Unofficial Translation

In the event of any doubt or misunderstanding arising from this translation, the standard in Thai will be held to be authoritative

Notification of the Ministry of Industry
(No.2802) B.E.2544(2001)
issued under the Industrial Product Standards Act B.E.2511(1968)
Subject: Amending to Thai Industrial Standard for
Liquefied Petroleum Gas Containers (Amendment No.1)

Whereas it is deemed expedient appropriate to revise the Thai Industrial Standard for Liquefied Petroleum Gas Containers (TIS 27-2540).

By virtue of Section 15 of the Industrial Product Standards Act B.E.2511 (1968), the Minister of Industry hereby issues a notification amending the Thai Industrial Standard for Liquefied Petroleum Gas Containers (TIS 27-2540) which is attached to the Notification of Ministry of Industry No.2239, dated 17 March, B.E.2540(1997) as follows:

1. The number of the standard is amended from "TIS 27-2540" to "TIS 27-2543."
2. The statement in clause 6.1(8) is withdrawn and replaced with the following statement:
   "(8) Name or trade mark of oil trader according to fuel law"
3. The statement in clause 6.3 is withdrawn and replaced with the following statement:
   " The information as in clause 6.1 shall be in Thai language, exception of clause (7) (8) the foreign language may be used."

This ministerial notification shall come into force 120 days as from the date of its publication in the Government Gazette.

Given on 19 January B.E.2544 (2001)
Minister of Industry

Published in the Government Gazette Vol.118, Part 30 ngor., dated 12 April, B.E.2544 (2001)

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Thai Industrial Standards
TIS 27-2540(1997)
Standard for Liquefied Petroleum Gas Containers

1. Scope

1.1 This standard specified types, materials, components and construction, requirements, marking and labeling, sampling and criteria for conformity, testing, and use and maintenance for electric-arc welded liquefied petroleum gas containers having the capacity from 1 dm^3 up to 500 dm^3.

1.2 This standard does not cover liquefied petroleum gas containers for internal combustion engines.

1.3 This standard does not include quality requirements for valves, safety devices and other devices used for filling and applying gas which are to be given separately in the corresponding standards.

2. Definitions

For the purpose of this standard, the following definitions apply:

2.1 Liquefied petroleum gas, hereinafter referred to as “Gas” : a fluid which is composed predominantly of any of the following liquefied hydrocarbons or mixture of all or any of them:

Propane
Propene
Butane
Butene

2.2 Liquefied petroleum gas container, hereinafter referred to as “Container” a vessel for the storage of liquefied petroleum gas.

2.3 Tare weight : the weight of container complete with valve and other permanently affixed appurtenances, but excluding any valve protection cap or plug. The tare weight may vary from the nominal container weight by not more than 1% and shall be indicated in kg to three significant figures. For instance, a container of nominal weight of 10.2 kg shall be weight between 10.1-10.3 kg.

2.4 Capacity : Volumetric capacity of container determined from the water capacity in dm^3 to three significant figures.

2.5 Maximum working pressure, WP : Pressure used for the purpose of design calculation.

2.6 Test pressure, TP : the pressure for which the container is tested, which is equal to two times the maximum working pressure.

2.7 Nominal wall thickness : The minimum thickness of the cylindrical section or part in millimetres to the second decimal point.

2.8 Type test : The testing of prototype container to verify whether the container comply with the requirements of type test.

3. Types

Containers in this standard are listed in 2 types.

3.1 Two-section container

A two-section container is composed of the head and the end sections, each being made from one piece of steel, which when welded together shall make one circumferential weld (see Figure 1).

3.2 Three-section container

A three-section container is composed of the head, the middle cylindrical and the end sections. The head and the end sections each being made from one piece of steel, and the middle section which when welded together shall make two circumferential welds. In case where the middle section is made from a steel sheet, there shall be only one longitudinal weld parallel to the axis of the containers (see Figure 2)

4. Materials, Components and Construction

4.1 Material

4.1.1 The material used for making the container shell shall be killed steel of good and uniform quality.

4.1.2 Steel for making of container shell is of 3 grades, the chemical composition of which when determined by means of the ladle analysis shall comply with Table 1 and the mechanical properties shall comply with Table 3.

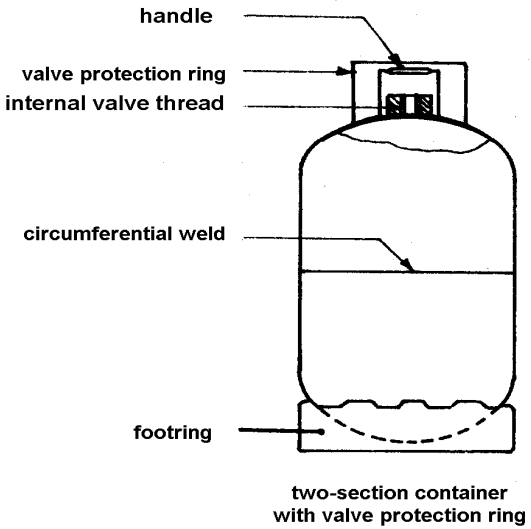
Chemical composition shall be determined by a general chemical analysis or other technically equivalent method.

The testing for mechanical properties shall be in accordance with TIS 244, Part 5.

4.1.3 Steel for making of fittings, valve protection ring and footring shall comply with the requirements of clause 4.1.2, or shall have the chemical composition as follows:

Carbon %, max	0.25
Manganese %, max	0.60
Phosphorus %, max	0.045
Sulfur %, max	0.05

4.1.4 Steel for making of container shell shall be free from seams, cracks, laminations or other injurious defects.



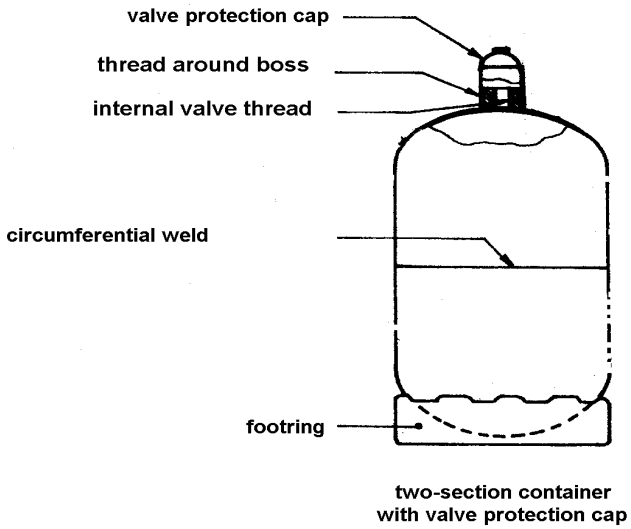
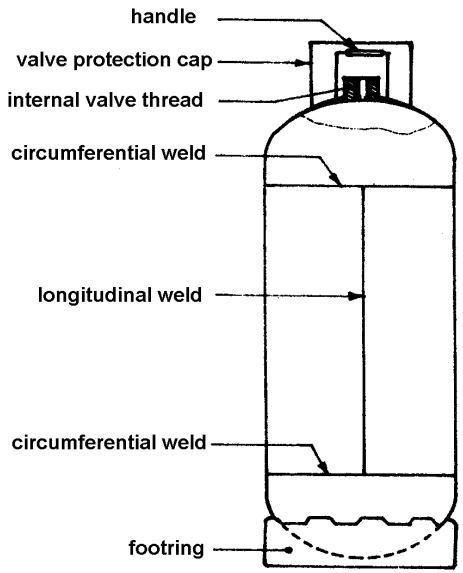
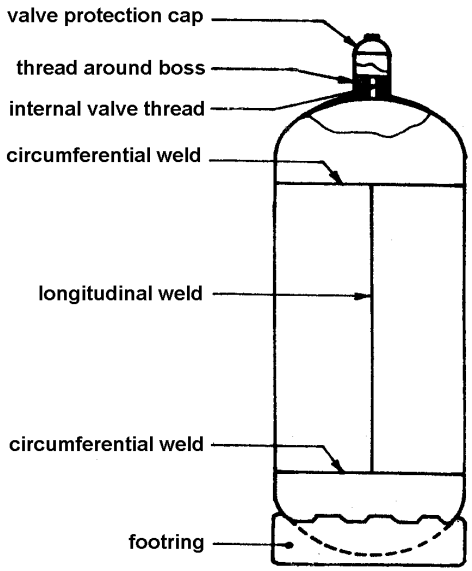


Figure 1 Two-section container with valve protection ring and two-section container with valve protection cap (manufacture for export purpose)
(clause 3.1)



three-section container
with valve protection ring



three-section container
with valve protection cap

Figure 2 Three-section container with valve protection ring and two-section container with valve protection cap (manufacture for export purpose)
(clause 3.2)

Table 1
Chemical composition of steel for making container shell when determined by means of the ladle analysis
(clause 4.1.2)

Chemical composition %	Grade of steel		
	1	2	3
Carbon, max	0.20	0.20	0.20
Manganese, max	0.60	1.20	1.50
Silicon, max	0.30	0.35	0.30
Sulfur, max	0.05	0.04	0.04
Phosphorus, max	0.05	0.04	0.04
Niobium (columbium)	-	-	0.01 to 0.04

Note In case of product analysis, permissible variation in chemical composition shall be as specify in Table 2.

