ΠΑΡΑΡΤΗΜΑ ΤΡΙΤΟΝ

ΤΗΣ ΕΠΙΣΗΜΟΥ ΕΦΗΜΕΡΙΔΟΣ ΤΗΣ ΔΗΜΟΚΡΑΤΙΑΣ

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ΔΙΟΙΚΗΤΙΚΑΙ ΠΡΑΞΕΙΣ

ΜΕΡΟΣ I

Κανονιστικαὶ Διοικητικαὶ Πράξεις

Ἀριθμὸς 125

Ο ΠΕΡΙ ΚΥΠΡΙΑΚΩΝ ΠΡΟΤΥΠΩΝ ΚΑΙ ΕΛΕΓΧΟΥ ΠΟΙΟΤΗΤΟΣ ΝΟΜΟΙ ΤΟΥ 1975 ΚΑΙ 1977

(68 ΤΟΥ 1975 ΚΑΙ 6 ΤΟΥ 1977)

Ἀναφορικῶς πρὸς τοὺς δημοσιευθέντας εἰς τὴν ἐπίσημον ἐφημερίδα τῆς Δημοκρατίας Κανονισμοὺς περὶ Κυπριακῶν Προτύπων καὶ Ἐλέγχου Ποιότητος (Καθωρισμένα Πρότυπα) (Ἀρ. 1753 τῆς 12.2.82, Κ.Δ.Π. 22/82), δημοσιεύονται κάτωθι τὰ πλήρη κείμενα τῶν ἐν λόγῳ προτύπων.

Τετάρτη Σειρά:

CYS 76:1980 Προδιαγραφὴ διὰ Περιοδικὸν Ἔλεγχον, Δοκιμὰς καὶ Συντήρησιν Κυλίνδρων Μεταφορᾶς Ὑγραερίου.
Specification for Periodic Inspection, Testing and Maintenance of Containers for the Transport of Liquefied Petroleum Gas (LPG).

CYS 77:1980 Προδιαγραφὴ διὰ Κυλίνδρους Μεταφορᾶς Ὑγραερίου.
Specification for Refillable Containers for the Transport of Liquefied Petroleum Gas (LPG).

SPECIFICATION FOR PERIODIC INSPECTION, TESTING AND MAINTENANCE OF CONTAINERS FOR THE TRANSPORT OF LIQUEFIED PETROLEUM GAS (LPG)

1 SCOPE

This Cyprus Standard specifies the requirements for the periodic inspection, testing and maintenance of containers for the transport of Liquefied Petroleum Gas (LPG) of water capacity 1 litre up to 130 litres.

2 REFERENCES

This standard makes reference to the following Cyprus Standard:

CYS 77:1980 Specification for Refillable Containers for the Transport of Liquefied Petroleum Gas (LPG).

3 DEFINITIONS

For the purposes of this standard the following definitions apply.

3.1 Liquefied Petroleum Gas (LPG)

Any substance comprising mainly any one or any mixture of the following hydrocarbons: propane, propylene, butane (either normal butane or iso-butane) and butylene.

3.2 Corrosion

A chemical reaction on material that results in the removal of the surface of the material.

3.3 Competent Authority

Is the Authority established under the Petroleum Law, chapter 272 and Law 64 of 1976, part IXA, special regulations of liquefied petroleum gas, paragraph 100A, as being responsible for the assessment and acceptance of LPG containers, throughout the Republic of Cyprus+, or any Organization to which that Authority delegates such responsibility.

+ At the present time the Department of Electrical and Mechanical Services of the Ministry of Communications and Works

3.4 Authorised Test Station
Any test facility which is authorised by the Competent Authority to conduct the inspection and test regimes given in this standard.

3.5 Authorised Filling Station
Any LPG filling station authorized by the Competent Authority to undertake the filling of LPG containers, with appropriate regard to the visual inspection and leakage testing requirements of this standard.

3.6 Inspection
A complete examination by a person so authorized by the Competent Authority.

4 GENERAL REQUIREMENTS

4.1 All containers shall be subjected to a five (5) year inspection in accordance with section 7 of this standard, not later than five (5) years after first coming into service.

4.2 All containers shall be subjected to a periodic inspection and a hydraulic pressure of 3.0 MPa+ in accordance with section 6 of this standard, five (5) year intervals, commencing not later than ten (10) years after first coming into service.
Note: Notwithstanding the provisions of clause 4.1 and 4.2 above, the competent authority may require the inspection and the testing of containers before the expiration of the 5 year and 10 year periods where necessary.

4.3 Containers due for periodic inspection and test shall be identified as follows:
4.3.1 From the date of manufacture stamped on the container,
or
4.3.2 By means of the last inspection date marked on an aluminium ring located between the valve and the neck of the container, placed there by the authorized testing station.

4.4 Any container that has not been inspected or tested within the period specified in clauses 4.1 and 4.2 shall not be placed in service.

+1 MPa = 10^6 N/m^2 = 1.02 x 10^5 kgf/m^2 = 10 bar = 1.45 x 10^2 lbf

4.5 The responsibility for ensuring that the gas container is tested at the prescribed intervals and remains serviceable rests with the owner of the container.

4.6 The equipment and methods used for testing and inspecting the containers shall comply with the requirements of this standard. It is emphasized that the inspection is of prime importance for the identification of defects liable to render the container unsafe.

4.7 All containers shall be filled at authorised filling stations, and shall be subject to the following before being released for service, or before being filled as the case may be:

4.7.1 All containers shall be examined in accordance with clause 6.3.1 of this standard.

4.7.2 All containers after filling shall be subjected to a leakage test to detect the escape of gas from the valve and valve boss, to the satisfaction of the competent authority.

4.8 The competent authority shall designate a symbol for each authorized testing station to be stamped upon cylinders inspected and tested by that station.

5 SEGREGATION

5.1 A scrutiny of all markings on each container shall be carried out to establish that it complies with the requirements of CYS 77:1980 and the requirements of the Law*.

5.2 Containers shall be segregated into one of the following categories in accordance with clauses 4.1 and 4.2 of this standard.

5.2.1 Containers due for periodic inspection and hydraulic testing.

5.2.2 Containers due for periodic inspection only.

6 PERIODIC INSPECTION AND HYDRAULIC TESTING

6.1 Preparation

6.1.1 Each container shall be depressurized to atmospheric pressure, the

* Petroleum Law, chapter 272 and Law 64 of 1975, part IXA, special regulations ...eum gas, paragraph 100F.

contents being discharged in a safe manner. If any subsequent operations to be carried out on the container offer the risk of hazard by ignition of the container contents, the container shall be rendered gas free by an appropriate procedure. Where there is doubt regarding the operation of the container valve, with the result that the container does not become depressurized, the container shall be set aside and dealt with as in appendix B.

6.1.2 The valve shall be removed from the container for inspection and maintenance in accordance with clause 6.7.

6.1.3 Each container shall have all plastics coating, loose paint, corrosion products, tar, oil or other foreign matter removed from the external surfaces by wire brushing, shot blasting, water jet abrasive cleaning, chemical cleaning or other suitable method. Care shall be taken to avoid damaging the container.

6.1.4 The container valve boss threads shall be cleaned to remove particles of jointing or other foreign matter.

6.1.5 Moisture, loose scale, plastics linings and other foreign matter shall be removed from the interior of the container.

6.2 Inadequate Markings

Each container shall be checked for compliance with the requirements of CYS 77:1980 and shall be refurbished, as necessary.

6.3 Inspection

Each container shall be inspected, externally and internally, for any sign of corrosion or other defects.

6.3.1 External inspection. Each container shall be inspected for:

(a) dents, cuts, gouges, bulges, cracks, laminations (rejection limits are specified in table 1),

(b) corrosion (rejection limits are specified in appendix A),

(c) other defects, such as depressed or misaligned valve boss, damaged shrouds, base rings and other fittings, illegible or unauthorized markings, fire damage, electric arc or torch burns, etc., unauthorized additions or modifications (rejection limits are specified in table 2).

Defect	Definition	Rejection limits for destruction in accordance with section 8
Bulge	Visible swelling of the container	All
Dent	A depression in the container that has neither penetrated nor removed metal	When the depth of any dent exceeds one-quarter of its width at any point. Consideration of appearance also plays a part in the evaluation of dents, especially in the case of small containers
Cut or gouge	A sharp impression where metal has been removed or redistributed	All
Dent containing cut or gouge	A depression in the container within which there is a cut or gouge	All
Crack	A split or rift in the container shell (see figure 1(h))	All
Lamination	Laminations may show in the form of a crack or bulge (see figure 1 (d) and (e))	All

Table 1: Rejection limits relating to physical and material defects in the container shell

6.3.2 Rejection. Containers rejected in accordance with the criteria specified in tables 1 and 2 and appendix A shall be destroyed in accordance with section 8 of this standard. Defects able to be remedied shall be dealt with in accordance with section 9.

6.3.3 Internal inspection. Each container shall be inspected internally, using an inspection lamp of sufficient intensity to identify any of the defects listed in (a) and (b) above. Any container showing signs of

Item	Definition	Rejection limits for destruction in accordance with section 8
Fire damage (see note)	Excessive general or localized heating of a container usually indicated by:	When evidence of fire damage is accompanied by (b) or (c)
	a) charring or burning of the paint; b) burning of the metal; c) distortion of the container; d) melting of metallic valve parts	If only (a) or (d) is evident see note
Boss	Metal attachment welded to the container for the purpose of receiving a valve or other fitting	If the boss is depressed or misaligned
Stamping	Marking by means of a metal punch	When any container shows stamping on the body or where the stamping is illegible or inadequate or has been altered. Where it can be clearly established from records or otherwise, that the container complies fully with the requirement of CYS 77:1980, an altered marking may be acceptable (see 5.4 and 5.9.2) and illegible or inadequate marking may be corrected
Arc or torch burns	Burning of the container base metal a hardened heat affected zone, the addition of extraneous weld metal, or the removing of metal by scarfing or cratering	

Table 2: Rejection limits for containers at time of inspection

Note. If paint is only charred a container 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 become the responsibility, of the competent authority. When so decided by the competent authority, heat treatment and retest must be carried out in accordance with the requirements of CYS 77:1980, excluding the burst and tensile tests.

corrosion+ shall be cleaned internally by shot blasting, water jet abrasive cleaning, wire flailing, steam jet, hot water jet, rumbling, chemical cleaning or other suitable method. Care shall be taken to avoid damaging the container. After cleaning, the containers shall be inspected again. Containers with excessive corrosion, as described in appendix A, shall be destroyed in accordance with section 8.

6.4 Check Weighing

The accuracy of the stamped tare of each container shall be checked by weighing to an accuracy of 0.2%.

6.4.1 The tare of the container includes the mass of the container valve and of all permanent fittings but does not include the mass of the valve cover. Any container having a tare that is less than 95% of that stamped on the container shall be deemed unfit for further service and destroyed in accordance with section 8, unless the disparity between the actual and stamped tare of the container results from the fitting of a different valve, shroud, base ring or other attachment.

6.4.2 Where it can be clearly established that a disparity between the actual and stamped tare is not due to excessive corrosion, the correct tare shall be marked on the container and the original tare obliterated.

6.5 Inspection of Container Boss Threads

The internal boss threads of each container shall be inspected to ensure that they are of full form, clean and free from burrs and other imperfections.

6.6 Hydraulic Proof Pressure Test

Each container shall be subjected to a hydraulic proof pressure test.

6.6.1 Test equipment.

(a) All rigid pipework, flexible tubing, valves, fittings and components forming the pressure system of the test equipment

+ Tarnishing may occur on the inside of a container. Provided that the layer is slight and there is no localized pitting it will not be necessary to clean the inside of the container before reissue.

shall be capable of withstanding a pressure twice the maximum test pressure of any container that may be tested.

(b) Pressure gauges shall be approved by the competent authority with a scale range appropriate to the test pressure. They shall be calibrated at regular intervals, and in any case not less frequently than once per month.

(c) The design and installation of the equipment, and of the containers connected to it, shall be such as to avoid trapping air in the system.

6.6.2 Test method

(a) More than one container may be tested at a time provided that each individual test point is capable of being isolated.

(b) The containers shall be subjected to a hydraulic pressure of 3.0 MPa.

(c) Before applying pressure the external surface of the container(s) shall be completely dry.

(d) The test pressure, once attained, shall be held for a minimum period of 2 min, during which period the pressure as registered on the test gauge shall remain constant.

(e) Under these conditions of test the container(s) shall not show any sign of leakage, visible deformation or defect.

(f) If there is a leakage in the pressure system it shall be corrected and the container(s) shall be retested.

6.6.3 Failed containers. Any container that fails to comply with the requirements of 6.6 shall be destroyed in accordance with section 8 of this standard.

6.6.4 Drying of containers. Where water has been used as the test medium, the interior of each container shall be thoroughly dried by a suitable method, immediately after hydraulic testing.

6.6.5 Contamination. The interior of the container shall be inspected to ensure that it is free from contamination. Any contamination shall be removed by a suitable method.

6.7 Inspection and Maintenance of Valves

Each valve shall be inspected and maintained so that when it is reintroduced into service, it will perform satisfactorily.

6.7.1 In particular, all threads shall be checked to ensure that the thread diameters, form, length and taper are satisfactory.

6.7.2 If threads show signs of distortion, deformation or burring, these faults shall be rectified. Valve with excessive thread damage or def

of the valve body handwheel spindle or other components shall be replaced.
6.7.3 Maintenance of the valve shall include general cleaning, together, where necessary, with replacement of worn or damaged components and packings. Any external sealing devices shall be replaced.

6.8 Revalving

Each valve shall be replaced using a suitable jointing medium and the optimum torque necessary to ensure a seal between the valve and container.
6.8.1 Where necessary for tare purposes, the original valve shall be refitted to the container. The test date ring in accordance with clause 4.3.2 shall be fitted over the valve stem prior to revalving.

