

JIS

JAPANESE INDUSTRIAL STANDARD

Horizontal type cylindrical
storage tanks used for liquefied
petroleum gas — Construction

JIS B 8242—1991

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Horizontal type cylindrical storage
tanks used for liquefied petroleum
gas - Construction

B 8242-1991

1. Scope

This Japanese Industrial Standard specifies the construction of the horizontal type cylindrical storage tanks ⁽¹⁾ (hereafter referred to as the "storage tanks") to be installed on ground which store liquefied petroleum gas (hereafter referred to as the "LP gas", given in the following at an ordinary temperature. However, this shall not be applicable to those which are to be installed in cold northern districts exceeding -10°C (the lowest value of the mean month value of the lowest day temperature).

- (1) LP gas of which vapor pressure at a temperature of 55°C is over 1.77 MPa {18.0 kgf/cm²} up to 2.12 MPa {21.6 kgf/cm²} or under.
- (2) LP gas of which vapor pressure at a temperature of 55°C is over 1.06 MPa {10.8 kgf/cm²} up to 1.77 MPa {18.0 kgf/cm²} or under.
- (3) LP gas of which vapor pressure at a temperature of 55°C is 1.06 MPa {10.8 kgf/cm²} or under.

Note ⁽¹⁾ The storage tank mentioned herein shall be that in which the storage tank body specified in 3.2 and the accessories specified in 8. have been included.

Remarks 1. The applicable standards to this Standard are as given in Attached Table 1.

2. The units and numerical values given in { } in this Standard are in accordance with the traditional standards and are standard values.

Furthermore, the traditional units and numerical values in this Standard shall not be used from April 1, 1995.

2. Definitions

For the purposes of this Standard, the following definitions apply, and others are in accordance with JIS B 0190.

- (1) liquefied petroleum gas The mixture of which the main component is any one among the liquefied gases of propane, propylene, butane, butylene, butadiene, etc.
- (2) nominal storage capacity The mass of 1. (1), (2) and (3) capable of being stored in the said storage tank, and it has been calculated according to the liquid densities of LP gas.

3. Classification of storage tanks and storage tank body

3.1 Types of storage tanks The types of storage tanks shall be classified as given in the following according to the nominal storage capacities and design pressures.

- (1) The nominal storage capacities shall be 8 classes of 10 t, 15 t, 20 t, 30 t, 40 t, 50 t, 60 t and 70 t.
- (2) The design pressures of the storage tanks shall be 3 classes of Table 1 according to the types of LP gas.