Table 2
Permissible variations in chemical composition when determined by means of the product analysis
(Table 1)

Chemical composition	Requirement %	Permissible variation, %
Carbon	0.20 max	0.03
Manganese	0.60 max	0.03
	above 0.60 up to 1.50	0.04
Silicon	0.30 max	0.03
	above 0.30 up to 0.35	0.05
Sulfur	All ranges	0.01
Phosphorus	All ranges	0.01
Niobium (columbium	All ranges	0.01

Table 3
Mechanical requirements of steel for making container shell
(clauses 4.1.2, 5.8.1, 5.8.2(1), 5.8.3.1, 5.9.3(2) and 8.6.2)

Grade	Minimum tensile strength MPa	Minimum yield strength MPa	Elongation %	Bend property[1)] mm
1	402	255	28	2a
2	440	300	24	3a
3	490	340	20	3a

Note : 1) refer to the distance between the parallel surfaces of bend test specimen where “a” is the specified thickness. The external surface of the test specimen after bending shall show no sign of cracking.

4.2 Components and construction

4.2.1 Fittings

4.2.1.1 Containers of both types shall be provided with valve fittings which welded to the head section of the containers so that no leakage shall occur.

Compliance is check by visual inspection.

4.2.1.2 The sum of external diameter of all fittings on the head section shall not exceeding half of the external diameter of the container, and that of any fitting shall not exceeding

(1) 1.3 times the major diameter of the internal thread of fitting, or

(2) 6 mm plus the major diameter of the internal thread of fitting, whichever is greater.

Compliance is checked by measurement.

4.2.1.3 The valve thread shall be clean cut and of taper or parallel type in accordance with Table 4 and Appendix A.

Compliance is checked by measurement.

4.2.1.4 Thread around boss shall be of parallel type in accordance with Table 4 and Appendix A.

Compliance is checked by measurement.

4.2.2 Valve

The valves to be fitted to the container shall have the thread of the same type and size as that of the fitting and shall be equipped with safety device conforming to TIS 255.

The valve shall comply with standard recognized as sufficiently safe.

Table 4 Nominal size, capacity, nominal size of valve thread, and nominal size of thread around boss

(clause 4.2.1.3 and 4.2.1.4)

Nominal size [1] kg	Capacity dm^3	Nominal size of valve thread[2]	Nominal size of thread around boss
0.5 1 1.5 2 2.5 3 4	1.0 up to less than 2.4 2.4 up to less than 4.0 4.0 up to less than 4.8 4.8 up to less than 6.0 6.0 up to less than 7.2 7.2 up to less than 9.2 9.2 up to less than 11.9	0.6 - 14 0.715 - 14 $\frac{3}{4}-14\text{NGT}$ or $\text{M - }22\times1.25$	
5 12 13.5 15 25	11.9 up to less than 26.2 26.2 up to less than 30.5 30.5 up to less than 35.5 35.5 up to less than 54.0 54.0 up to less than 108.0	$\text{W }28.8\times\frac{1}{14}$ or $\frac{3}{4}-14\text{NGT}$	
50	108.0 up to less than 454.0		W 80-11
200	454.0 up to less than 500.0	$1\frac{1}{4}-11.5\text{NGT}$	

Notes : 1). Nominal size is based on weight in kg of LP gas contained.

2) The basic profile and the basic sizes of the thread shall comply with Appendix A.

4.2.3 Valve protection ring, cap and plug

For transportation safety and convenience, containers shall be provided with any of the following.

4.2.3.1 Valve protection ring

(1) The valve protection ring shall be made of steel of a thickness not less than the designed minimum wall thickness. It shall be of adequate construction to protect the valve against damage during transportation or usage and of adequate strength to withstand the weight of at least 5 superposing gas-filled containers. Suitable holder shall be provided for safe lifting of the filled containers.

(3) The valve protection ring shall have a smooth rounded horizontal edge of such width as will fit with the footring of the container of the same size. When piles one on the other, the distance from the end section of the upper container to the valve shall be not less than 5 mm for container having the capacity from 1 to 10 dm^3 and 10 mm for container having the capacity from 10 to 500 dm^3.
Compliance is check by measurement and visual inspection.

4.2.3.2 Valve protection cap

The valve protection cap (for export purpose container) shall be of adequate strength to prevent valve from damage during transportation and shall be provided with a side vent for proper ventilation.

4.2.3.3 Plug may be used where the container was fitted with one-way valve, and having the capacity not exceeding 10 dm^3.
Compliance is checked by visual inspection.

4.2.4 Footring

4.2.4.1 The footring shall be made of steel of a thickness not less than the designed minimum wall thickness welded to the end section of the container at a distance of at least 15 mm below the circumferential weld. The lower edge of the footring shall be curled inwards forming a semi-circular or similar shape to facilitate safe handling. The footring shall be suitably drained by means of the water outlet at the lowest part of the curved footring. The footring shall be welded to the container at equal intervals along the circumference. For container having capacity above 10 up to 500 dm^3 , the length of such welding shall altogether be not less than 25% of the container circumference.

4.2.4.2 After attachment of the footring, the container shall not deviate from the vertical line by more than 1 degree.
Compliance is checked by measurement

4.2.4.3 The external diameter of the footring (D_F) and the distance from container end to the floor (C) shall comply with Table 5.
Compliance is checked by measurement.

Table 5
The external diameter of footring and the distance from container end to the floor
(clause 4.2.4.3)

Capacity dm^3	External diameter of footring,DF minimum, mm	Distance from container end to the floor, C minimum, mm
1.0 to 11.0	0.8 D	3
Over 11.0 to 40.0	0.8 D	12
Over 40.0 to 500	D	12

Note : D = nominal external diameter of the container, mm.

4.2.5 Welding

4.2.5.1 Prior welding, examination for defects on the steel surface both inside and outside of the container, circularity of the cylindrical part, curvature of the head and end sections and workmanship of components to be welded shall be made. The manufacturer shall be able to ensure the uniformity of the wall thickness and that the thickness at any part of container not less than the designed specification.

4.2.5.2 Longitudinal weld

For the cylindrical part of a three-section container, a longitudinal weld shall be of butt joint electric welded by using a welding machine having automatic feed and welding guidance mechanisms. The joint shall be complete joint penetration and shall be free from undercuts, overlaps or abrupt ridges or valleys. Misalignment of mating butt edges shall not exceed 1/6 of the nominal wall thickness or 0.8 mm, whichever is lower.

Where container wall thickness not exceeding 3.2 mm all joints shall be tightly butted. Where container wall thickness exceeding 3.2 mm, the joint shall be gapped for maximum distance equal to 0.8 mm. The fit-up of head, end and cylindrical sections before welding shall be satisfied.

4.2.5.3 Circumferential weld

A circumferential weld shall be of a joggle butt or lap electric welded by using a welding machine having automatic feed and welding guidance mechanisms. The joint shall be complete joint penetration and shall be free from undercuts, overlaps or abrupt ridges or valleys. The lap shall be at least 4 times the nominal wall thickness.