6.9 Marking

6.9.1 After satisfactory completion of the periodic inspection and test each container or aluminium ring shall be stamped in accordance with clause 4.3.2 with:

(a) the symbol of the testing station

(b) the date of test (which may be indicated by the month and year or by the year followed by a number within a circle to denote the quarter of the year).

6.9.2 Where a new or reconditioned valve has been fitted, or following the replacement of a damaged collar, base ring or other attachment, the container tare shall be established, and if this differs from the marked tare the latter shall be obliterated and the correct tare marked in a permanent and legible fashion.
6.9.3 Any added or replacement markings shall be stamped on the valve boss or collar of the container and not on the cylindrical part or domed end.

6.10 Painting

Where necessary, each container shall be repainted.

7 FIRST FIVE YEAR INSPECTION

7.1 Preparation

Each container shall have all loose paint, corrosion products, tar, oil or other foreign matter removed from the external surfaces by wire brushing, chemical cleaning or other suitable method.

7.2 Inspection

Each container shall be visually inspected externally for:

7.2.1 Dents, cuts, gouges, bulges, cracks or laminations (rejection limits are specified in table 1).

7.2.2 Corrosion (rejection limits are specified in appendix A).

7.2.3 Damaged valves (containers with damaged valves shall be dealt with in accordance with 6.1.1, 6.1.2, 6.1.4, 6.1.5 and 6.5). A full inspection and hydraulic test of the container shall be carried out in accordance with section 6 of this standard.

7.2.4 Inadequate marking (containers shall be checked for compliance with the requirements of CYS 77:1980, and shall be refurbished as necessary).

7.2.5 Other defects, such as depressed or misaligned valve boss, damaged collars, base rings or other fittings, illegible or unauthorized markings fire damage electric arc or torch burns, etc., unauthorized additions or modifications (rejection limits are specified in table 2).

7.3 Rejection

Containers rejected in accordance with the criteria specified in tables 1, 2 and appendix A shall be destroyed in accordance with section 8. Defects able to be remedied shall be dealt with in accordance with section 9.

7.4 Marking

7.4.1 After satisfactory completion of the periodic inspection each container shall be stamped in accordance with clause 4.3.2 with

(a) the symbol of the testing station;

(b) the date of inspection (which may be indicated by the month and year or by the year followed by a number within a circle to denote the quarter of the year);

(c) the letter 'V' to indicate visual examination only.

7.4.2 Where a new or reconditioned valve has been fitted, or following the replacement of a damaged collar, base ring or other attachment, the container tare shall be established, and if this differs from the marked tare the latter shall be obliterated and the correct tare marked in a permanent and legible fashion.

7.4.3 Any added or replaced markings shall be stamped on the valve boss or collar of the container and not on the cylindrical part or domed end.

7.5 Painting

Where necessary, each container shall be repainted.

8 DESTRUCTION OF UNSERVICEABLE CONTAINERS

8.1 Containers that have been deemed unsuitable for further service shall be destroyed by the testing station using one of the following methods, but before any container is destroyed the procedure specified in 6.1.1 shall have been followed.

8.1.1 The container shall be crushed or flattened by mechanical means.

8.1.2 An irregular hole shall be burned in a safe manner in the top dome of the container, equivalent in area to approximately 10% of the area of the top dome.

8.2 Drilling a hole in a container shall not be considered as satisfying the requirements of this section.

9 REMEDIAL TREATMENT

9.1 Major repairs involving welding and/or de-denting shall be carried out only by approved container manufacturers or by others specifically approved by the Competent Authority for carrying out such work. Before hot work is carried out the procedure specified in 6.1 shall have been followed. Following any such repairs the container shall be subjected to the heat treatment process and non-destructive test requirements of CYS 77:1980.

9.2Minor repairs, such as reforming damaged collars, base rings, etc., not involving welding or heating of the pressure-containing part, may be carried out at, or under the supervision of, an approved testing station.

Appendix A

CORROSION

A.1 General

The walls of the container may be subjected to environmental conditions that could cause external corrosion of the metal.

A.1.1 Internal corrosion of the metal may also occur owing to service conditions.

A.1.2 Extensive experience and judgement are required in evaluating whether containers that have corroded internally or externally are safe and suitable for return to service. It is important that the surface of the metal is completely cleaned of corrosion products prior to the inspection of the container.

A.2 Types of Corrosion

The types of corrosion generally experienced may be classified as follows.

A.2.1 General corrosion (see figure 1 (a)). General corrosion is that which has caused a reduction in wall thickness over an area exceeding 20% of the container external surface, and may occur externally or internally.

A.2.2 Area corrosion (see figure 1(a)). Area corrosion, which may occur externally or internally, is that which has caused a general reduction in wall thickness over an area not exceeding 20% of the container external surface. It excludes other types of corrosion described in A.2.3, A.2.4, A.2.5 and A.2.6.

A.2.3 Chain pitting and line corrosion (see figure 1 (c)). Chain pitting and line corrosion may occur along the length, or part of the length, of a container, and may also extend round the circumference of the wall. They may be external or internal and are usually made up of a series of pits or corroded cavities in the wall thickness. Generally, they are of a limited width.

A.2.4 Channel corrosion (see figure 1 (g)). Channel corrosion can be a more concentrated form of line corrosion or a channel formation in the metal. It may be formed externally by the metal being in contact with a corrosive substance or internally by the passage of gas over the surface of the metal.

A.2.5 Isolated pits (see figure 1 (b) and 1 (f)). Isolated pits are a pitting of the metal, in isolated areas, and may occur externally or internally.

A.2.6 Crevice corrosion. Crevice corrosion is a circumferential corrosion occurring, for example, at the junction of the wall and foot ring.

A.3 Evaluation of Corrosion

A recommended procedure for evaluating container corrosion is given in A.3.1 to A.3.3.

A.3.1 If the bottom of the defect can be seen it may be possible, with judgement and experience, to evaluate it sufficiently to pass or fail the container for that defect. The limits set in A.4.1 to A.4.5 shall be used as a guide on allowable wall thickness.

A.3.2 If the defect is borderline, or gives rise to uncertainty, set the container aside for more detailed examination, using specialist equipment if necessary.

A.3.3 Where the bottom of the defect cannot be seen, where its extent cannot be evaluated using specialist equipment, the container shall be destroyed in accordance with section 8.

A.4 Rejection Limits

Defects in excess of those described in A.4.1 to A.4.5 are cause for rejection.

A.4.1 General corrosion. If the depth of penetration exceeds 10% of the original wall thickness or if the original metal surface is not recognizable. If corrosion is extensive in area the container shall be dealt with as specified in A.3.2 or A.3.3.

A.4.2 Area corrosion. If the depth of penetration exceeds 15% of the original wall thickness or if the original metal surface is not recognizable.

A.4.3 Chain pitting, line corrosion and channel corrosion.

If the total length of corrosion in any direction exceeds the circumference of the container, or if the depth of penetration exceeds 25% of the original wall thickness.

A.4.4 Isolated pit. Pits at a concentration greater than 1 per 500 mm^2 of the surface area shall be classified as area corrosion. The depth of discrete pits of greater than 5 mm diameter shall not exceed 25% of the original wall thickness. Pits less than 5 mm in diameter shall be assessed, as far as practicable, to ensure that the remaining wall thickness is adequate for the duty envisaged for the container.

A.4.5 Crevice corrosion. If the depth of penetration exceeds 20% of the

Appendix B

PROCEDURE TO BE ADOPTED WHEN A CONTAINER VALVE IS APPARENTLY OBSTRUCTED

B.1 If there is any doubt, when the valve of a container is opened, that the gas is not being released and that the container may still contain residual gas under pressure, a check or checks shall be made to establish that free passage through the valve is not obstructed.

B.1.1 The method adopted shall be a recognized procedure such as the following, or one that provides equivalent safeguards.

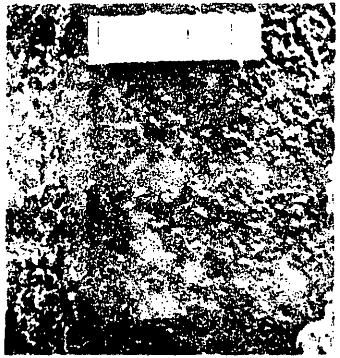
B.1.2 First check to establish that the total mass of the container is the same as the tare stamped on the container. If there is a positive difference, the container may contain either liquefied gas under pressure or non-pressure contaminants.

B.2 When it is established that there is no obstruction to gas flow in the container valve, the valve may be removed.

B.3 When a container is found to have an obstructed gas passage in the valve the container shall be set aside for special attention as follows:

B.3.1 Partially unscrew the valve within a glanded cap, secured and jointed to the container and vented to a safe discharge. The principles of a suitable device are shown in figure 2.

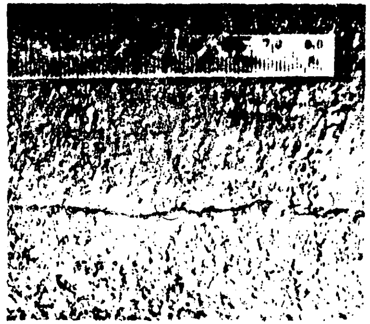
B.3.2 This procedure shall be carried out only by trained personnel. When the gas, if any, has been released and the pressure within the container has been reduced to atmospheric pressure, and there is no frost or dew on the outside of the container, the valve may be removed.



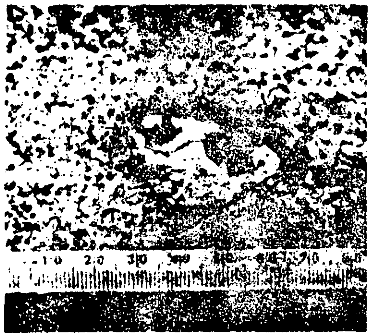
(a) General or area corrosion

(b) Isolated pits

(c) Line corrosion



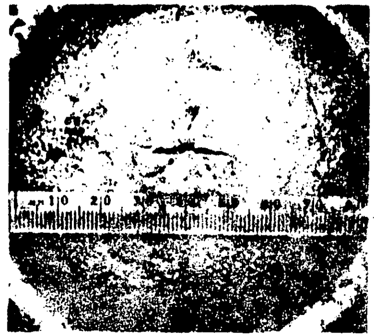
(d) Lamination



(e) Lamination

(f) Isolated pits

(g) Channel corrosion (internal)



(h) Crack

Figure 1. Illustrations of typical defects

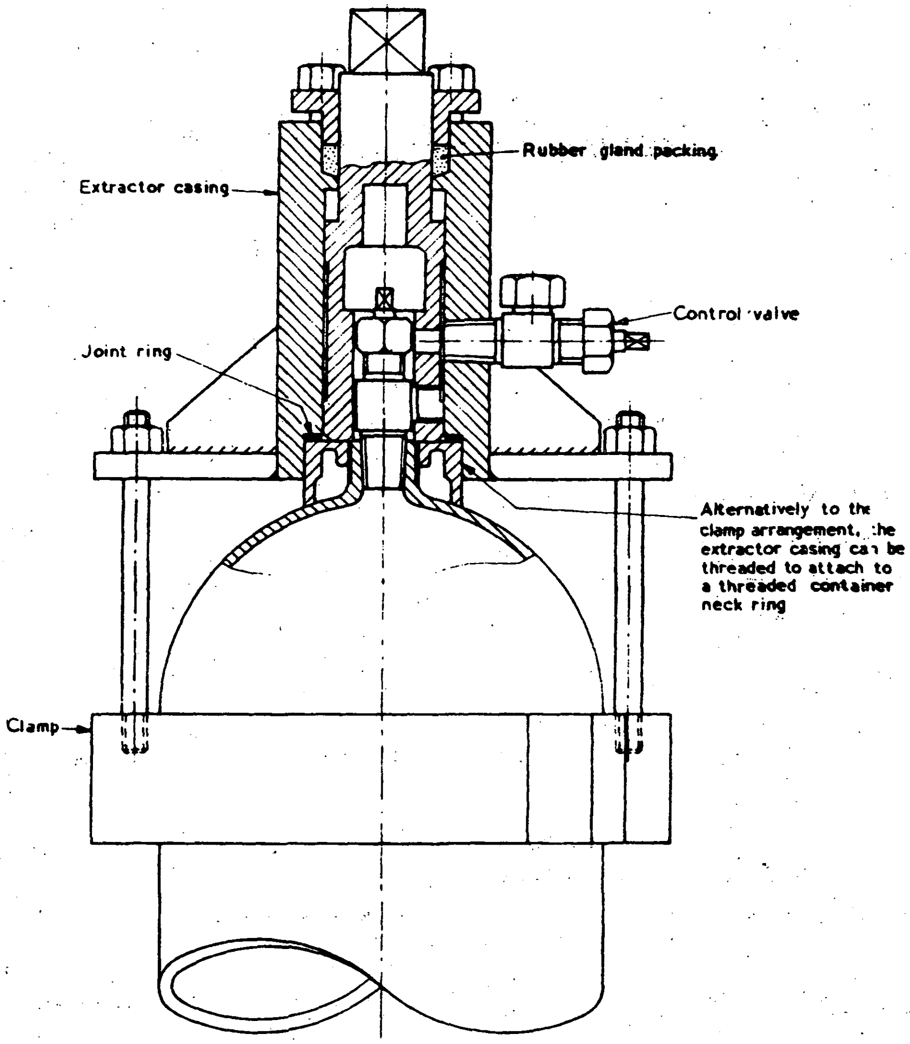


Figure 2. Typical device for the removal of a damaged gas container valve

SPECIFICATION FOR REFILLABLE CONTAINERS FOR THE TRANSPORT OF LIQUEFIED PETROLEUM GAS (LPG)

1 SCOPE

This Cyprus Standard specifies the requirements for the materials, design, construction, marking, sampling and testing of refillable steel containers for the conveyance and storage of Liquefied Petroleum Gas, (LPG), of water capacity 1 litre up to 130 litres and maximum working pressure of 2.0 MPa+.
Containers employing concave ends are excluded from the provisions of this standard.

