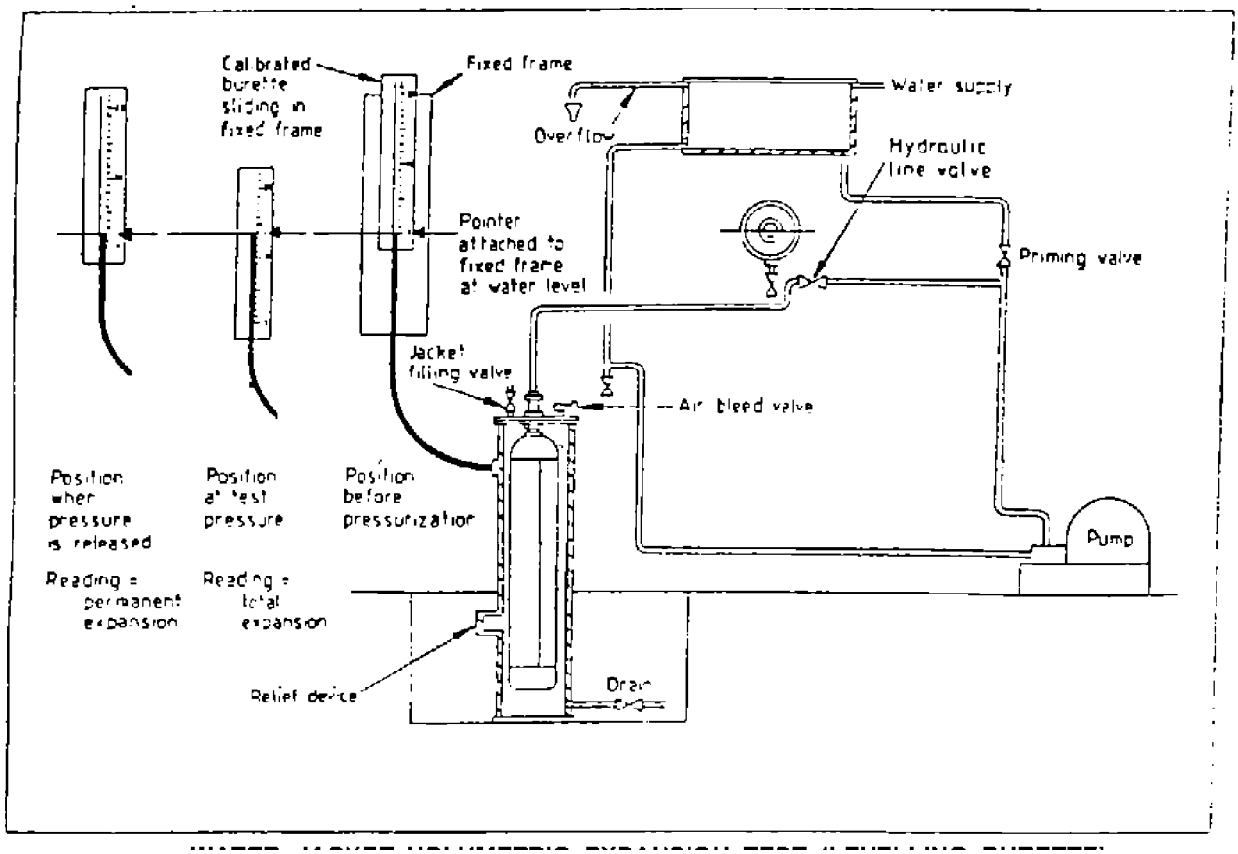
c) Fill the jacket with water, allowing air to bleed off through the air bleed valve. Close the air bleed valve when water issues freely from it.

d) Adjust the zero level on the burette to the datum mark on the burette support stand. Adjust the height of the water to the burette zero level by manipulation of the jacket filling valve and the drain valve.

e) Raise the pressure in the container to two-thirds of the test pressure. Close the hydraulic line valve and check that the burette reading remains constant.

Note:

A rising water level indicates a leaking joint between the container and the jacket. A falling water level indicates a leaking joint between the water jacket and the atmosphere.



WATER JACKET VOLUMETRIC EXPANSION TEST (LEVELLING BURETTE)
Fig. 2

f) Open the hydraulic line valve and continue the pressurization of the container until the test pressure is reached. Close the hydraulic line valve.

g) Lower the burette until the water level is at the datum mark on the burette support stand. Take the reading of the water level in the burette. Record this reading, the total expansion, on the test certificate.