4.2.5.4 Attachment of fittings to the shell shall comply with any of the illustrations given in Figure 3 as follows:

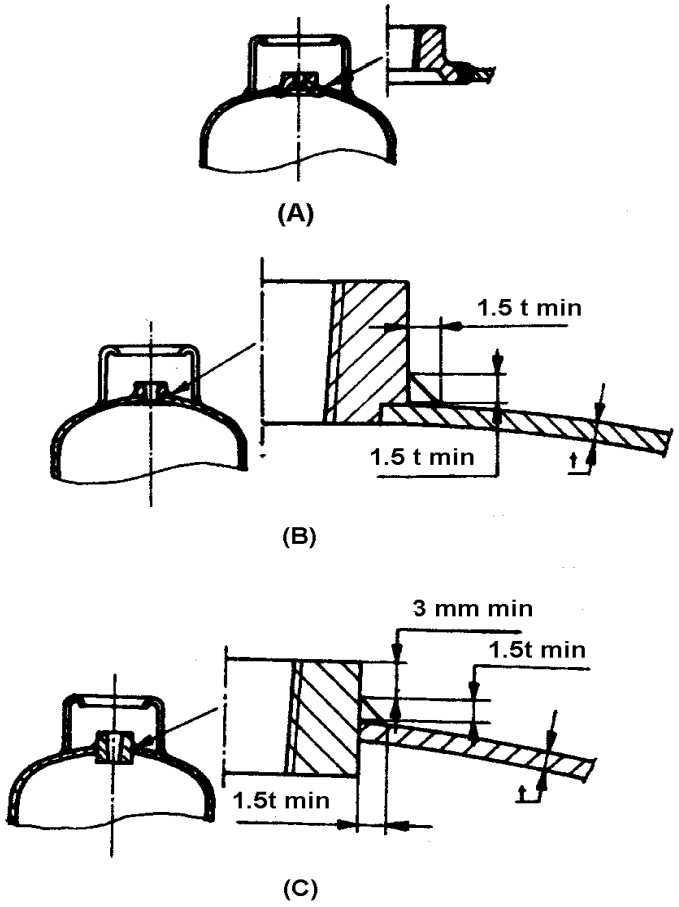


Figure 3 Attachment for valves
(clause 4.2.5.4)

4.2.5.5 Attachment of other components shall be made to the head or end section of the container only. Such components shall be of steel complying with the requirements of clause 4.1.3 for the process of arc welding or resistance welding, the carbon content of which shall not exceed 0.15 % for resistance welding.

4.2.6 Heat treatment

4.2.6.1 After forming and welding operation, all containers including those with repair welds shall be uniformity heat treated before hydrostatic test. The containers shall be heated by an appropriate method to ensure that they are at a temperature higher than 600°C and shall then be cooled in still air.

For the attachment of weldable, low carbon parts to the components attached to the head and end sections of container, which have been properly heat treated. The heat treatment as of clause 4.2.6.1 are not necessary, if such welding does not cause temperature of any part of container for not exceeding 200°C.

4.2.7 Cleaning

Before delivery, inside of all containers shall be thoroughly cleaned, and then shall be dried by purging with dry air or nitrogen or by heating at a temperature not higher than 200°C.
Where the container are supplied without fitted valves, all apertures shall be fitted with a plug of suitable non-absorbent material to protect the thread and to prevent entry of moisture.

5. Requirements

5.1 The maximum working pressure shall be not less than 1.65 Mpa.

5.2 General characteristics

The container shall be free from sharp edges or fragile parts which may be injurious to individual or property.
Compliance is checked by visual inspection.

5.3 Length

5.3.1 For container having capacity from 1 to 10 dm^3, its length shall not exceed 3 times the container diameter.

5.3.2 For container having capacity above 10 up to 500 dm^3,its length shall not exceed 4 times the container diameter.

Compliance is checked by the test of clause 8.1.

5.4 Wall thickness

5.4.1 For container with external diameter above150 mm, the wall thickness of the cylindrical section or portion shall be not less than that specified by the manufacturer and not less than:
- 1.75 mm for container having capacity from 1 to 10 dm^3
- 2.0 mm for container having capacity above 10 up to 500 dm^3

5.4.2 For container with external diameter less than 150 mm, the wall thickness of the cylindrical section or portion shall be not less than that specified by the manufacturer and not less than:
- 1.0 mm for container with external diameter not exceeding 75 mm
- 1.0 mm plus 0.01 mm for each increment of 1 mm of container diameter for container with external diameter exceeding 75 mm.

5.4.3 The wall thickness of the head and end sections (t′) shall be not less than 90% of that of the cylindrical section or portion that specified by the manufacturer.

5.4.4 Where stamping is made as in clause 6.2 on the head section the minimum thickness of the head section shall be not less than 2.2 mm.

Compliance is checked by the test of clause 8.2.

5.5 Head or end section

The head and the end sections shall be made from one piece of material, concave to pressure and shall have either hemispherical or semi-ellipsoidal form, the ratio of the dished end(h) to the external diameter of the container (D) being $\frac{1}{2} \geq \frac{h}{D} \geq \frac{1}{4}$ (see Figure 4). They shall be checked to a true form by means of an external or internal template. Any deviation from the template shall not be greater than 1.25% of the container diameter (see Figure 4).

The head and the end sections shall have a cylindrical portion with the length (l) of not less than 4 times the wall thickness (t).

Compliance is checked by tested of clause 8.3.

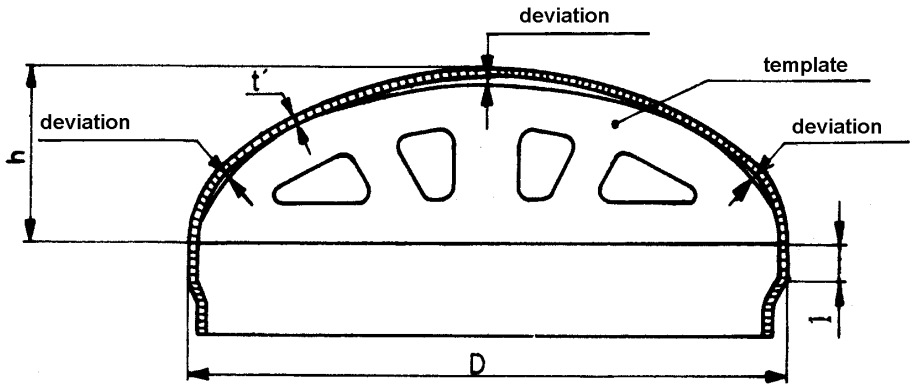


Figure 4 Dimension of head and end section

(clause 5.5)

5.6 Welds

When radiographed in accordance with the Compressed Gas Association (CGA) Pamphlet C-3, “Standards for welding and brazing on thin walled containers”, the welds shall not show any of the following imperfections.

5.6.1 Crack, incomplete fusion or incomplete penetration

5.6.2 Isolated porosity or cavity or slag inclusion with a length greater than 1/3 of the minimum wall thickness (t)

5.6.3 Aligned porosity or cavity or slag inclusion of dimension smaller than that mentioned in clause 5.6.2 with the sum of the longest dimensions of such defects greater than the minimum wall thickness by at least 6 times the length of the longest defects.

See Figure 5 and 6 for the acceptance limit in a length of 12 t.

5.7 Capacity

After tested by filled with water, the capacity shall be not less than that specified on the label.