2 DEFINITIONS

For the purposes of this standard, the following meanings are applied to the terms employed.

2.1 Bursting Pressure (point of bursting)
The pressure at which a rupture occurs on the container.

2.2 Collar, Valve Boss, Upper Domed End, Cylindrical Part, Lower Domed End, Base Ring.
Those parts of the steel container as shown in figures 4 and 5.

2.3 Competent Authority
Is the Authority established under the Petroleum Law, chapter 272 and Law 64 of 1976, part IXA, special regulations of liquefied petroleum gas, paragraph 100 A.

2.4 Elongation
The total extension produced at fracture on gauge length, $Lo = 5.65\sqrt{So}$ in a test-piece during a tensile test, expressed as a percentage of the original gauge length of the test-piece. So is the cross-sectional area of the test-piece.

+1MPa = $10^6 N/m^2$ = 1.02×10^5 kgf/m^2 = 10 bar = 1.45×10^2 lbf/in^2

2.5 Gauge Length

The length of the parallel portion of the test-piece used for the measurement of extension by means of an extensometer.

2.6 Heat Treatment

The process of relieving fabrication welding stresses induced in the container by a sustained heat soaking.

2.7 Liquefied Petroleum Gas, (LPG)

Any substance comprising mainly any one or any mixture of the following hydrocarbons: propane, propylene, butane (either normal butane or iso-butane) and butylene.

2.8 Ultimate Tensile Strength

The ratio of the highest load applied to a test-piece during a tensile test, divided by the original cross-sectional area.

2.9 Water Capacity

The total volume of water required to fill the container completely.

2.10 Lower Yield Stress

The stress corresponding to that point in the tensile test on a test-piece where the deformation increases suddenly and a substantial amount of plastic deformation takes place.

3 INFORMATION TO BE SUPPLIED BY THE PURCHASER AND THE MANUFACTURER

3.1 Information to be Supplied by the Purchaser

The purchaser shall inform the manufacturer of the following as appropriate.

(a) Material of construction, including ladle analysis
(b) Preferred dimensions
(c) Type of base
(d) Internal and/or external neck thread specification
(e) Fittings required
(f) External/internal finish required
(g) Whether any addition is required to the requirements of this standard
(h) The filling ratio as determined in accordance with section 4

3.2 Information to be Supplied by the Manufacturer

The manufacturer shall supply the purchaser and the Competent Authority with the following information:

(a) Fully dimensioned sectional drawing of the container including:

water capacity (minimum);
material of construction;
test pressure;
minimum and maximum masses of container;
statement that the container will be constructed to the requirements of this standard;
large scale dimensional details of the weld preparation for all joints.

(b) Fittings to be supplied

(c) Marking arrangement drawing

(d) Certificate of compliance for materials and container

4 FILLING RATIO

The ratio of the mass of gas introduced into any container complying with this specification to the mass of water at 15°C which fills the container as fitted for use, shall not exceed the following:

(a) For Propane, 0.431

(b) For Iso-Butane, 0.498

(c) For LPG mixtures, as determined in accordance with appendix C.

5 CERTIFICATE OF COMPLIANC

The Competent Authority shall certify that the manufacture of the containers was carried out in accordance with the requirements of this standard (see appendix E).

6 MATERIALS

6.1 Characteristics of Steel Plates

6.1.1 The steel plates used for the fabrication of the cylindrical part and/or of the domed ends shall be of malleable and weldable steel; the chemical composition and mechanical properties of such steels shall be not less suitable for the intended use than those specified in tables 1 and 2 respectively. The mechanical properties shall be obtained after the heat treatment of the container specified in clause 8.4 of this standard.

6.1.2 Each bundle or coil shall be marked with the number of the relevant National Standard, including the grade number and letter, as appropriate and with numbers or other identification marks by which it can be traced to the ladle of steel from which it was made. If the plate or sheet is not supplied directly by the steel maker to the container manufacturer, then the material shall also be marked to identify the steel maker.

6.1.3 Steel suppliers shall provide an appropriate manufacturer's certificate with each batch of steel giving details of ladle analysis and mechanical properties.

6.1.4 The ladle analysis of materials shall be within the composition limits given for the steel listed in table 1. In the event of one melt being divided between more than one ladle, samples shall be analysed from each ladle and a separate analysis provided for each ladle.

Element	Chemical Composition %	Permissible deviation from the specified composition
Carbon C	0.20 max	± 0.03
Silicon Si	0.35 max	± 0.05
Manganese Mn	0.50 - 1.30	± 0.10
Phosphorous P	0.050 max	+ 0.005
Sulphur S	0.050 max	+ 0.005
Nitrogen N	0.009+ max	

Table 1: Chemical Composition of Steel Plates

Note:

(a) The steel specified in table 1, is the Steel No. P7 given by ISO 2604/IV-1975(E). Various designations are given to steels by national and international standards organizations. However, for the purposes of this Cyprus Standard, any steel is accepted, provided that the requirements specified in tables 1 and 2 are met.

+For electric furnace steel, N ≤ 0.012%

(b) Elements not quoted in table 1 shall not be intentionally added without the agreement of the purchaser, other than for the purpose of finishing the melt. All reasonable precautions shall be taken to prevent the addition of such elements from scrap or other materials used in manufacture, but residual elements may be present provided the mechanical properties specified in table 2 and applicability are not adversely affected. If the level of residual elements is important in relation to the properties or weldability of the steel, the cast (ladle) analysis for such elements shall be reported. If the purchaser so requires, for reasons of formality etc, a maximum copper (Cu) content of 0.25% may be imposed.

Property		
Lower yield stress	MPa	235
Tensile strength	MPa	410-530
Elongation	%	24 min
Bend test		2.0 t^{+}

Table 2: Mechanical Properties of Steel Plates

6.2 Appearance

The steel plates shall be free from flaws, blow-holes, cracks or chippings, or any other visual defects. Any means of repair for covering such defects shall not be accepted.

$^{+}$t is the minimum manufacturing thickness as specified on the drawing including corrosion allowance if any.

6.3 Valve Boss

The mechanical characteristics and chemical composition of the metal of the valve boss shall be the same as those of the steel plates specified in section 6.1 of this standard.

6.4 Base Ring, Collar

The base ring, and the collar shall be compatible with the parent metal and be made of weldable mild steel.

6.5 Weld Deposition Metal

The weld deposition metal shall be such as to give the required mechanical characteristics of the joints indicated in this Cyprus Standard.

7 DESIGN

7.1 Minimum Wall Thickness

7.1.1 The minimum wall thickness for any diameter of container shall be not less than that indicated by the graph given in figure 1, for both the domed ends and cylindrical parts of the container, which shall be of the same thickness.

7.1.2 A corrosion allowance of 0.2 mm shall be added to the value of minimum wall thickness specified in 7.1.1.

7.2 External Height of Domed Ends

7.2.1 The external height of the domed end 'h' indicated in figure 2 shall not be less than 25.5% of the container outside diameter.

7.2.2 The following limitations of shape apply:

(a) The shape of the domed end shall represent a continuous curve without any flats.

(b) The maximum radius of curvature, R shall not exceed 95% of the outside diameter of the container.

(c) The minimum radius of curvature, r shall not be less than 19% of the outside diameter of the container nor less than three times the actual wall thickness, whichever is the greater.

(d) The parallel portion, S_f of the domed end, see figure 2, shall be not less than the appropriate value given in figure 3 for any diameter of container.

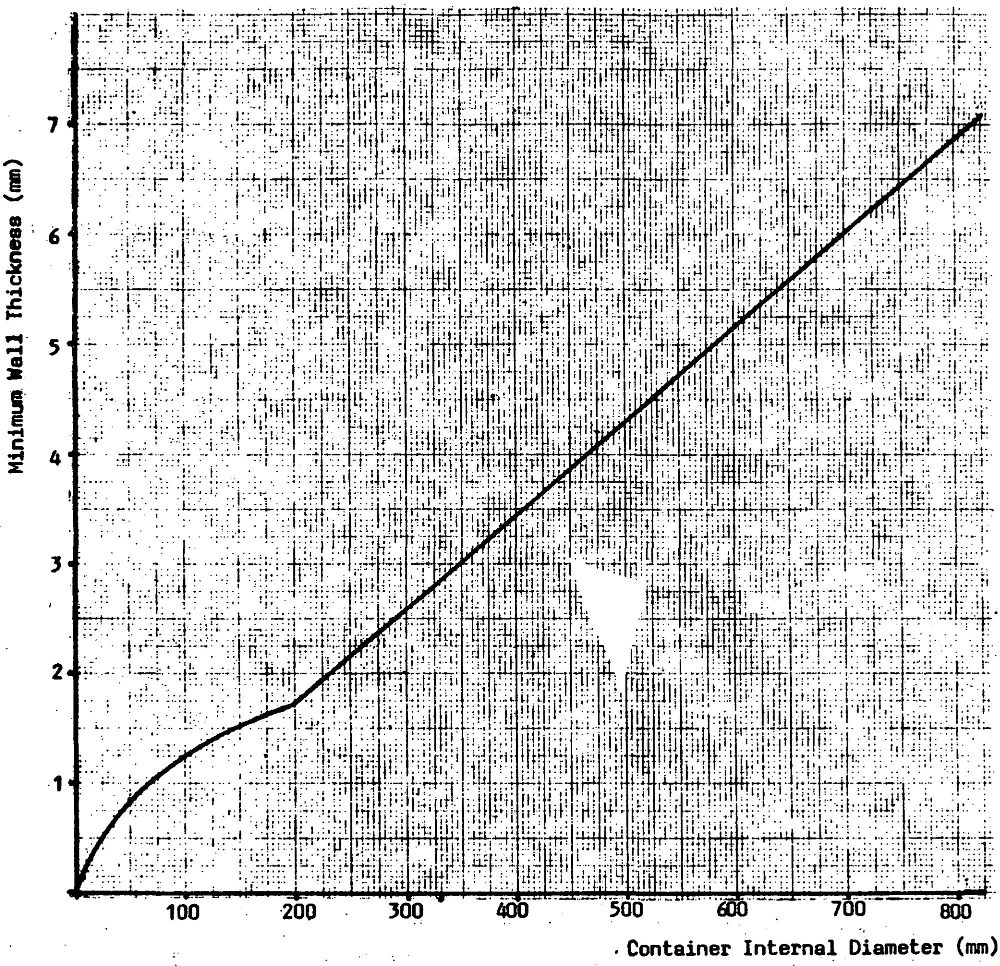


FIG. 1: Relationship between minimum wall thickness and container internal diameter

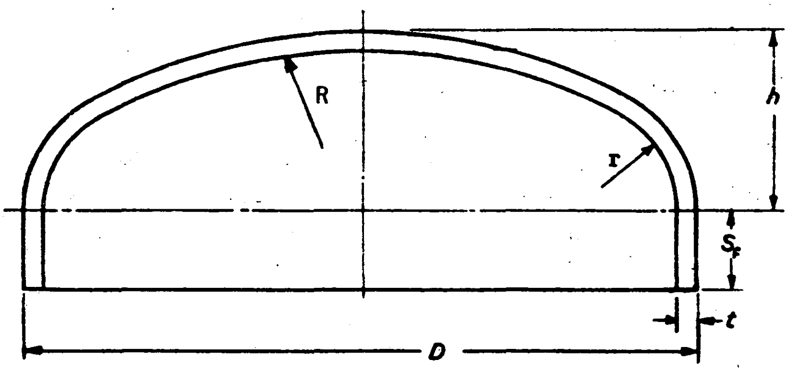


Fig. 2. Domed Ends

7.3 Valve Boss Hole

The hole for the insertion of the valve boss shall not exceed 75 mm in diameter, and shall be placed centrally in the upper domed end.

8 CONSTRUCTION

8.1 Construction of Containers

The container shall be free from any bulge, dent, cut, gouge, crack, internal or external rust.

8.1.1 The body of the container shall be assembled by either of the following:

(a) Rotation welding of two domed ends, (container in two pieces, see figure 4), or:

(b) One cylindrical part, seamless or welded longitudinally and two outwardly domed ends, (container in three pieces, see figure 5).

8.1.3 Each container shall also comprise:

(a) One valve boss, turned or hot stamped, with a left hand taper thread on the inside to admit the tail of the valve and fitted with a feature left to the choise of the manufacturer for the fixing of the protective cap of the valve.

(b) A base ring of robust construction fixed by welding of a height sufficient to ensure 12 mm clearance of the bottom of the container when on a flat surface, the diameter of the base ring shall not be less than 0.8 times the diameter of the cylinder.

(c) A collar, fixed by welding to the upper domed end, incorporating one or two handles of a height not less than 12 mm above the valve and protective cap. The protective collar shall be of adequate construction to prevent damage to the valve if a filled container was dropped from a height of 1.2 m so that the protective collar struck a hard flat surface.