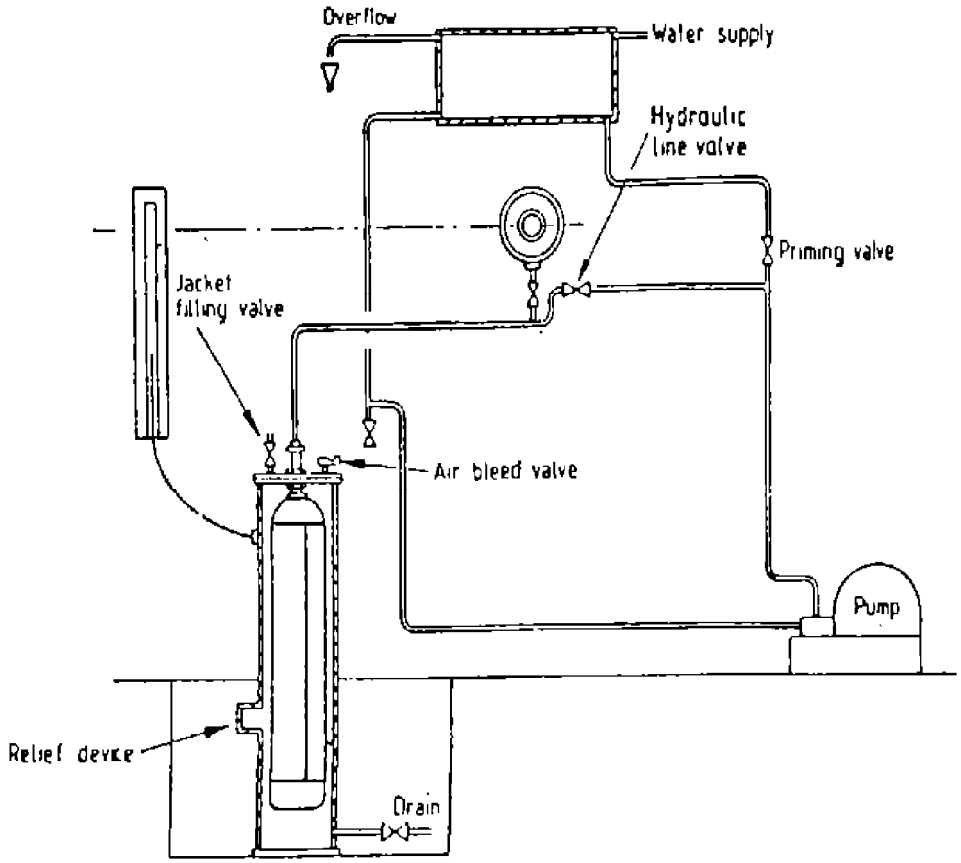
h) Open the hydraulic line drain valve to release pressure from the container. Raise the burette until the water level is again at the datum line on the burette support stand. Check that the pressure is at zero and that the water level is constant.

i) Check that the permanent expansion does not exceed 10% of the total expansion as determined by the following equations:

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

B.3.3.3 Water jacket volumetric expansion test

Fixed burette method. An example of the equipment required is shown in Fig. 3 but other types of installation may be acceptable.



WATER JACKET VOLUMETRIC EXPANSION TEST (FIXED BURETTE)
Fig. 3

Carry out the following procedures:

a) Fill the container with water and attach the water jacket cover to it.

b) Seal the container in the jacket and attach the pressure line to the container.

c) Fill the jacket with water, allowing air to bleed off through the air bleed valve. Close the air bleed valve when water issues freely from it.

d) Adjust the water level to the zero mark on the burette by manipulation of the jacket filling valve and the drain valve.

e) Raise the pressure in the container to two-thirds of the test pressure. Close the hydraulic line valve and check that the burette reading remains constant.

Note:

A rising water level indicates a leaking joint between the container and the jacket. A falling water level indicates a leaking joint between the water jacket and the atmosphere.

f) Open the hydraulic line valve and continue the pressurization of the container until the test pressure is reached. Close the hydraulic line valve.

g) Read the level of the water in the burette. Record this reading, the total expansion, on the test certificate.

h) Open the hydraulic line drain valve to release pressure from the container. Check that the pressure is at zero and that the water level is constant.

i) Read the level of the water in the burette. Record this reading, the permanent expansion, if any, on the test certificate.

j) Check that the permanent expansion does not exceed 10% of the total expansion as determined by the following equation:

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

DATA SHEET
FOR
GAS CYLINDERS (L.P.G., ACETYLENE, HIGH PRESSURE)

a) General

Project:.....Location: .....
Order No.: .....
Manufacturer: .....
Site Hazard Class: .....
Mountings:..... Enclosed space: .....Open space: .....
Space Application:..... Commercial:..... Residential: ..... Industrial: .....

b) Specified Requirements

Capacity(Net):.....m^3 ..... Litres
Design pressure:..... kg/cm^2..... Working pressure: ..... kg/cm^2
Hydrostatic test pressure: ..... kg/cm^2
Air test: ..... kg/cm^2

c) Test Certificates

Materialtest:.....Analysis:.....
Welding test: .....
Structural test: .....
Rupture test: .....

d) Physical Data

Weight:kg(lbs).....net,.....gross
Dimension : ..... Ht.: ..... mm Dia: .....mm, Thickness.....mm