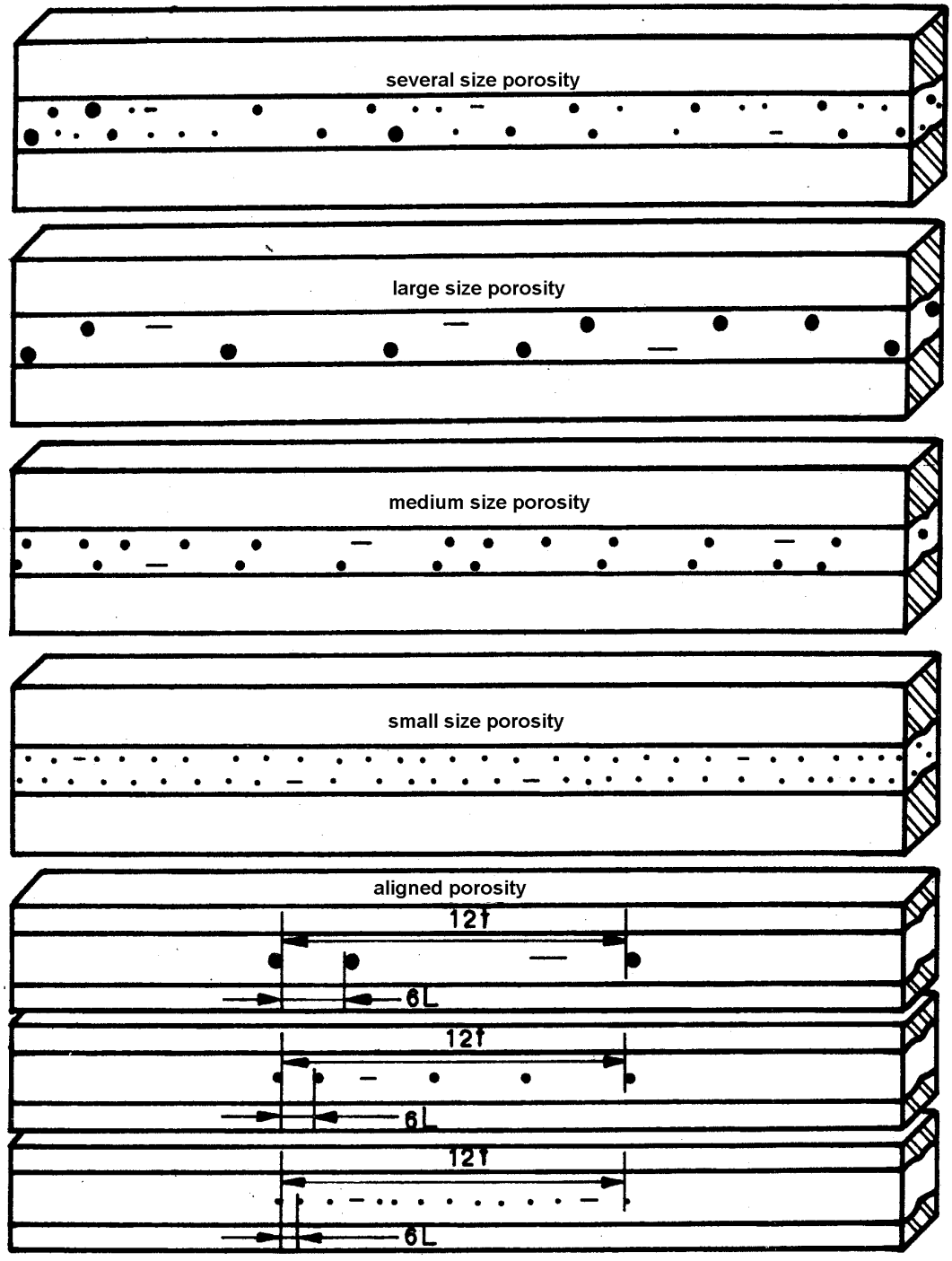


Figure 5 Porosity acceptance limits for plate thickness less than 5 mm
(clause 5.6.3)

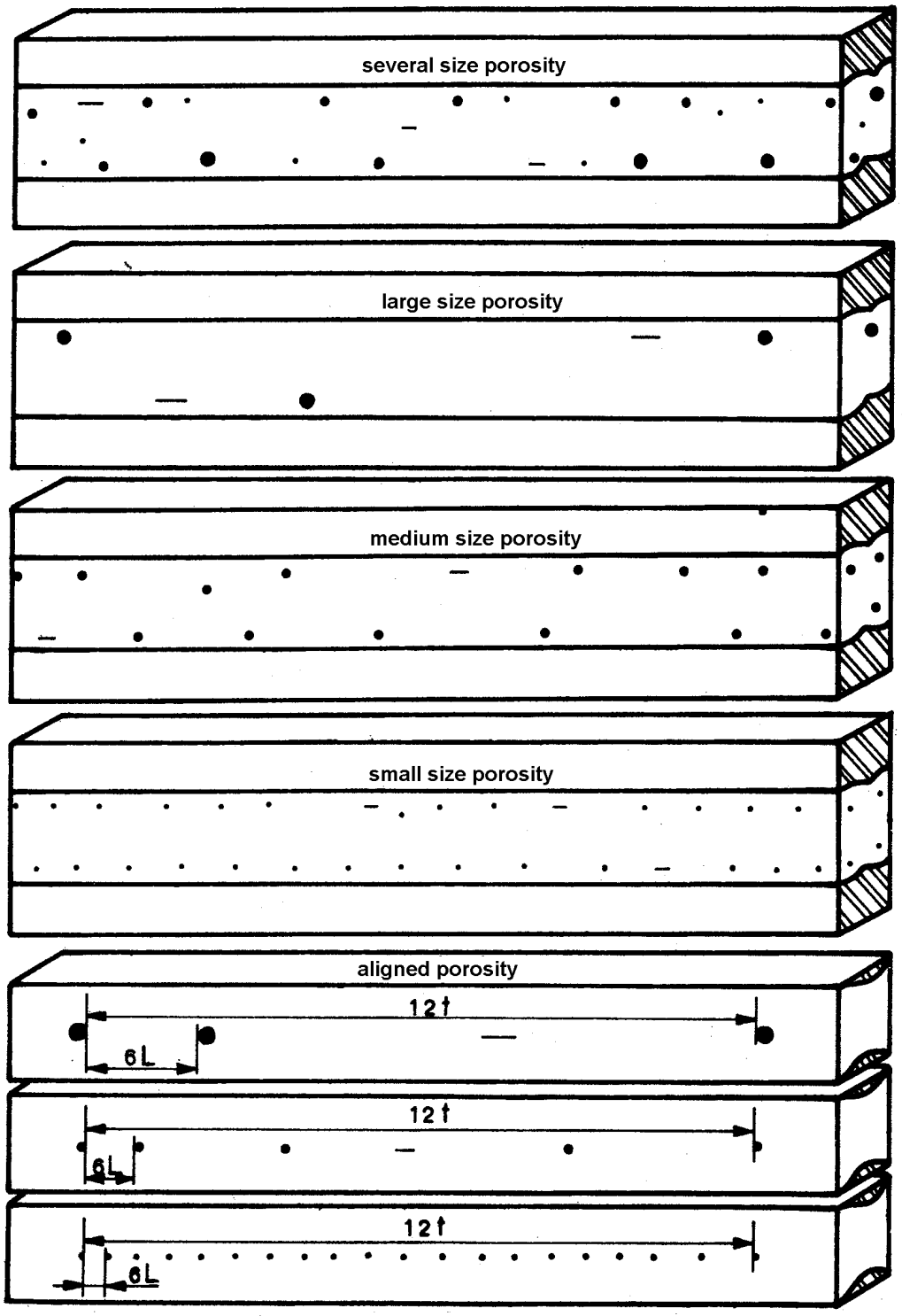


Figure 6 Porosity acceptance limits for plate thickness 5mm up to less than 10 mm
(clause 5.6.3)

5.8 Mechanical properties

5.8.1 Mechanical properties of parent metal
Steel for the making of container, after tested in accordance with TIS 244, Part 5, shall satisfy the requirements given in Table 3.

5.8.2 Mechanical properties of steel after construction

After tested in accordance with clause 8.4.2.1, steel from the selected container shall

(1) comply with the bending requirements of Table 3.

(2) have the minimum tensile strength of not less than the maximum value obtained from the following formula:

$$T = \frac{6.25 D_i}{t^2}$$

and $$T = \frac{f}{0.6}, \qquad f = \frac{P_h(D - t)}{2000Jt}$$

or the yield strength of not less than $\frac{f}{0.9}$ where $f = \frac{P_h(D - t)}{2000\,Jt}$

Where
- T is the tensile strength of steel, in Mpa
- D_i is the nominal internal diameter, in mm
- t is the nominal wall thickness, in mm
- f is the maximum allowable stress, in Mpa, in any case, shall not exceed 294 Mpa
- P_h is the test pressure in, kPa
- D is the oexternal diameter, in mm
- J is the joint factor (see clause 5.6)

For two-section container J = 1.0 where a container is spot radiographed. Each spot radiograph shall cover the area from the circumferential weld at least 75 mm and from the longitudinal weld at least 25 mm(see Figure 7).

For three-section container J = 1.0 where a container is fully radiographed on the longitudinal weld and circumferential weld. The radiographed shall cover entire weld and cover the area from the weld at least 25 mm in both side.

J = 0.9 where the container is spot radiographed as follows:

(1) spot radiograph examination on the longitudinal weld shall cover at least 150 mm from the intersection and 25 mm from the weld in both direction. (see Figure 7)

(2) spot radiograph examination on the circumferential joint shall cover both side of the circumferential weld at least 75 mm and at least 25 mm of the longitudinal weld.(see Figure 7)

(4) The elongation may vary from the values specified in Table 3 but shall not be less than the values given in Table 6.