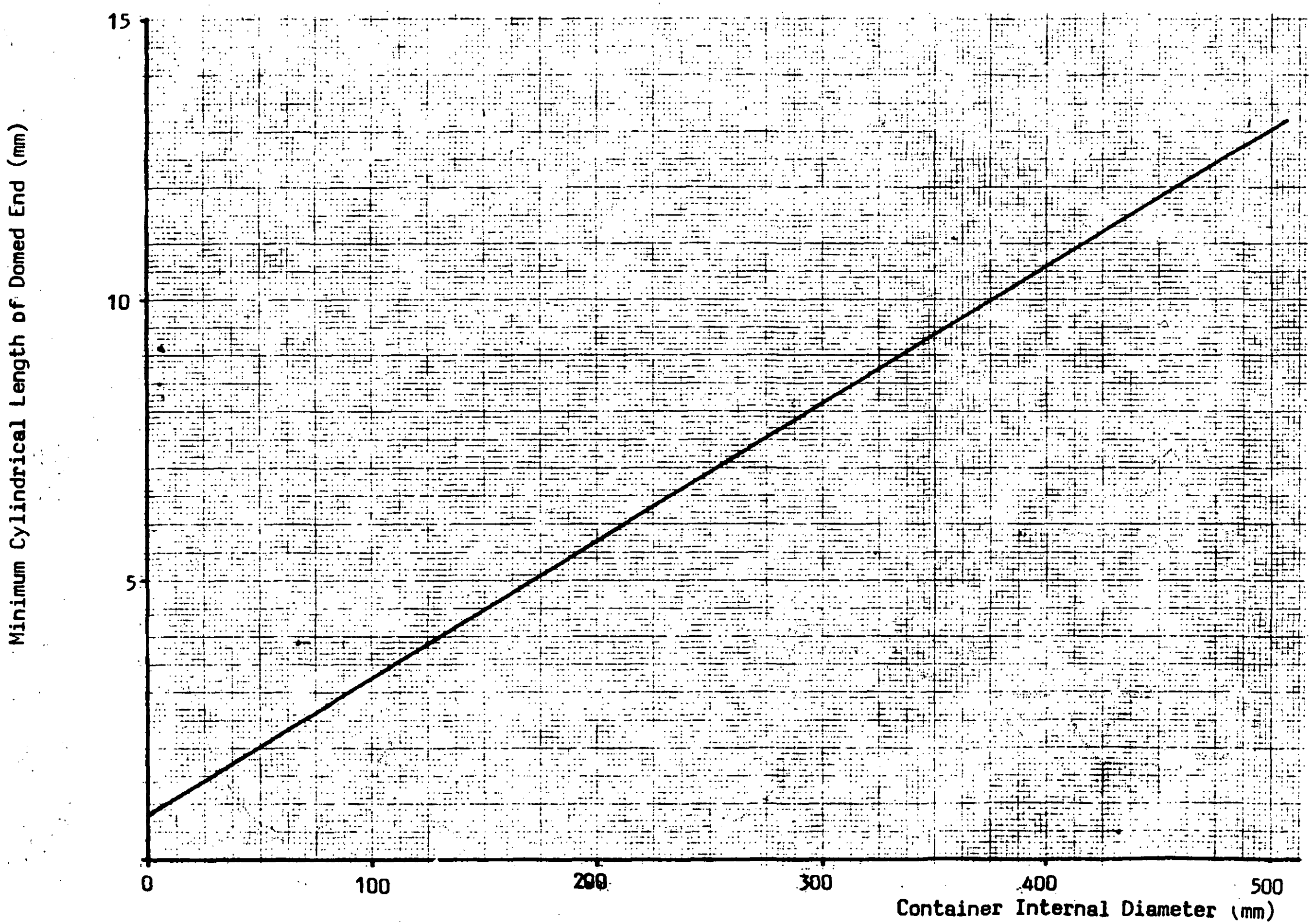


FIG. 3: Relationship between minimum cylindrical length of domed end and container internal diameter

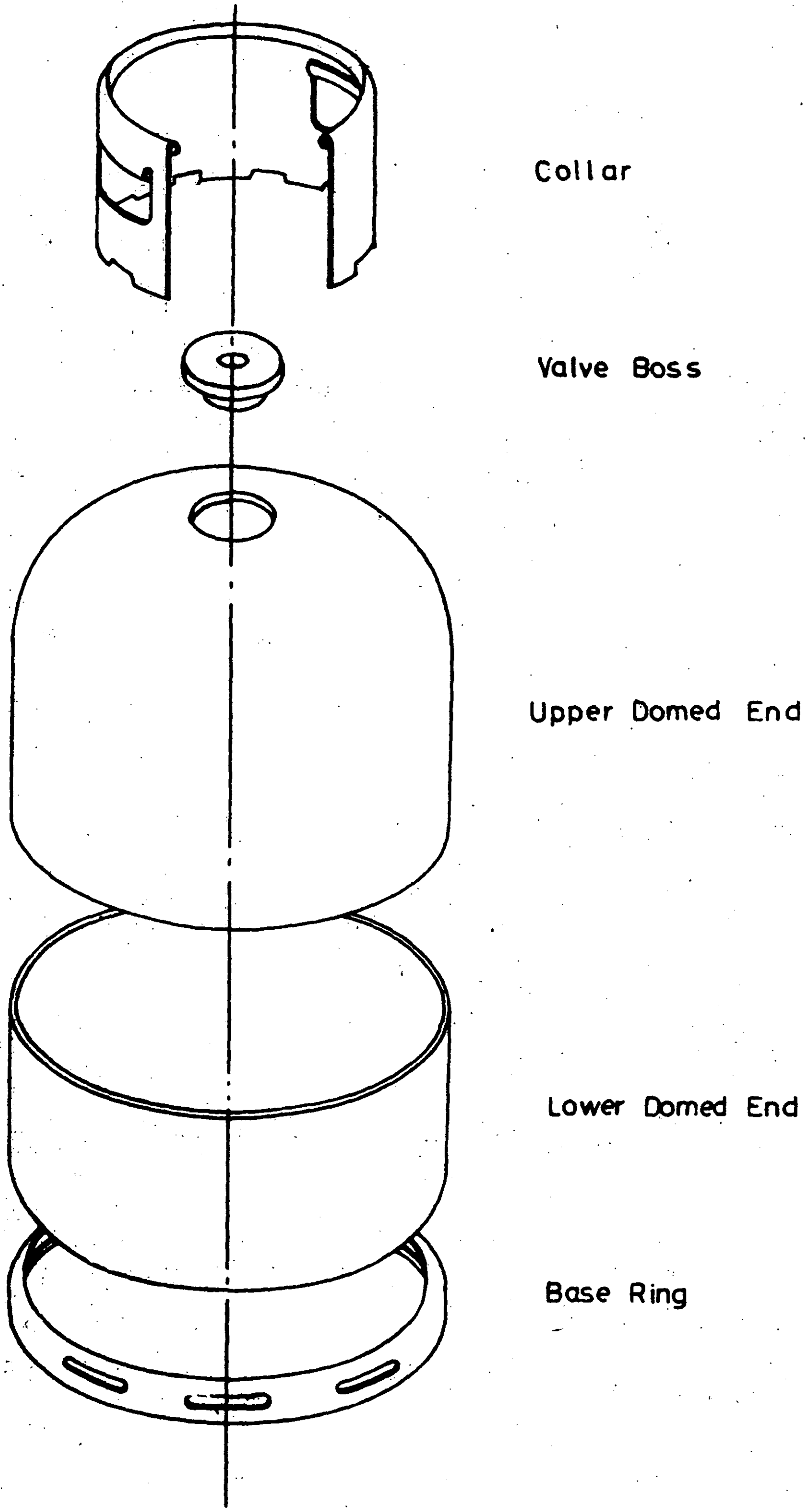


FIG. 4: Diagram of a ''two-piece'' container

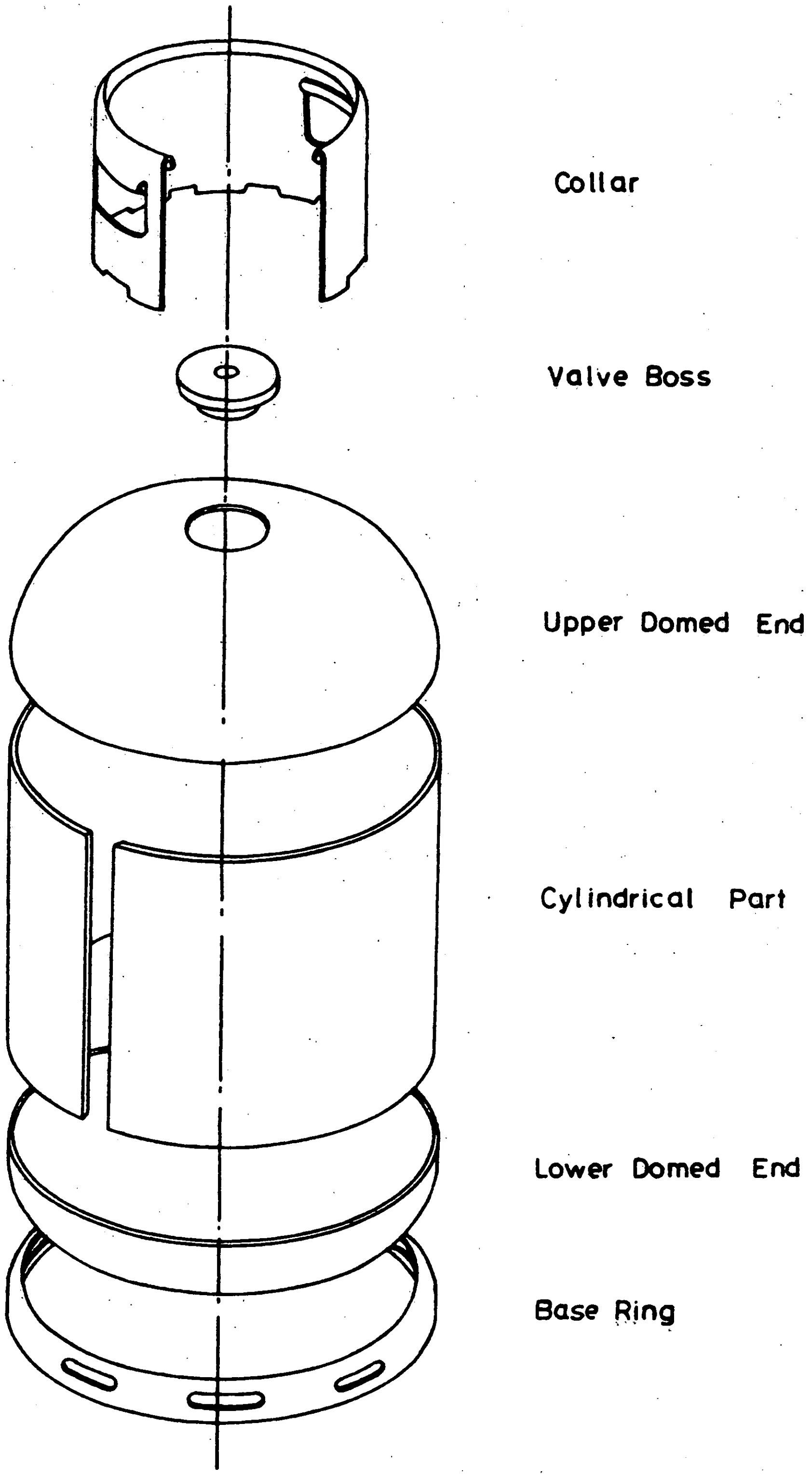


FIG. 5: Diagram of a ''three-piece'' container

8.2 Welding

All body welds shall be continuous full depth butt welds.

8.2.1 Welding shall be carried out by means of electric arc welding under electroconductive flux or inert atmosphere. Such welding may be either under non-permanent support, or on a backing strip incorporated in the construction (this strip shall be made of steel conforming to all the requirements of section 6.1 of this standard). Before any other proposed method of welding is used the manufacturer shall satisfy the Competent Authority that an equivalent level of assurance to that required by this Cyprus Standard is attained.

8.2.2 The welding shall be conducted in such a sequence as to allow maximum visual inspection of the welds from the inside of the container.

8.3 Weld Preparation

8.3.1 Prior to welding, components shall be examined in accordance with 10.2

8.3.2 All filler metal shall be such as to ensure the required physical properties in the completed weld.

8.3.3 Prior to welding, all welding surfaces shall be cleaned by degreasing and dressed smooth. Surfaces and edge preparations shall be consistent with the welding process.

8.3.4 The surfaces of the plates at the seams shall not be out of alignment with each other at any point by more than 10% of the plate thickness.

8.3.5 Welds except the ends of longitudinal welds, shall not be dressed without the approval of the Competent Aurhority. The weld surface shall have a smooth contour and there shall be no undercutting.

8.3.6 All welding of the container and attachments shall be completed before final heat treatment.

8.3.7 The manufacturer shall satisfy the Competent Authority that semi or fully automatic welding machines will produce the required standard of welding.

8.3.8 Where manual welding is employed for the attachment of non-pressure parts, the manufacturer shall satisfy the Competent Authority.

that a welder has passed a suitable approval test before being permitted to weld the containers.

8.3.9 The Competent Authority may require re-tests from an approved welder if not satisfied with the work of that welder or if there has been a lapse of time since the welder was last employed on welding containers manufactured in accordance with the requirements of this standard.

8.3.10 Welds in the body of the container shall be prepared in accordance with figure 6.

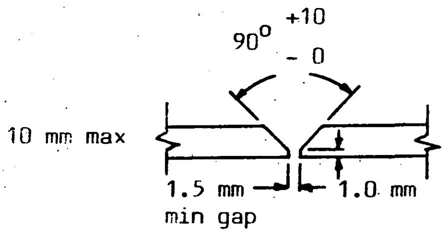
Joint	Name
	Single-welded butt joint with 'V' groove, without backing strip.

Figure 6: Container body welds

8.3.11 The valve boss shall be welded to the body of the container by the method given in figure 7 and with weld dimensions no less than those indicated.

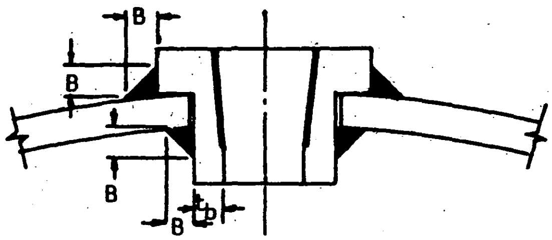
8.3.12 The welding of the valve boss and the collar may be carried out by hand using the electric arc method.

8.3.13 The welding of the base ring and the collar on the container may be carried out by continuous arc welding without overlap in such a way, that the approach of the base ring and the collar is perpendicular to the appropriate surface of the container.

8.4 Heat treatment

8.4.1 Containers shall be normalized at a temperature between 890°C and 930°C, after completion of all welding (including that of attachments) and before hydraulic test. Steels with a specified niobium content equal to or greater than 0.01% shall be normalized at a temperature between 840°C and 880°C. For normalizing, the containers shall be heated for a sufficiently long period to ensure that they are all uniformly at the required temperature and then cooled in still air, or treated in an equivalent continuous process as approved by the Competent Authority.

Dimensions as in table below



Screwed connections should not exceed 1½ in. B.S.P. thread size or equivalent.

t	3mm	5mm	6mm	8mm	9.5mm
B	6.5mm	8mm	10mm	12.5mm	14.5mm

t = Thickness of socket (t_b) or vessel whichever is the smaller.
Weld dimensions are minima.

Fig. 7: Valve boss connection

9 TOLERANCES

9.1 Cylindrical Part of the Container

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

9.1.2 Circumference. The external circumference of the cylindrical part of the completed container 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).

9.1.3 Straightness. Unless otherwise shown on the drawing, the maximum deviation of the cylindrical part from a straight line shall not exceed 0.3% of the cylindrical length.

9.2 Domed Ends

9.2.1 Circularity. The difference between the maximum and minimum outside diameters of the straight flange (corresponding to S_f, see figure 2) shall not exceed 1% of the specified internal diameter.

9.2.2 Circumference. The external circumference of the dished ends 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).

10 INSPECTION AND TESTS

10.1 General

10.1.1 The purchaser and the Competent Authority shall have free access at all reasonable times to that part of the manufacturer's works engaged upon the order, and shall be at liberty to inspect the fabrication at any stage and to reject any process, container or part of a container that does not comply with the requirements of this standard.

10.1.2 The manufacturer shall supply the labour and appliances for such inspection and tests as are required and for any additional checks which may be agreed between the Competent Authority and the manufacturer.

10.1.3 The manufacturer shall give reasonable notice to the Competent Authority, as agreed between them, of when the containers will reach a stage at which inspection is required.

10.2 Inspection of Components

10.2.1 All pressings and cylindrical parts shall be examined for surface defects before any seam is welded. If there are defects which, in the opinion of the Competent Authority, would be detrimental to the sound construction of the container, the pressing or cylindrical part shall be rejected.

10.2.2 At the discretion of the Competent Authority 2% or more of the pressings and of the cylindrical parts shall be selected at random to represent all batches of material used for the manufacture of the containers and these samples shall be examined for minimum thickness before any seam is welded.

Should any pressing or cylindrical part so sampled be less than the minimum specified thickness, the whole of the output from the relevant batch of material shall be examined for minimum thickness and any pressing or cylindrical part which is less than the specified minimum thickness shall be rejected.

For the purpose of this clause, 'batch of material' is defined as meaning pressings or cylindrical partsmanufactured in a continuous production run.

10.3 Mechanical Tests

10.3.1 The mechanical tests shall consist of tests on the parent material and the welds.

Test specimens shall be obtained from locations on containers indicated in figure 8 sampled in accordance with section 12 of this standard. The specimens for tests on the parent material shall be cut so that no part of the gauge length of the test specimen is within 4t of the edge of the weld, where t = minimum manufacturing thickness as specified on the drawing (including corrosion allowance if any).

The mechanical test carried out on each container shall be in accordance with the following:

10.3.2 Tensile test on parent material.
10.3.3 Bend test on parent material.
10.3.4 Tensile test on the welds.
10.3.5 Bend test across the welds.
10.3.6 Nick-break test on the welds.

A test specimen of each type required under 10.3.2 and 10.3.3 shall be cut from the cylindrical part and from one of the domed ends.

Test specimens of each type required under 10.3.4 to 10.3.6 inclusive shall be cut tranversely across the longitudinal weld and alternately from the top and bottom circumferential welds on successive containers selected for test.

10.3.2 Tensile test on parent material. The tensile test specimen T1 and T4 (see figure 8) shall be made from strips cut from a finished container with the axis of the strips, where possible, parallel to the axis of the container. The face and back of the test specimen shall not be machined, but shall represent the surface of the container as manufactured. The ends only may be flattened for gripping in the testing machine. Tensile test specimens shall have correct form and dimensions+.

When the parallel length is in excess of the gauge length, a series of overlapping gauge lengths shall be marked or alternatively gauge marks be applied every 5 mm, 10 mm or 20 mm along the parallel length so that the elongation on the prescribed gauge length can be determined by some suitable method of interpolation.

The results obtained shall meet the specified requirements of Table 2.

10.3.3 Bend test on parent material. The width of the test specimens B1 and B2 (see figure 8) shall be not less than 25 mm or four times the minimum manufacturing thickness of the container as shown in the drawing (including corrosion allowance if any), whichever is the greater. The face and back of the test specimen shall not be machined except that the edges may be rounded off. When bent at room temperature, round a former of radius not greater than that given in Table 2 for the steel until the gap between the ends is not greater than twice the radius of the former, the specimen shall remain uncrached.

10.3.4 Tensile test on the welds. The test specimens T3 and T4 (see figure 8) shall be cut transversely to the weld and it shall be the full thickness of the material at the welded joint. The shape and dimension of the test specimen shall be as shown in figure 9. In preparing the test specimens the face and back shall not be machined. The face and back of the test piece shall each represent the surface of the parent material and the weld. The test specimen may be carefully staightened cold as necessary in order to place it in the testing machine. The tensile strength shall be not less than that specified for the parent material.

10.3.5 Bend test across the welds. The width of the test specimen shall be 25 mm or four times the design thickness of the container, whichever is the greater. In preparing the test specimen the corners may be rounded off and any weld reinforcement shall be machined off before testing

Specimens B3 and B4 (see fig. 8) shall be bent with the outer surface of the weld in tension, and specimens B5 and B6 (see figure 8) with the inner surface of the weld in tension.

When bent round a former of radius not greater than that given for the

+ Note: The requirements, as appropriate, of BS18 Parts 2 and 3 are considered satisfactory for this purpose.

steel in Table 2 until the gap between the ends is not greater than twice the radius of the former, each test specimen shall remain uncracked.

10.3.6 Nick-break test on the welds. Two nick-break tests shall be made, the specimens NB1 and NB2 (see figure 8) being similar to those required for a bend test, except that a slot is cut along the weld on each side at the centre line. The slot shall be of the form shown in figure 10. The specimen shall then be broken cold in the weld and the fracture shall reveal a sound, homogeneous weld with complete penetration, free from oxide, slag inclusions or excessive porosity.

10.4 Hydraulic Volumetric Expansion Test

10.4.1 After heat treatment the container(s) selected in accordance with the requirements of clause 12 shall be subjected to a volumetric expansion test preferably by the 'water jacket' method (see Appendix A).

10.4.2 The test pressure shall be 3 Mpa.

10.4.3 The permanent volumetric expansion shall not exceed 10% of the total expansion under the test pressure.

Should the permanent volumetric expansion of a container, selected according to Appendix B, exceed this value, the procedure laid down in 12.6 shall be followed.

10.5 Hydraulic Bursting Test

The containers selected in accordance with Appendix B, shall be hydraulically tested to destruction. The nominal hoop stress corresponding to the pressure at which destruction occurs shall be calculated from the formula:

$$f_b = \frac{P_b D_i}{20 t_m}$$

where f_b = nominal hoop stress (N/mm^2) at which destruction occurs,

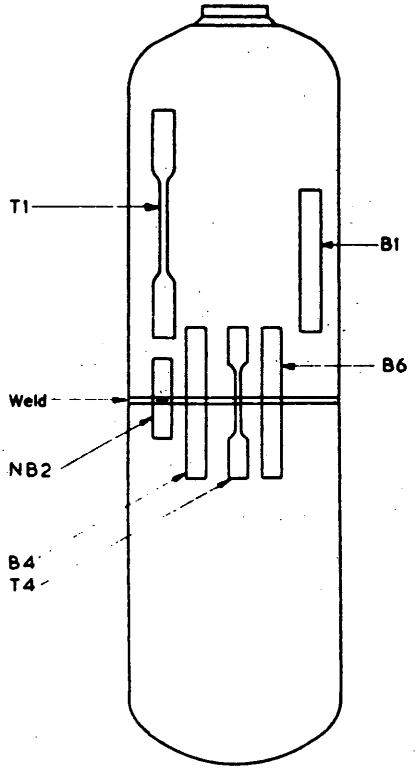
P_b = internal pressure (bar) at which destruction occurs,

D_i = nominal original internal diameter (mm) of the container,

t_m = minimum manufacturing thickness (mm), as specified on the drawing (including corrosion allowance, if any) of the wall of the container.

The value of f_b shall be not less than 0.95 of the minimum specified tensile strength of the material of the container.

The container shall burst without fragmentation.



T1 Tensile test on parent material.

T4 Tensile test on welded joint.

B1 Bend test on parent material.

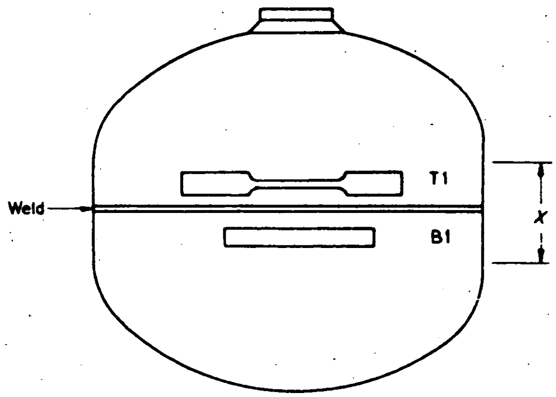
B4 Bend test on weld, outer surface in tension.

B6 Bend test on weld, inner surface in tension.

NB2 Nick-break test on weld.

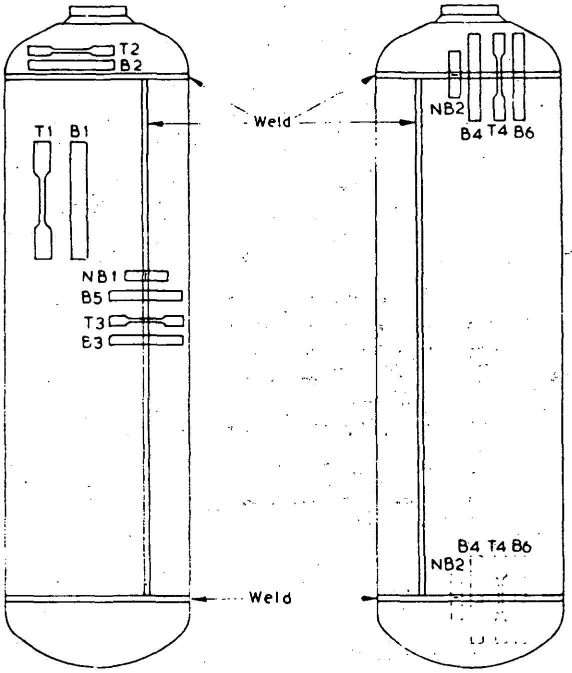
The location of specimens around the circumference of the cylinder is not specified.

(a) Containers with circumferential seams only



(b) Containers with circumferential seams only. Alternative positions for T1 and B1 for containers with parallel portion dimension X less than 150 mm

Figure 8. Location of test specimens in a container



T1 Tensile test on parent material
T2 Tensile test on parent material
T3 Tensile test on weld
T4 Tensile test on weld (see 10.3.1 regarding alternate test pieces)
B1 Bend test on parent material
B2 Bend test on parent material
B3 Bend test on weld outer surface in tension
B4 Bend test on weld outer surface in tension (see 10.3.1 regarding alternate test pieces)
B5 Bend test on weld inner surface in tension
B6 Bend test on weld inner surface in tension (see 10.3.1 regarding alternate test pieces)
NB1 Nick-break test on weld
NB2 Nick-break test on weld (see 10.3.1 regarding alternate test pieces)

8(c). Containers with longitudinal and circumferential seams

Figure 8. Location of test specimens in a container

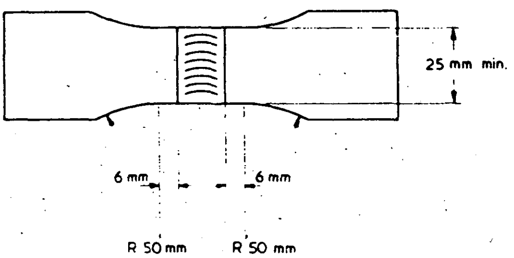
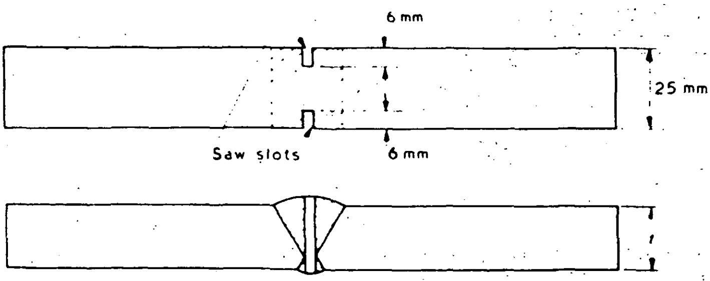


Figure 9. Reduced section tensile test specimen



The test piece is to be broken by pressure or blows applied on one of the slotted faces.

Figure 10. Nick-break test piece

10.6 Pressure Test

After all heat treatment each container shall be subjected to a hydraulic test in which the test pressure shall be 3 MPa. The test pressure shall be held for at least 2 min. Under these conditions of test the container shall not show any sign of pressure loss, leakage, visible deformation or defect.