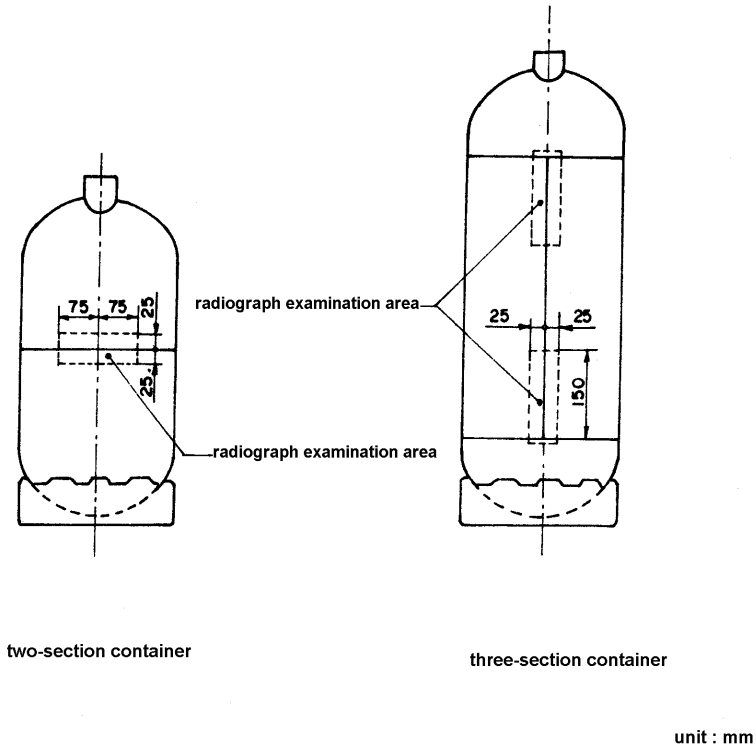


Figure 7 Spot radiograph examination
(clause 5.8.2(2))

Table 6
Elongation of steel after construction
(clause 5.8.2(3))

Tensile strength [1)] MPa	Elongation Min, %
Under 400	20
400 up to less than 450	19
450 up to less than 500	18
500 up to less than 550	17
550 and above	16

Note : 1) These tensile strength values are obtained from the test as of clause 8.4.2.1.

5.8.3 Mechanical properties of welds

5.8.3.1 Transverse tensile strength
After tested in accordance with clause 8.4.2.2(1), the transverse tensile strength shall be not less than 95% of tensile strength specified in Table 3.

5.8.3.2 Transverse bend
After tested in accordance with clause 8.4.2.2(2), any crack or defect on the surface of the weld shall not exceed 1.5 mm when measured transversely or 3 mm when measured lengthwise.

5.9 Resistance to pressure

5.9.1 Hydrostatic proof pressure
All containers shall be able to withstand a pressure twice the maximum working pressure for a duration of 30 seconds without developing a visible bulge, distortion or leakage.

5.9.2 Stretch

After tested in accordance with clause 8.5, the permanent volumetric expansion of the container shall not exceed 10% of the total expansion under the test pressure or 1/5000 of the container volume, whichever is lower.

5.9.3 Burst pressure

After tested in accordance with clause 8.6,:
(1) The container shall not crack or burst ;
(2) The nominal hoop stress shall be not less than 95% of the tensile strength specified in Table 3, when calculated from the following formula:

$$f_b = \frac{P_b d}{2t}$$

Where f_b is the nominal hoop stress, in MPa
P_b is the hydrostatic pressure under test, in MPa
d is the nominal internal diameter of container, in mm
t is the wall thickness specified on the design (including corrosion allowance), in mm

(3) The percentage increase in water capacity after rupture shall not be less than

10% of the water capacity before test for $L \leq D$

$10 + \frac{5}{2}\left(\frac{L}{D} - 1\right)$% of the water capacity before test for $D < L \leq 3D$

15% of the water capacity before test for $L > 3D$

Where L is the length of the container, in mm
D is the external diameter of the container, in mm

5.9.4 Leakage

All containers and those subjected to the hydrostatic proof test and the test of clause 8.5, after tested in accordance with clause 8.7, shall show no sign of leakage.

5.10 Drop resistance

After test in accordance with clause 8.8, the container shall show no sign of leakage and its valve shall operate properly.

6. Marking and labeling

6.1 Each container shall bear at least number, letter or mark of the height not less than 4 mm indicating clearly, legibly and permanently the following information.

(1) Name of product, and maximum working pressure
(2) Code or serial number
(3) Wall thickness
(4) Capacitty, in dm^3
(5) Tare weight
(6) Name of manufacturer, factory or registered trade mark
(7) Inspector's mark and month and year of hydrostatic proof test
(8) Name or trade mark of oil trader according to fuel law

Note : For the export purpose, marking and labeling shall be according to agreement between purchaser and manufacturer

6.2 The information as in clause 6.1 shall be stamped permanently on the steel in any of the following locations on the container without causing any alteration in its performance.

(1) On top heads with wall thickness not less than 2.2 mm.
(2) On footring, valve protection ring, or other part which permanently attached to head section of container.
(3) On a plate attached to the top of the container, sufficient space shall be left on the plate to provide for stamping at least 6 retest dates; the plate shall be at least 1.6 mm thick and attached by welding or by brazing at a temperature of at least 590°C throughout all edges of the plate.

6.3 Incase foreign language is used, the meaning shall correspond to that in Thai specified above.

6.4 Any person who manufactures product complying with this standard may use the Standards Mark in connection with his product only after having received a license from the Industrial Product Standards Council.

7. Sampling and criteria for conformity

7.1 Lot : containers of the same type and capacity, manufactured from the same material and procedure at the same period of time and belonging to the same group in any single delivery or purchasing.

7.2 Sampling and criteria for conformity shall comply with the following sampling plan or other technically equivalent sampling plan.

7.2.1 Sampling and acceptance for testing on chemical composition and mechanical properties of materials

7.2.1.1 The sample steel sheets shall be adequate for the preparation of 3 test specimens for each of chemical composition and mechanical properties.

7.2.1.2 Provided all the test specimens comply with clause 4.1.2, the materials shall be deemed to meet the requirements

Note : Where the manufacturer declare the conformity with clause 4.1.2 of the chemical composition of the materials, The chemical analysis need not to be done.

7.2.2 Sampling and acceptance for testing on components, general characteristics, length, capacity, and mechanical properties of steel after construction.

7.2.2.1 One samples shall be from products of the same lot of size 200(or part thereof), then to carry out the testing on components, general characteristics, length, capacity, and mechanical properties of steel after construction respectively.

7.2.2.2 Provided the sample comply with clause 4.2.1, 4.2.2, 4.2.3, 4.2.4, 5.2, 5.3, 5.7 and 5.8.2, that lot shall be deemed to comply with the requirement.

7.2.3 Sampling and acceptance for testing on wall thickness, dimensions of head and end sections and mechanical property of welds

7.2.3.1 One samples shall be drawn from products of the same lot of size 200 (or part thereof), then to carry out the testing of wall thickness, dimensions of head and end sections and mechanical property of welds respectively. That sample shall be new container and shall have not been subjected to test as of clause 8.5.

7.2.3.2 If the sample non-comply with clauses 5.4, 5.5 and 5.8.3, 2 additional samples from that lot shall be drawn for retest.
Provided all additional samples comply with 5.4, 5.5 and 5.8.3, that lot shall be deemed to comply with the requirement.

7.2.4 Sampling and acceptance for tests on welds

7.2.4.1 Two-section container

(1) One sample from every 200 (or part thereof) consecutively welded containers shall be drawn for testing on weld in accordance with Compressed Gas Association (CGA) Pamphlet C-3.

(2) If the sample non-comply with clause 5.6, 2 additional samples from that lot shall be drawn for retest.
Provided all additional samples comply with clause 5.6, that lot shall be deemed to comply with the requirement.

7.2.4.2 Three-section container

(1) Where J = 1.0, all containers shall be inspected and the radiographic films shall be retained.

(2) Where J = 0.9, one sample from every 50 (or part thereof) consecutively welded containers or one container from the first 5 containers welded following a shutdown of welding operations exceeding 4 hours, shall be drawn for testing on the welds in accordance with Compressed Gas Association (CGA) Pamphlet C-3.

(2) If the sample non-comply with clause 5.6, 2 additional samples from that lot shall be drawn for retest.
Provided all additional samples comply with clause 5.6, that lot shall be deemed to comply with the requirement.

7.2.5 Sampling and acceptance for stretch test

7.2.5.1 One sample from every 200 (or part thereof) containers of the same lot shall be drawn at random for test. The containers shall have not been subjected to an internal pressure exceeding 90% of the test pressure subsequent to any final heat treatment.

7.2.5.2 If the 5.9.2, 2 additional samples from that lot shall be drawn for retest.
Provided all additional samples comply with clause 5.9.2, that lot shall be deemed to comply with the requirement.

7.2.6 Sampling and acceptance for bursting test

7.2.6.1 One sample from every 500 (or part thereof) containers of the same lot shall be drawn at random for bursting test.

7.2.6.2 If the sample non-comply with clause 5.9.3, 2 additional samples from that lot shall be drawn for retest.
Provided all additional samples comply with clause 5.9.3, that lot shall be deemed to comply with the requirement.

7.3 Criteria for conformity
Provided the material and containers comply with all of clauses 7.2.1.2, 7.2.2.2, 7.2.3.2, 7.2.4.1(2), or clause 7.2.4.2(3), 7.2.5.2 and 7.2.6.2, that lot shall be deemed to comply with this standard.