10.7 Tightness Test

After each container has passed the hydraulic test specified in 10.6, it shall be subjected to an internal pneumatic pressure equal to 0.7 MPa. If any leakage occurs the container shall be regarded as having failed the test. Any leakage shall be detected by either immersing the container in water, by applying a soap solution to the welds or by any other test of equivalent sensitivity.

10.8 Repair of Welds

10.8.1 If during the hydraulic or tightness test minor leaks are found, the weld may, at the discretion of the Competent Authority, be repaired by rewelding either by automatic or manual means.

10.8.2 After such rewelding all containers shall be reheat treated in accordance with 8.4 and retested in accordance with 10.6 and 10.7.

10.9 Checking of Water Capacity

The water capacity of each container shall be checked. This shall be done by weighing, by filling the container with a calibrated volume of liquid or by other means approved by the Competent Authority in order to ensure compliance with the required minimum specified water capacity as marked on the container.

11 MARKING

11.1 Each container purporting to comply with the requirements of this standard shall be permanently and legibly marked with the following information.

(a) The manufacturer's name or trade mark, serial number and year of manufacture.

(b) The water capacity of the container in litres.

(c) The date of hydraulic test, (which date may be indicated by the month and year or by the year with a symbol to denote the quarter of the year).

(d) The tare, i.e. the mass of the container in kg.

(e) The maximum working pressure, i.e. 2.0 MPa.

(f) The test pressure to which the container was manufactured, i.e. 3.0 MPa.

(g) The number of this Cyprus Standard i.e. CYS 77:1980.

Note: Additional marking is required under the Petroleum Law, Chapter 272 and Law 64 of 1978, part IXA, special regulations for liquefied petroleum gas, paragraph 100E.

11.2 Method of Markings

The marks shall be as large as possible, preferably not less than 6 mm, but in any case not less than 3 mm in height. They shall be permanently and legibly marked on:

(a) a label welded to the container; or

(b) the foot ring; or

(c) the collar; or

(d) the valve boss

12 ESTABLISHMENT OF COMPLIANCE

To establish compliance with this standard, batches of containers shall be presented to the Competent Authority, with a statement of the manufacturing process and analysis of the steel used in their construction. The following series of inspections and tests shall then be conducted.

12.1 Freedom from Defects, Construction and Marking

Each container shall be visually inspected for compliance with sections 8 and 11 of this standard.

12.2 Pressure and Tightness Tests

Each container shall be subjected to the pressure and tightness tests specified in clauses 10.6 and 10.7 of this standard. If any container fails to meet the specified requirement, the whole batch shall be rejected.

12.3 Capacity and Elasticity

The batch shall be sampled in accordance with Appendix B, and each sample subjected to the tests specified in clauses 10.4 and 10.9 of this standard in that order.

If the number of failures to meet the requirements of any clause equals the rejection number given in Appendix B, the whole batch shall be rejected.

12.4 Material Tests

From each 400 containers, or part there of, a sample shall be selected at random, and specimens taken and tested in accordance with clauses 10.3.2, 10.3.3, 10.3.4, 10.3.5 and 10.3.6.

12.5 Bursting Test

Samples which have satisfactorily completed the tests required in 12.3 above shall be further sampled in accordance with Appendix B, and subjected to the test specified in clause 10.5 of this standard, any failure shall result in the rejection of the lot.

12.6 Resubmission

Should any batch be rejected, the Competent Authority may at its discretion allow the rework or reheat treatment of the batch for subsequent resubmission. Should a resubmitted batch again fail, the whole batch shall be destroyed.

Appendix A

VOLUMETRIC EXPANSION TESTING OF WELDED CONTAINERS

A.1 General

This appendix gives details of two methods for determining the volumetric expansion of welded steel gas containers as required by clause 10.4.

(a) the water jacket method (preferred method);

(b) the non-water jacket method.

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

A.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 twice the maximum test pressure of any container that may be tested. They shall be fitted with relief devices set to relieve at a pressure of 1.5 times the maximum test pressure of any container that may be tested.

(b) Glass burettes shall have bores of uniform diameter and be of sufficient length to contain the full volumetric expansion of the container.

(c) Pressure gauges used shall be accurate to within 0.5% at test pressure and shall be checked on a deadweight tester at regular intervals of not less than once per month.

(d) A suitable device shall be employed to ensure that no container is subjected to a pressure in excess of its test pressure.

(e) Pipework shall utilize long bends in preference to elbow fittings, and pressure pipes shall be as short as possible. Flexible tubing shall be capable of withstanding twice the maximum test pressure in the equipment and have sufficient wall thickness to prevent kinking.

(f) All joints shall be leak-tight.

(g) When installing equipment care shall be taken to avoid trapping of air in the system.

A.3 Water jacket volumetric expansion test

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.

The water jacket may 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 shall be fitted to the highest point of the jacket.

Two methods of performing this test are described in A.3.1 and A.3.2.

Other methods are acceptable provided that they are capable of measuring the total and, if any, the permanent volumetric expansions of the container.

A.3.1 Water jacket volumetric expansion test: levelling burette method.

An example of the equipment required is shown in figure 1, but other types of installation may be accepted. The procedure is as follows:

(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 pressure supply valve and check that the burette reading remains constant.

Note: A rise in water level indicates a leaking joint between the container and the jacket. A fall in water level indicates a leaking joint between the water jacket and the atmosphere.

(f) Open the hydraulic pressure line valve and continue the pressurization of the container until the test pressure is reached. Closed the hydraulic pressure 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. This reading is the total expansion and shall be recorded on the test certificate.

(h) Open the hydraulic pressure 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) Read the water level in the burette. This reading is the permanent expansion, if any, and shall be recorded on the test certificate.

(j) Check that the permenent expansion does not exceed 10% of the total expansion as determined by the following equation.

$$\frac{\text{Permanent expansion X 100}}{\text{Total expansion}} \leq 10\%$$

1.3.2 Water jacket volumetric expansion test: fixed burette method. An example of the equipment required is shown in figure 2, but other types of installation may be acceptable. The procedure is as follows:

(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 zero mark on the burette.

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

Note: A rise in water level indicates a leaking joint between the container and the jacket. A fall in water level indicates a leaking joint between the water jacket and the atmosphere.

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

(g) Read the level of the water in the burette. This reading is the total expansion which shall be recorded on the test certificate.

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

(i) Read the level of the water in the burette. This reading is the permanent expansion, if any, which shall be recorded on the test certificate.

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

$$\frac{\text{Permanent expansion} \times 100}{\text{Total expansion}} \leq 10\%$$

A.4 Non-water jacket volumetric expansion test

The method consists of measuring the amount of water passed into the container under proof pressure, and on release of this pressure, measuring the water returned to the burette. It is necessary to allow for the compressibility of water, and for the volume of the container under test to obtain true volumetric expansion. No fall in pressure under this test is permitted.

The water used should be free of air. Any leakage from the system or the presence of free or dissolved air will result in false readings.

Every care should be taken to maintain steady temperature conditions and sufficient time shall be allowed to permit the apparatus, the container and the water to attain a uniform constant temperature.

The equipment shall be installed as shown in figure 3. This figure illustrates diagrammatically the different parts of the apparatus.

The water supply pipe should be connected to an overhead tank as shown, or to some other supply giving a sufficient head of water.

A.4.1 Requirements for testing. The apparatus shall be arranged such that all air can be removed. The glass tube reservoir shall be calibrated in millilitres and be accurate to 1% of reading. It shall be so arranged that accurate readings can be determined of the volume of water required to pressurize the filled container, and of the volume expelled from container when depressurized. In the case of larger containers, it may be necessary to augment the glass tube with metal tubes arranged in a manifold.

The pressure gauges shall be calibrated. If a single-acting hydraulic pump is used, care must be taken to ensure that the piston is in the 'back' position when water levels are noted.

A.4.2 Test method.

(a) Completely fill the conainer with water and determine the mass of water required.

(b) Connect container to hydraulic test pump through coil A and check that all valves are closed.

(c) Fill pump and system with water from tank C by opening valves D, E and H.

(d) To ensure expulsion of air from the system, close valve H and raise system pressure to approximately one third of test pressure. Open bleed valve G to release trapped air by reducing the system pressure to zero and re-close valve G. Repeat if necessary.

(e) Continue to fill system until level in glass tube M is approximately 300 mm from the top of this tube. Close valve D and mark water level by pointer P, leaving valves E and H open. Record level.

(f) Close valve H. Raise the pressure in system until the check pressure gauges K records the required test pressure. Stop the pump. After approximately 30s there should be no change in either water level or pressure. A change in level indicates leakage. A fall in pressure, if there is no leakage, indicates that the container is still expanding under pressure.

(g) Record the fall of water level in glass tube. Providing there has been no leakage, the water drained from the glass tube will have been pumped into container to achieve the test pressure. This difference in water level is the temporary volumetric expansion.

(h) Open valve H slowly to release the pressure in the container and allow water so released to return to the glass tube. The water level should return to the original level marked by pointer P. If the water level returns to a point below pointer P, this difference in level will denote the amount of permanent volumetric expansion in the container, neglecting the effect of compressibility of water at test pressure. The true permanent volumetric expansion of the container is obtained by correcting for compressibility of the water.

(i) Before disconnecting the container from the test rig, close valve E. This will leave the pump and system full of water for the next test.

Action (d) shall, however, be repeated at each subsequent test.

(j) If permanent volumetric expansion has occurred, record the temperature of water in the container.

A.4.3 Test results

(a) The tests determine the volume of water in millilitres required to pressurize the filled container to test pressure.

(b) The total mass and temperature of water in the container are known, enabling change in volume of the water in the container due to its compressibility to be calculated. The volume of water expelled from the container when depressurized is known. Thus total volumetric expansion (TE) and permanent volumetric expansion (PE) can be determined.

(c) The permanent volumetric expansion shall not exceed 10% of the total volumetric expansion.

A.4.4 Example calculation. In the following calculation, allowance for pipe stretch has been ignored. The compressibility for water is calculated from the following formula:

$$C = WP \left(K - \frac{0.68P}{10^5}\right)$$

where C is the volume of water forced into the container due to the compressibility of water (ml),

W is the mass of water in the container at test pressure (kg),

P is the test pressure (bar),

K is a factor, dependent upon temperature, with values listed in the table below.

°C	K	°C	K	°C	K
6	0.049 15	13	0.047 59	20	0.046 54
7	0.048 86	14	0.047 42	21	0.046 43
8	0.048 60	15	0.047 25	22	0.046 33
9	0.048 34	16	0.047 10	23	0.046 23
10	0.048 12	17	0.046 95	24	0.046 13
11	0.047 92	18	0.046 80	25	0.046 04
12	0.047 75	19	0.046 68	26	0.045 94

Given that 1 kg of water = 1 litre, a typical example is as follows:

Test pressure = 232 bar gauge

Mass of water in container at zero gauge pressure = 113.8 kg

Temperature of water = 15^{o}C

Water forced into container to raise pressure to 232 bar = 1745 ml or 1.745 kg.

Total mass of water (W) in container at 232 bar = 113.8 + 1.745 = 115.545 kg.

Water expelled from container to depressurize = 1742 ml

Therefore PE (without correction for compressibility) = 1745 - 1742 = 3 ml.

From the formula $C = WP\ (K - \frac{0.68P}{10^5})$

Volume of water (C) forced into the container due to the compressibility of water at 232 bar and 15^{o}C = 115.545 x 232 (0.047 25 - 0.001 50) = 1224 ml.

Total volumetric expansion = 1745 - 1224 = 521 ml

Permanent expansion = $\frac{3 \times 100}{521}$ = 0.58%

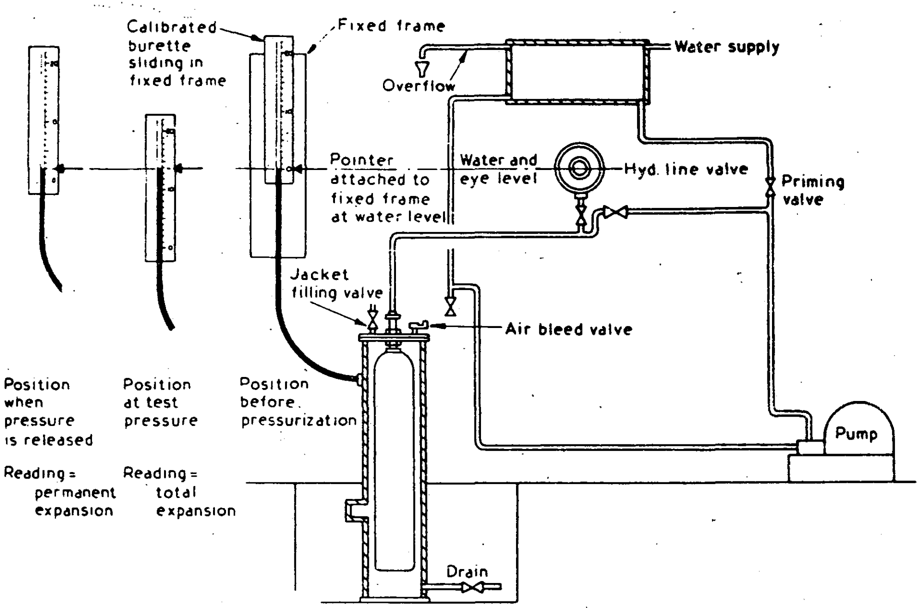


Figure 1. Water jacket volumetric expansion test (levelling burette)