7.4 Sampling and acceptance for type test

7.4.1 Sampling for drop resistance test
One sample from every 500 (or part thereof) containers of the same lot shall be drawn at random for drop resistance test.

7.4.2 Criteria for conformity
If the sample non-comply with clause 5.10, 2 additional samples from that lot shall be drawn for retest.
Provided all additional samples comply with clause 5.10, that lot shall be deemed to comply with this standard.

8. Tests

8.1 length
The length L (see Figure 8) shall be measured by means of appropriate apparatus with an accuracy of 1 mm.

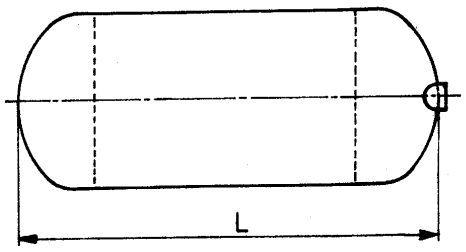


Figure 8 Measurement of container length
(clause 8.1)

8.2 Wall thickness
The sample container shall be halved along its axis and measurement of wall thickness shall be made where the wall is thinnest.

8.3 Dimensions of head and end sections
A template with the cross-sectional dimensions of the head and end sections as designed for the container of that lot shall be placed to the samples which have been inspected on the wall thickness. Measurement shall be made on the thickness, the depth of the hemispherical or semi-ellipsoidal form, the external diameter, the length of cylindrical section or portion and the deviation from template.

8.4 Mechanical properties

8.4.1 Cutting of test specimens

8.4.1.1 Test specimens shall be cut from the locations of the container indicated in Figure 9 and machined to the specified size. Grip ends may be flattened to within 25 mm of each end of the reduced section.

8.4.1.2 Where it is impracticable to obtain straight test specimens, the specimens may be taken in any location or direction and may be straightened or flattened cold by pressure only. Forging and heating of specimens is not allowed. The test report shall include detailed

information in regard to such flattening or preparation of the specimens.

8.4.1.3 Specimens from head and end sections for tensile and bend tests shall be cut at least 25 mm away from the weld and not in the zone of minimum thickness transition.

8.4.2 Preparation of test specimens and test procedure

8.4.2.1 Mechanical properties of steel after construction

(1) Tensile strength, yield strength and elongation

The test specimen 1 (see Figure 9) shall be tested in accordance with TIS 244: Part 5, choosing the gauge length of 50 mm. During the test, the stress acceleration shall not exceed 7.72 MPa/sec or elongation acceleration shall not exceed 2.5×10^{-4} up to 2.5×10^{-3} until approaching the yield stress.

(2) Bend property

The test specimen 2 (see Figure 9) shall be tested in accordance with TIS 244: Part 12.

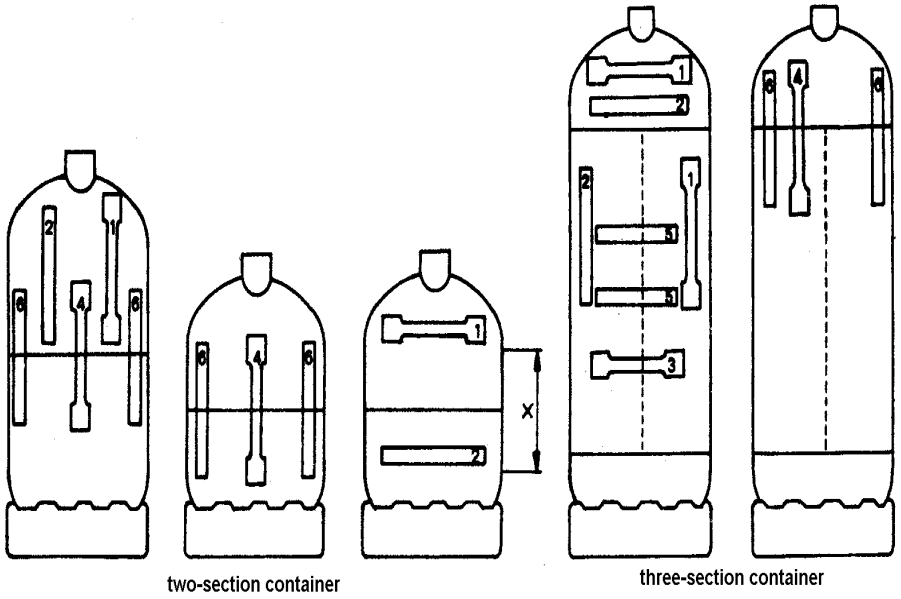
8.4.2.2 Mechanical properties of welds

(1) Transverse tensile strength

The test specimen 3 and 4 (see Figure 9) shall be tested in accordance with clause 8.4.2.1(1). The weld shall be at the center of the gauge length.

(2) Transverse bend

The test specimens 5 and 6 (see Figure 9) having the dimensions as given in Table 7 shall be tested in accordance with clause 8.4.2.1(2). The weld shall be at the center of two supporting rollers. One specimen shall be tested with the root of the weld in tension and the other with the face of the weld in tension by movement of a former.



1 Tensile test specimen
2 Bend test specimen
3 Transverse tensile test specimen (longitudinal weld)
4 Transverse tensile test specimen (circumferential weld)
5 Transverse bend test specimen (longitudinal weld)
6 Transverse bend test specimen (circumferential weld)

Where the parallel portion dimension X of the two section container is less than 150 mm, the test specimens for tensile test and bend test shall be cut transversely to axis of the container.

Figure 9 Location of test specimens in a container
(clauses 8.4.1.1 and 8.4.2)

Table 7 Dimensions of transverse bend test specimens
(clause 8.4.2.2(2))

Unit : mm

Thickness	Length	Width
Less than 1.52 1.52 and above	100 times the thickness Not less than 152	25 times the thickness 38

Note : Any protrusion or weld reinforcement shall be machined off before testing.

8.5 Stretch

The water jacket method or other suitable method operated so as to obtain accurate data shall be applied.

8.5.1 Apparatus

8.5.1.1 The pressure gauge shall be capable of reading to 1% of the test pressure.

8.5.1.2 The expansion gauge shall be capable of reading to 1% of total volumetric expansion or 0.1 cm^3.

8.5.2 Test method

A hydrostatic pressure of twice the maximum working pressure shall be applied to the sample and maintained for at least 60 seconds or longer to ensure complete expansion and record the total volumetric expansion. The pressure

shall then be released to atmospheric pressure and the permanent volumetric expansion shall be recorded.

(1) permanent volumetric expansion shall be calculated by using the following formula

$$\text{permanent volumetric expansion} = \frac{V_2}{V_1} \times 100$$

where V_1 is the total volumetric expansion, in dm^3
V_2 is the permanent volumetric expansion, in dm^3

(2) $$\text{permanent volumetric expansion ratio} = \frac{V_2}{V}$$

where V is the volumetric of container, in dm^3
V_2 is the permanent volumetric expansion, in dm^3

8.6 Bursting

8.6.1 Apply the hydrostatic pressure to the container until failure or destruction occur. That pressure shall be recorded.

8.6.2 The nominal hoop stress corresponding to the pressure at which destruction occurs shall be calculated from the formula given in clause 5.9.3(2) and compare with the tensile strength specified in Table 3.

8.6.3 After failure, the container shall be filled with water as much as possible and weigh the water content. The increasing of water volume shall be calculated and compare with the provision given in clause 5.9.3(3).

8.7 Leakage

Subsequent to the hydrostatic proof test and hydrostatic stretch test of clause 8.5, the inside of sample shall be dried and tested for leakage by apply air pressure of 690 kPa, then immerse in water.

8.8 Drop resistance

With the container filled with water to represent its total mass when filled with gas, lifted the container where the valve protection and cap are on the bottom and over the concrete floor. Drop the container from a height of 1.2 ± 0.05 m. The container leakage and the operation of valve shall be checked.

9. Use and maintenance

9.1 Use and maintenance of containers which have been in use for 5 years shall comply with TIS 151.

Appendix A

Thread sizes

(clauses 4.2.1.3, 4.2.1.4 and Table 4)

For inspection on threads, the precision ring gauge and plug gauge or the profile projector approved by a recognized authority and which is regularly calibrated shall be used.

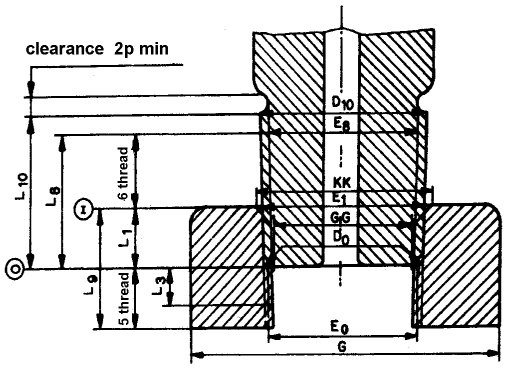
A.1 Taper thread NGT (Taper 1 : 16)
The basic profile and the basic size of thread shall comply with Figure A.1 and Table A.1.

A.2 Taper thread 0.715-14 and 0.6-14
The basic profile and the basic size of thread shall comply with Figure A.2 and Table A.2.

A.3 Taper thread $\mathrm{W}\ 28.8\times\frac{1}{14}$
The basic profile and the basic size of thread shall comply with Figure A.3 and Table A.3.

A.4 ISO metric thread $\mathrm{M}\ -\ 22\times1.25$ shall comply with Figure A.4.

A.5 Parallel thread W 80-11
The basic profile and the basic size of thread shall comply with Figure A.5 and Table A.4.



Where
D = Nominal major diameter at reference plane
E = Nominal pitch diameter at reference plane
G = external diameter of fitting
GG = Chamfer 45° X diameter
K = Nominal minor diameter at reference plane
KK = Countersink 90° X diameter
L_1 = Length of hand tight engagement
L_3 = 3 threads (for wrenching)
L_8 = Full external threads
L_9 = Full roots on internal threads
L_{10} = Overall external threads
⓪ = Reference plane for gauging external thread
Ⓘ = Reference plane for gauging internal thread
P = Thread pitch

Figure A.1 basic profile of NGT taper thread
(clause A.1)

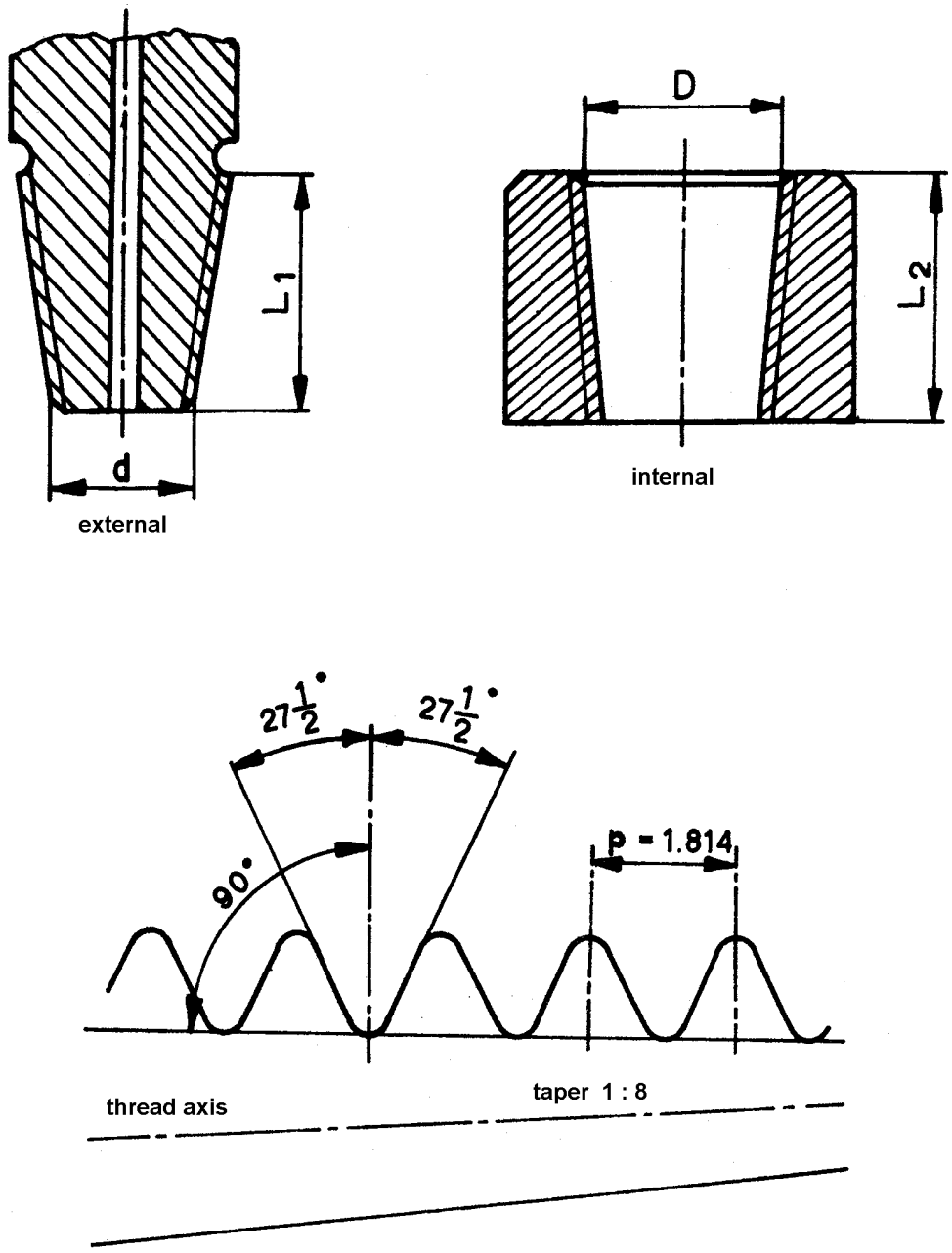


Figure A.2 Basic profile of taper threads 0.715-14 and 0.6-14

(clause A.2)