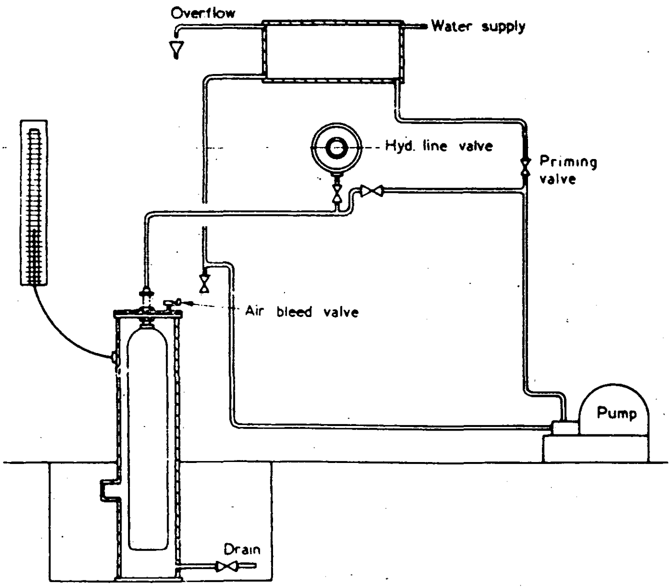


Figure 2. Water jacket volumetric expansion test (fixed burette)

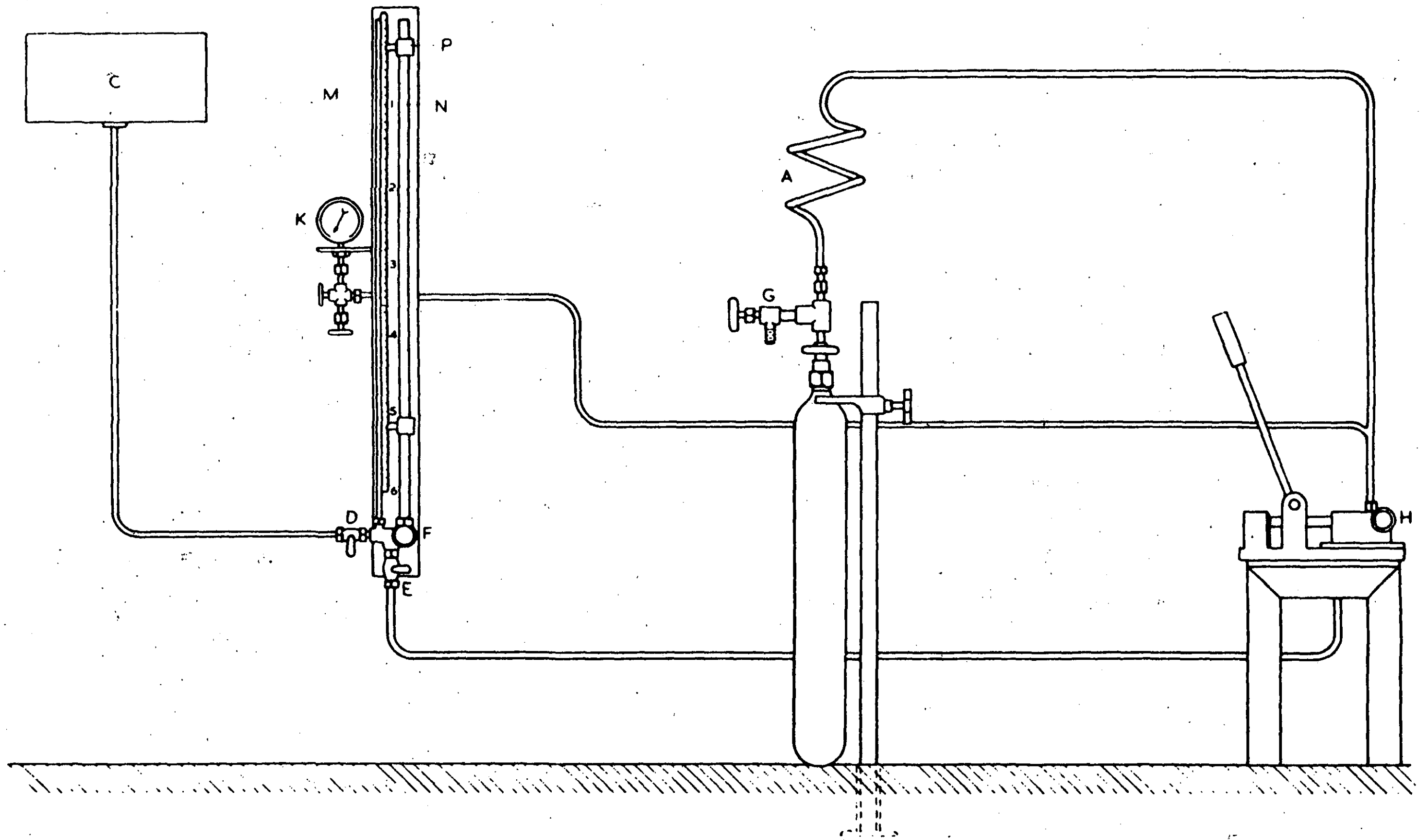


Figure 3. Non-water jacket volumetric expansion test

Appendix B

SAMPLING

B.1 Batch definition.

For the purpose of this standard, a batch is defined as a number of containers of the same design, shape and capacity , manufactured by the same manufacturer under essentially the same conditions, and presented for appraisal at the same time.

B.2 Sampling.

Samples shall be drawn from the batch at random making use of a table of random numbers, see Table 3.

B.3 Number of samples.

The number of samples shall be appropriate to the batch size as given in Tables 1 and 2.

B.4 Acceptance and rejection numbers.

The numbers used for acceptance or rejection of a batch of containers shall be those given in Tables 1 and 2 as appropriate to the batch size and clause in question.

BATCH SIZE	SAMPLE SIZE		ACCEPTANCE & REJECTION NUMBERS FOR CLAUSES:			
	CLAUSES 12.3	CLAUSES 12.5	12.3		12.5	
			ACC	REJ	ACC	REJ
0 TO 280	13	5	0	1	0	1
281 TO 500	20	5	1	2	0	1
501 TO 1200	32	5	2	3	0	1
1201 TO 3200	50	8	3	4	0	1
3201 TO 10,000	80	8	5	6	0	1

Table 1: Sampling plan, 1st submission

BATCH SIZE	SAMPLE SIZE		ACCEPTANCE & REJECTION NUMBERS FOR CLAUSES			
	CLAUSE 12.3	CLAUSE 12.5	12.3		12.5	
			ACC	REJ	ACC	REJ
0 TO 280	13	5	0	1	0	1
281 TO 500	20	5	0	1	0	1
501 TO 1200	32	5	0	1	0	1
1201 TO 3200	50	8	1	2	0	1
3201 TO 10,000	80	8	2	3	0	1

Table 2: Sampling plan. Resubmission

TABLE 3 (PART 1). RANDOM SAMPLING NUMBERS

0110	9140	2804	8046	7142	6277	6210	8627	3209	6845
5327	3946	6289	6117	0060	2827	6546	2738	8760	6604
5373	8259	4956	8185	0135	8640	7410	6335	0831	2774
9244	9452	8324	8062	9817	9853	7479	9559	4264	6919
4148	3948	5399	8687	3568	4046	4558	0705	5075	4440
2403	4351	8240	3554	3568	4701	7494	6036	7735	4082
1828	1956	1646	1370	9096	0738	8015	0513	6969	0949
7249	9634	4263	4345	0567	1272	5302	3352	7389	9976
7116	9731	2195	3265	9542	2808	1720	4832	2553	7425
6659	8200	4135	6116	3019	6223	7323	0965	8105	4394
2267	0362	5242	0261	7990	8886	0375	7577	8422	5230
9460	9813	8325	6031	1102	2825	4899	1599	1199	0909
2985	3541	6445	7981	8796	9480	2409	9456	7725	0183
4313	0666	2179	1031	7804	8075	8187	6575	0065	2170
6930	5368	4520	7727	2536	4166	7653	0448	2560	4795
8910	3585	5655	1904	0681	6310	0568	3718	3537	8858
8439	1052	5883	9283	1053	5667	0572	0611	0100	5190
4691	6787	4107	5073	8503	6875	7525	8894	7426	0212
1034	1157	5888	0213	2430	7397	7204	6893	7017	7038
7472	4581	3837	8961	7931	6351	1727	9793	2142	0816
2950	7419	6874	1128	5108	7643	7335	5303	2703	8793
1312	7297	3843	4767	5386	7361	2079	3197	8904	4332
8734	4921	6201	5057	9228	9938	5104	6662	1617	2323
2907	0737	8496	7509	9304	7112	5528	2390	7736	0475
1294	4883	2536	2351	5860	0344	2595	4880	5167	5370

TABLE 3 (PART 2). RANDOM SAMPLING NUMBERS

0430	5819	7017	4512	8081	9198	9786	7388	0704	0138
5632	0752	8287	8178	8552	2264	0658	2336	4912	4268
7960	0067	7837	9890	4490	1619	6766	6148	0370	8322
5138	6660	7759	9633	0924	1094	5103	1371	2874	5400
8615	7292	1010	9987	2993	5116	7876	7215	9714	3906
4968	8420	5016	1391	8711	4118	3881	9840	5843	0751
9228	3232	5804	8004	0773	7886	0146	2400	6957	8968
9657	9617	1033	0469	3564	3799	2784	3815	3611	8362
9270	5743	8129	8655	4769	2900	6421	2788	4858	5335
8206	3008	7396	0240	0524	3384	6518	4268	5988	9096
1562	7953	0607	6254	0132	3860	6630	2865	9750	9397
1528	4342	5173	3322	0026	7513	1743	1299	1340	6470
5697	9273	8609	8442	1780	1961	7221	5630	8036	4029
3186	0656	3248	0341	9308	9853	5129	3956	4717	7594
3275	7697	1415	5573	9661	0016	4090	2384	7698	4588
7931	1949	1739	3437	6157	2128	6026	2268	5247	2987
5956	2912	2698	5721	1703	2321	8880	3288	7420	2121
1866	7901	4279	4715	9741	2674	7148	8392	2497	8018
2673	7071	4948	8100	7842	8208	3256	3217	8331	7256
7824	5427	0957	6076	2914	0336	3466	0631	5249	7289
2251	0864	0373	7808	1256	1144	4152	8262	4998	3315
7661	8813	5810	2612	3237	2829	3133	4833	7826	1897
6651	6718	1088	2972	0673	8440	3154	6962	0199	2604
2917	4989	9207	4484	0916	9129	6517	0889	0137	9055
5970	3582	2346	8356	0780	4899	7204	1042	8795	2435

Appendix C

FILLING RATIOS

The filling ratio shall be such that under no circumstances shall the liquid portion at the gas occupy more than 97% of the volume of the container at the reference temperature at 50°C, neither shall the container be liquid full at 55°C.
For mixtures of saturated and unsaturated liquifiable petroleum gases, the filling ratio shall be determined by:

(a) Establishing the density for the LPG mixture by experiment at a convenient temperature.
(b) The required filling ratio is indicated by using either table 1 or table 2 as appropriate. Interpolation between results is acceptable where the exact temperature and density are not apparent.

Table 1. Filling ratios for liquefied saturated hydrocarbon gases, reference temperature 50 °C

Temperature for density determination °C	0	5	10	15	20	25	30
Density g/cm³							
0.500	0.397	0.408	0.417	0.427	0.437	0.446	0.455
0.505	0.404	0.415	0.424	0.434	0.443	0.451	0.461
0.510	0.410	0.421	0.430	0.440	0.449	0.458	0.466
0.515	0.417	0.427	0.436	0.446	0.455	0.464	0.471
0.520	0.424	0.434	0.442	0.452	0.461	0.469	0.476
0.525	0.431	0.441	0.449	0.459	0.467	0.474	0.481
0.530	0.438	0.447	0.456	0.465	0.472	0.480	0.488
0.535	0.445	0.453	0.462	0.470	0.478	0.485	0.493
0.540	0.451	0.461	0.468	0.476	0.484	0.491	0.498
0.545	0.459	0.467	0.474	0.482	0.490	0.497	0.503
0.550	0.465	0.472	0.480	0.488	0.496	0.502	0.509
0.555	0.471	0.478	0.486	0.493	0.501	0.507	0.514
0.560	0.477	0.484	0.492	0.499	0.507	0.513	0.519
0.565	0.483	0.491	0.498	0.504	0.512	0.518	0.524
0.570	0.489	0.497	0.503	0.510	0.517	0.523	0.529
0.575	0.496	0.503	0.509	0.516	0.522	0.528	0.534
0.580	0.502	0.509	0.515	0.521	0.527	0.534	0.540
0.585	0.508	0.515	0.521	0.526	0.533	0.539	0.545
0.590	0.514	0.520	0.526	0.532	0.539	0.545	0.551
0.595	0.520	0.525	0.532	0.538	0.545	0.551	0.557
0.600	0.525	0.531	0.538	0.545	0.551	0.558	0.563
0.605	0.531	0.537	0.543	0.548			
0.610	0.537	0.543	0.548	0.553			
0.615	0.542	0.548	0.553	0.560			
0.620	0.547	0.553	0.560	0.566			
0.625	0.553	0.560	0.566	0.571			

Table 2. Filling ratios for liquefied unsaturated hydrocarbon gases, reference temperature 50 °C

Temperature for density determination °C	0	5	10	15	20	25	30
Density g/cm³							
0.500	0.383	0.394	0.405	0.417	0.428	0.438	0.448
0.505	0.390	0.401	0.412	0.423	0.434	0.444	0.454
0.510	0.397	0.407	0.418	0.429	0.439	0.449	0.459
0.515	0.403	0.414	0.425	0.435	0.445	0.455	0.465
0.520	0.410	0.420	0.431	0.441	0.451	0.461	0.470
0.525	0.417	0.427	0.437	0.446	0.456	0.466	0.475
0.530	0.423	0.433	0.443	0.452	0.462	0.472	0.481
0.535	0.429	0.439	0.449	0.458	0.468	0.477	0.486
0.540	0.436	0.445	0.455	0.464	0.473	0.483	0.492
0.545	0.442	0.451	0.460	0.470	0.479	0.488	0.497
0.550	0.448	0.457	0.466	0.476	0.485	0.494	0.503
0.555	0.454	0.463	0.472	0.482	0.491	0.499	0.508
0.560	0.460	0.469	0.478	0.487	0.496	0.505	0.513
0.565	0.466	0.475	0.484	0.493	0.502	0.511	0.519
0.570	0.473	0.481	0.490	0.499	0.508	0.516	0.524
0.575	0.479	0.487	0.496	0.505	0.513	0.522	0.530
0.580	0.485	0.494	0.502	0.511	0.519	0.527	0.535
0.585	0.491	0.500	0.508	0.517	0.525	0.533	0.540
0.590	0.497	0.506	0.514	0.522	0.531	0.538	0.546
0.595	0.504	0.512	0.520	0.528	0.536	0.544	0.551
0.600	0.510	0.518	0.526	0.534	0.542	0.549	0.557
0.605	0.516	0.524	0.532	0.540	0.548	0.555	0.562
0.610	0.522	0.530	0.538	0.546	0.553	0.561	0.567
0.615	0.528	0.536	0.544	0.552	0.559	0.566	0.573
0.620	0.535	0.542	0.550	0.558	0.565	0.572	0.578
0.625	0.541	0.548	0.556	0.563	0.570	0.577	0.584

NOTE. The values underlined result from the over-riding condition that the container may not be liquid full at a temperature 5 °C above the reference temperature for filling ratio.