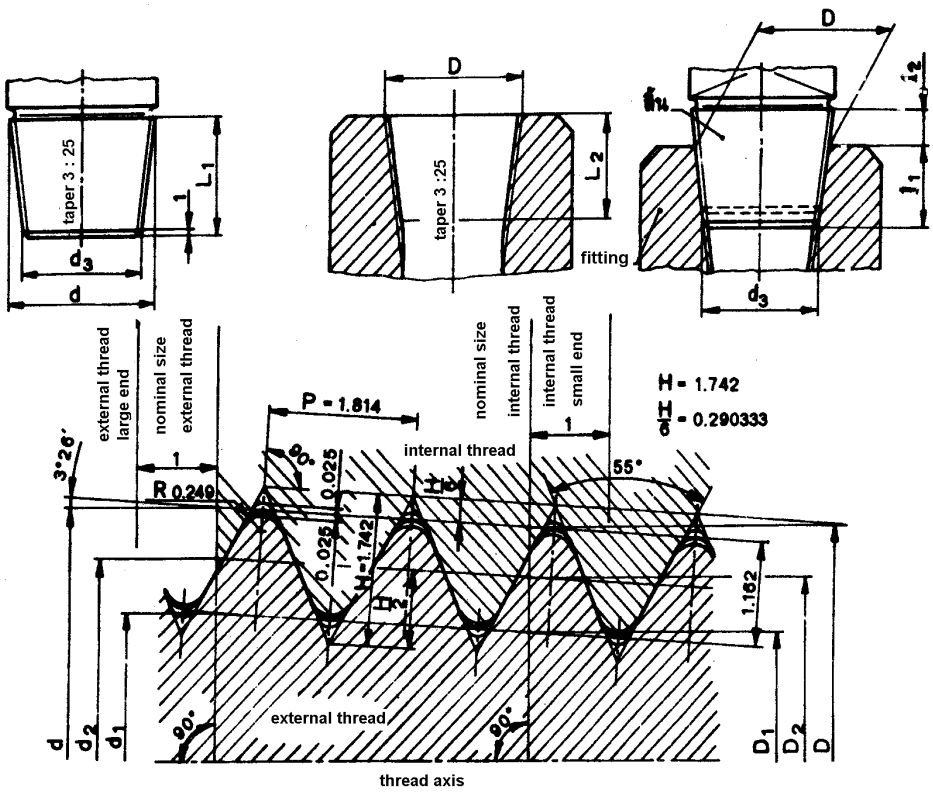
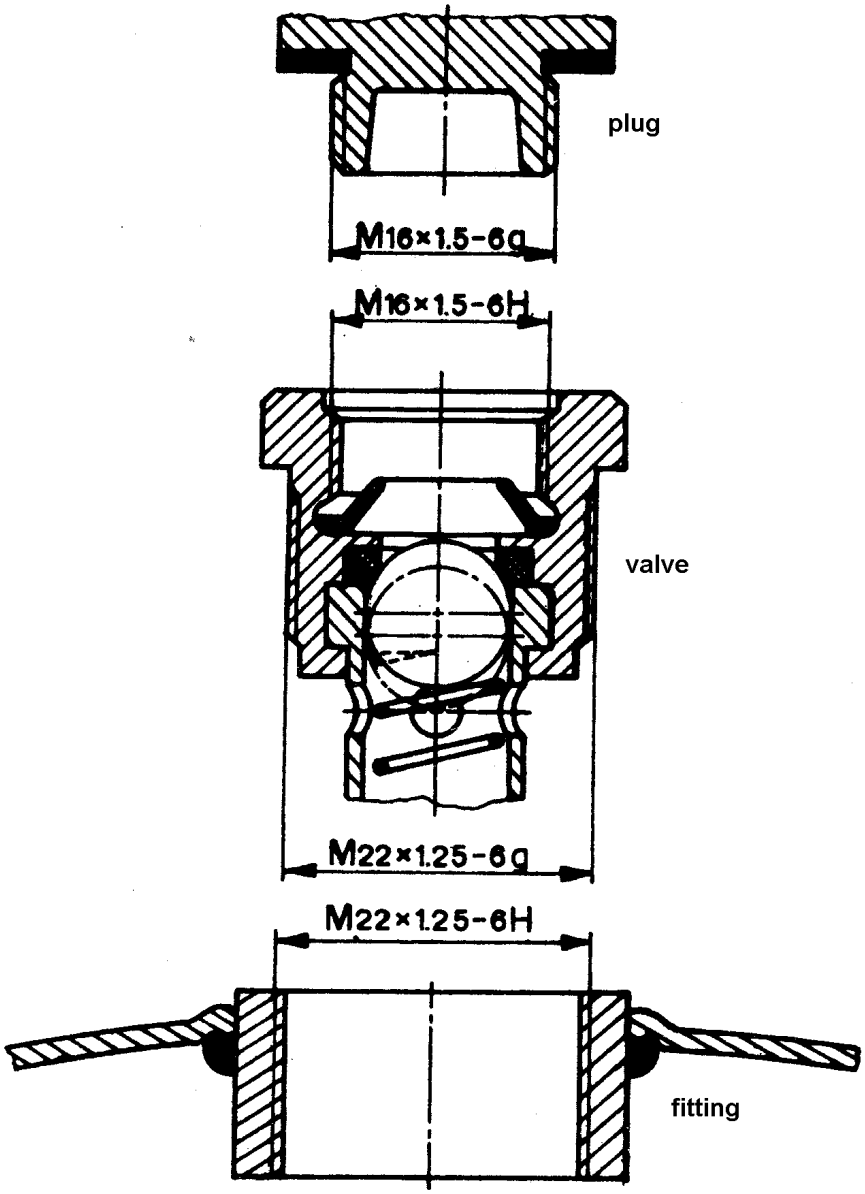
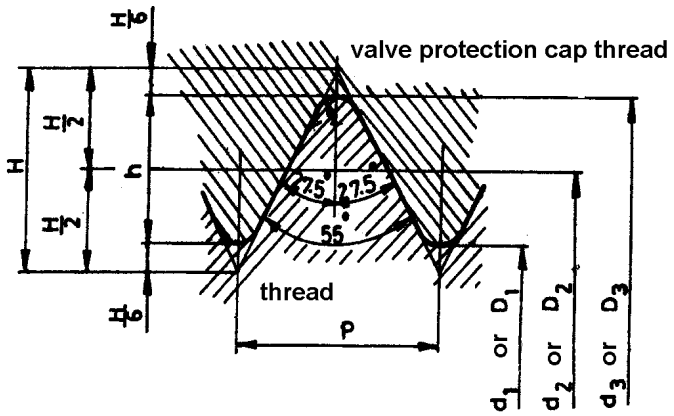


Figure A.3 Basic profile of taper thread $\mathrm{W}\,28.8 \times \frac{1}{14}$

(clause A.3)


plug
M16×1.5-6g
M16×1.5-6H
valve
M22×1.25-6g
M22×1.25-6H
fitting



$$P = \frac{25.4}{n}$$

$H = 0.960\,491P$

$h = 0.640\,327P$

$r = 0.137\,329P$

$d_2 = d\text{-}h,\ D_2\text{-}d_2$

$d_1 = d\text{-}2h,\ D_2\text{-}d_1$

Figure A.5 Basic profile of parallel thread W 80 - 11
(clause A.5)

Table A.1
Basic sizes of NGT taper threads
(clause A.1)

unit : mm

Designation of thread	1	2	3	4	5	6	7	8	9	10	11	12	13
		External							Internal				
		Small end			Full threads		Large end		Neck	Pitch	chamfer	Full threads	
	Hand tight engagement[1)]	Major diameter	Pitch diameter	Chamfer 45° diameter Minimum	Pitch diameter	Length [2)]	Major diameter approx.	Overall length approx.	diameter min.	diameter at face	90° diameter max.	Length	Length [3)]
	L_1	D_0	E_0	GG	E_8	L_8	D_{10}	L_{10}	G	E_1	KK	$L_1 + L_3$	L_9
¾ -14 NGT	8.16	26.029	24.579	23.018	25.798	19.49	27.419	22.23	40.00	25.118	26.987	14.05	15.875
1 ¼ - NGT	10.67	61.318	39.550	37.306	41.046	23.92	43.004	26.99	50.800	40.218	42.465	17.29	21.71

Notes :

1. Hand tight engagement
   The basic condition of fit is that the external thread with a pitch diameter of E_0 at the end (reference plane for gauging external thread) shall enter hand engagement to a distance L_1 into the internal thread with a pitch diameter of E_1 at the opening (reference plane for engaging internal thread).
2. Length
   External thread shall be threaded the approximate length L_{10} but gauged up to L_8. Dimension L_8 is equal to L_1 plus 6 threads. Dimension E_8 is measured at distance L_8 from E_0 and dimension D_{10} is measured at distance L_0 from E_0. These longer external threads are desirable if further tightening should be necessary. To facilitate gauging, provision should be made to allow the L_8 ring gage to advance a distance of 2 full threads beyond the L_8 length (one turn for allowable variation in pitch diameter and one turn for allowable variation in taper).
3. Minimum length of full root
   Full internal threads at the crests and roots shall extend throughout length L_1 plus L_3 (L_3 = 3 threads). This dimension determines the minimum metal on the inside of the neck to produce maximum bore K_3. Any metal below L_3 shall have tapped threads with full roots to a minimum length L_9 (L_1+ 5 threads).

Table A.2
Basic sizes of taper threads 0.715-14 and 0.6-14
(clause A.2)

unit : mm

Designation of thread	1	2	3	4		5		6		7		8	9		10		11	
	Taper	Threads per 25.4 mm	Thread engagement minimum	External								Internal						
				Length L_1		Major diameter d		Pitch diameter d_1		Minor diameter d_2		Length L_2	Major diameter D		Pitch diameter D_2		Minor diameter D_1	
				min	max	min	max	min	max	min	max	min	min	max	min	max	min	max
0.715-14	1 : 8	14	15.88	14	22.23	17.957	18.161	16.863	16.997	15.562	15.834	22.23	20.142	20.413	18.978	19.113	17.815	18.018
0.6-14	1 : 5.625	14	15.88	14	28.58	15.036	15.240	13.962	14.079	12.664	12.918	28.58	19.192	19.471	18.031	18.158	16.870	17.073

Table A.3

Basic sizes of taper threads W 28.8 x 1/4

(clause A.3)

unit : mm

Designation of thread	1		2		3		4		5	6		7		8		9	10		11
	External									Internal							Thread engagement		Residual external thread
	Large end						Small end		Length	Major diameter		Pitch diameter		Minor diameter		Length			
	Major diameter d		Pitch diameter d_2		Minor diameter d_1		Major diameter d_3		L_1	D		D_2		D_1		L_2	l_1		l_2
	min	max	min	max	min	max	min	max	min	min	min	max	min	max	min	min	min	min	Min
W 28.8 X 1/14	28.8	28.92	27.638	27.758	26.476	25.596	25.8	25.92	26	26.68	27.800	26.518	26.638	25.356	25.476	22	15.67	17.67	8.33

Table A.4
Basic sizes of parallel threads W 80-11
(clause A.5)

unit : mm

Designation of thread	1	2	3	4	5		6		7		8	9		10	
					Boss						Valve protection cap				
	Threads per 25.4 mm	Pitch p	Height h	Root radius r	Major diameter d		Pitch diameter d_2		Major diameter d_1		Major[1)] diameter D	Major diameter D_2		Pitch diameter D_3	
					min	max	min	max	min	max		min	max	min	max
W 80-11	11	2.3091	1.479	0.317	79.480	80.000	78.261	78.521	76.582	77.012	80.000	78.521	78.781	77.042	77.942

Note : 1) Tolerance has not been laid down quantitatively and is restricted by the functional requirements.