Appendix D

MATHEMATICAL REQUIREMENTS RELATED TO THE DESIGN OF LPG CONTAINERS+

D.1 Nomanclature for the cylindrical part of the shell

t is the minimum wall thickness (mm), to resist internal pressure and external forces due to handling, but excluding any additional thickness for corrosion and other influences.

P_1 is the test pressure (bar) applicable to design governed by equations (1) and (4).

P_2 is the test pressure (bar) applicable to design governed by equations (3) and (6).

P is the pressure (bar) developed by the contents of a container at the pressure reference temperature.

D_o is the external diameter of container (mm).

D_i is the internal diameter of container (mm).

f_e is the maximum permissible equivalent stress (N/mm^2) at test pressure (=0.75 x minimum specified yield stress Y (N/mm^2) of the material of construction x appropriate stress reduction factor).

T is the minimum specified tensile strength (N/mm^2) of the material of construction.

Y is the minimum specified yield stress (N/mm^2) of the material of construction.

Values of Y and T are given in table 2, page ...5.. of this standard.

D.2 Permissible pressure. The maximum pressure attainable in service by a permanent gas in an uninsulated container or liquefiable gas in an insulated container shall not exceed the lesser of:

+Based on BS5045:Part 2:1978. The class of container for low pressure gases and using a longitudinal weld is class IIb, for which a stress reduction factor of 0.8 is required.

(a) 0.90 of the test pressure; or

(b) 0.576 of the test pressure times the ratio of the minimum specified tensile strength to the minimum specified yield stress of the material of construction;

The maximum pressure attainable in service by a liquefiable gas in an uninsulated container shall not exceed the lesser of:

(c) the test pressure of the container; or

(d) 0.64 of the test pressure times the ratio of the minimum specified tensile strength to the minimum specified yield stress of the material of construction.

D.3 Thickness of cylindrical wall. The thickness of the cylindrical wall of a container shall be not less than the value given by equation (1).

$$t = \frac{0.3P_1D_i}{7f_e - P_i} \quad \text{or} \quad t = \frac{0.3P_1D_o}{7f_e - 0.4P_i} \qquad \ldots(1)$$

except that the thickness of the cylindrical wall shall be not less than the value given by equation (2).

$$t = 2.48\sqrt{\frac{D_i}{T}} \qquad \ldots(2)$$

Equation (2) will override equation (1) for comparatively low values of P_1, in which case the test pressure P_2 shall be derived from equation (3).

$$t = \frac{7_{fe}}{1+0.12\sqrt{D_iT}} \qquad \ldots(3)$$

D.4 Domed ends

D.4.1 Nomenclature for ends

t is the minimum wall thickness of the cylindrical shell (mm) to resist internal pressure and external forces due to handling, but excluding any additional thickness for corrosion and other influences.

t_e is the minimum wall thickness of ends (mm) to resist internal pressure and external forces due to handling, but excluding any additional thickness for corrosion and other influences.

D_o is the external diameter (mm) of domed end.

D_i is the internal diameter (mm) of domed end.

K is the shape factor obtained according to the values $\frac{h_e}{D_o}$ and $\frac{t_e}{D_o}$ (with interpolation where necessary from figure 1).

R_o is the external radius (mm) of dishing of torispherical end.

R_i is the internal radius (mm) of dishing of torispherical end.

r_o is the external knuckle radius (mm) of torispherical end.

r_i is the internal knuckle radius (mm) of torispherical end.

h_o is the external height (mm) of domed end (see note).

h_i is the internal height (mm) of domed end.

h_e = h_o for a semi-ellipsoidal end, or the least of

h_o, $D_o^2 / 4R_o$, or $\sqrt{\frac{D_o r_o}{2}}$ for a torispherical end.

S_f is the straight flange (mm).
(See figure 2, page ... of this standard or diagrammatic representation.)

Note. The external height of a domed end h_o, for a torispherical end, may be determined from:

$$h_o = R_o - \sqrt{(R_o - \frac{D_o}{2}) \times (R_o + \frac{D_o}{2} - 2r_o)}.$$

D.4.2 Wall thickness of domed ends. The thickness of a domed end shall be the greater of:

(a) the thickness of shell (see D.3); or,

(b) the value calculated from equation (7):

$$t_e = tK \qquad \dots (7)$$

D.4.3 Limitations of shape (see figure 2, page .8. of this standard):

(a) In a torispherical end R_i shall not be greater than D_o.

(b) In a torispherical end r_i shall be not less than 0.1 D_i nor less than three times the actual wall thickness of the dished end as manufactured.

(c) In a semi-ellipsoidal end the ratio h_o/D_o shall be not less than 0.192.

(d) S_f shall be not less than $0.3\sqrt{D_o t_e}$ (mm).

D.5 Additional thickness. Influences other than those of internal pressure and of external forces due to ordinary handling may require the provision of additional thickness above the calculated values. Additional thickness may be necessary to allow for corrosion during service; additional thickness may also be necessary, on containers for liquefied gases, so that the container can withstand stresses due to horizontal acceleration and retardation in road transportation. The variety of conditions occurring in practice makes it impracticable to give a general specification of the necessary allowances; they should be carefully considered and agreed upon in each particular case by the manufacturer and user of the containers. If a pronounced departure from normal practice is proposed or other unusual features arise, the Competent Authority should be consulted.

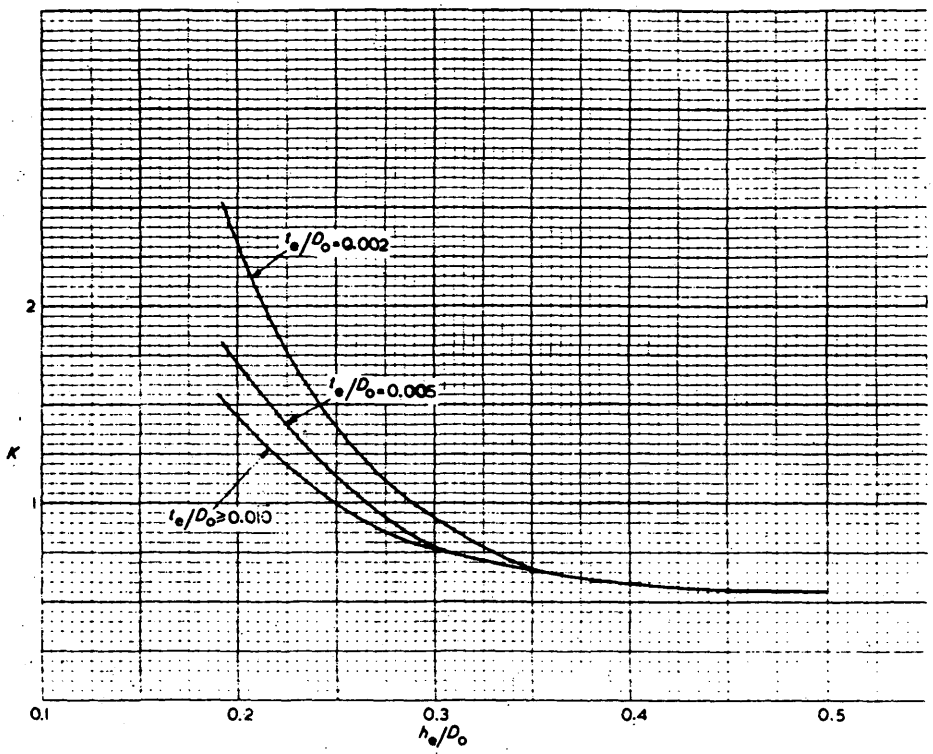


Figure 1(a). Shape factor *K*

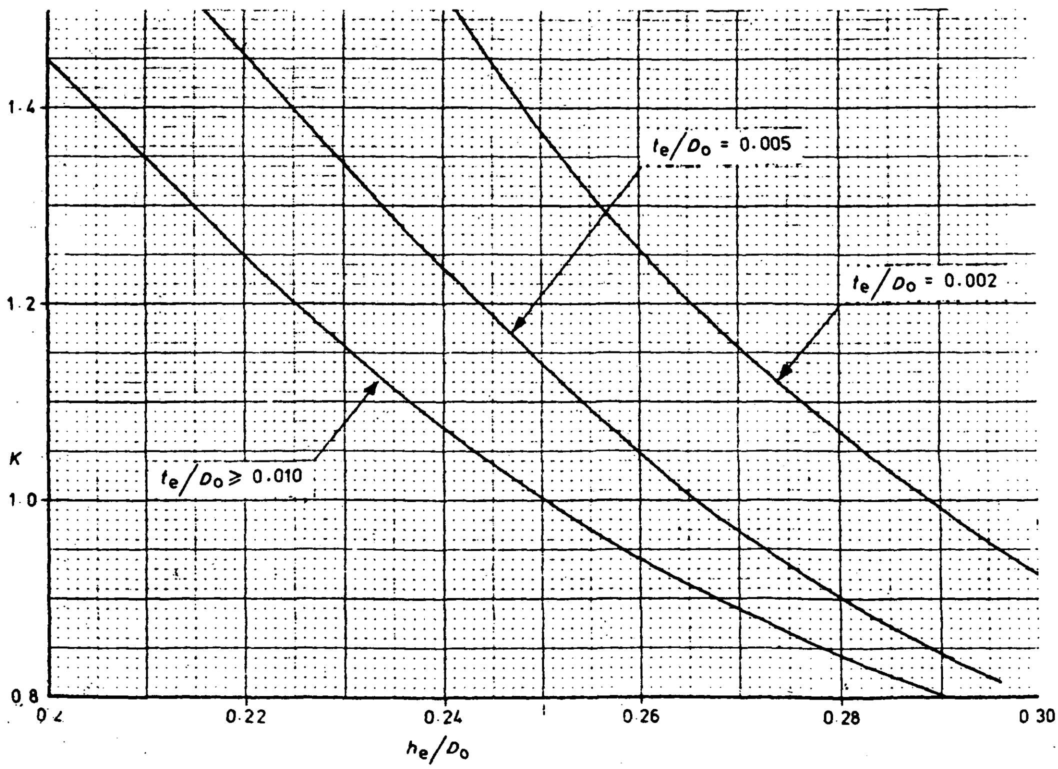


Figure 1(b). Shape factor *K* **(enlargement of figure 1(a))**

Appendix E

SPECIMEN CERTIFICATE OF COMPLIANCE FOR LPG CONTAINERS

Certificate number ....

Date ....

Concerning the manufacture and testing of (quantity) steel containers for the transport and storage of LPG according to CYS ...

Manufacturer:	Name Address		Symbol
Purchaser:	Name Address		

To purchaser's order number .... and container reference ....

Manuf. Nos. .... to ....

Purchaser's nos. .... to ....

Technical data

Containers

The above containers are manufactured in accordance with the requirements of CYS ... and as detailed on approved drawing no's ....

Container test pressure = ... bar.

Container max. attainable pressure = ... bar.

Materials

Steel manufacturer:	Name Address Ref. no.		Steel Specification ....

Cast no.	Chemical composition																
	C	Si	Mn	P	S	Nb											
Heat treatment	N ... normalized S ... stress relieved																

Container heat treatment

Each of the above containers has been heat treated at a temperature between ..... °C and ...... °C for .... min.

Water capacity

The water capacity of each of the above containers has been checked and found to be not less than .... litres.

Pressure test

Each of the above containers has been hydraulically tested at .... bar and subsequently air tested at .... bar.

Mechanical tests on representative container(s)

Test container serial no.	Containers represented by test	Tensile tests								Nick-break test	Thickness	
		+Symbol	Cross-sectional area mm	Yield stress N/mm²	Tensile strength N/mm²	% Elongation on...mm gauge	+Symbol	Former radius mm	Result	Result	Wall mm	End mm
		T1					B1					
		T2					B2					
		T3					B3					
		T4					B4					
							B5					
							B6					
		T1					B1					
		T2					B2					
		T3					B3					
		T4					B4					
							B5					
							B6					
		T1					B1					
		T2					B2					
		T3					B3					
		T4					B4					
							B5					
							B6					

+Symbols refer to figure 8 of this standard.

Hydraulic volumetric expansion and bursting tests

Test container number	Containers represented by test	Permanent/total expansion ratio....% at....bar	Bursting pressure bar		Nature of failure
			Calculated minimum	Actual	

Certified by .... Date ....
(For manufacturer)

On behalf of .... Date ....
(Independent Inspecting Authority)

Accepted by .... Date ....

Ἐτυπώθη ἐν τῷ Τυπογραφείῳ τῆς Κυπριακῆς Δημοκρατίας, ἐν Λευκωσίᾳ.