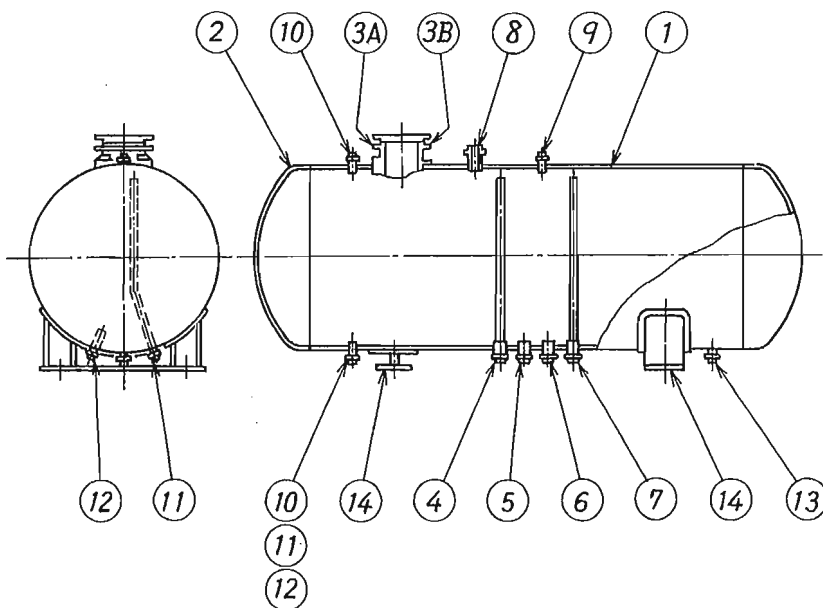
Table 1. Design pressures

Design pressure MPa {kgf/cm ² }	Type ⁽²⁾ of LP gas
2.12 {21.6}	LP gas of which vapor pressure at a temperature of 55°C is over 1.77 MPa {18.0 kgf/cm ² } up to 2.12 MPa {21.6 kgf/cm ² } or under
1.77 {18.0}	LP gas of which vapor pressure at a temperature of 55°C is over 1.06MPa {10.8 kgf/cm ² } up to 1.77 MPa {18.0 kgf/cm ² } or under
1.06 {10.8}	LP gas of which vapor pressure at a temperature of 55°C is 1.06 MPa {10.8 kgf/cm ² } or under.

Note ⁽²⁾ The type of LP gas shall express the LP gas of (1), (2) and (3) of 1. Scope.

3.2 Storage tank body The storage tank body of which range shall be as given in Fig. 1.

Fig. 1. Names for respective parts of storage tank body



No.	Name
①	Shell
②	Head
③A	Manhole (including cover plate)
③B	
④	Vent nozzle
⑤	Liquid intake nozzle
⑥	Liquid takeout nozzle
⑦	Pump bypass nozzle
⑧	Safety valve nozzle
⑨	Gas discharge nozzle
⑩	Level gauge nozzle
⑪	Pressure gauge nozzle
⑫	Thermometer nozzle
⑬	Drain nozzle
⑭	Saddle

Remarks 1. No. ⑧ and No. ⑨ may be installed on the manhole cover plate.

2. No. ③A indicates an integrated manhole, and No. ③B a reinforcing-material type manhole.

4. Materials

The materials to be used for the storage tank body shall be those conforming to the following requirements, or those equal to or superior to these in quality. However, the carbon steels of parts subjected to welding shall not exceed 0.35 % in carbon content.

(1) Shells and heads

SPV 315, SPV 355, SPV 450 and SPV 490 of JIS G 3115

(2) Nozzles (nozzle stubs), flanges and cover plates

SB 410, SB 450 and SB 480 of JIS G 3103

SM 400, SM 490, SM 520, SM 570 of JIS G 3106 However, A shall be excluded.

SPV 315, SPV 355, SPV 450 and SPV 490 of JIS G 3115

STPG 370 of JIS G 3454 However, in the case where the thickness in use exceeds schedule 80, STPT 370 of JIS G 3456

SFVC 1, SFVC 2A, and SFVC 2B of JIS G 3202

S20C, S22C, S25C, S28C and S30C of JIS G 4051

(3) Supporting structures SS 400, and SS 490 of JIS G 3101 [However, the wear plate, in the case where the pressure resistant components are of a high tensile strength steel (³), shall be excluded.]

Note (³) The high tensile strength steel means the carbon steel of which value of specified minimum tensile strength at an ordinary temperature is 568.8 MPa {58 kgf/mm²} or over.

SM 400, SM 490, SM 520 and SM 570 of JIS G 3106 (However, for the wear plate, in the case where the pressure resistant components are of a high tensile strength steel, SM 400 and SM 490, in the case where working thickness exceeds 12 mm, shall be excluded.)

SPV 315, SPV 355, SPV 450 and SPV 490 of JIS G 3115

(4) Bolts and nuts

S25C, S35C and S45C of JIS G 4051

SNB 5 and SNB 7 of JIS G 4107

SUS 304 of JIS G 4303

(5) Gaskets

JIS R 3453

5. Design

5.1 General design of storage tank In the case where the storage tank is to be designed, other requirements than those specified in the following shall be in accordance with JIS B 8243.

- (1) Design pressures The design pressures of the storage tank shall be those pressures which are used when calculated thicknesses or mechanical strengths [shapes and dimensions of nozzle (nozzle stubs), types of flange, etc.] are to be determined, and these shall be in accordance with Table 1.
- (2) Design temperature The design temperature of the storage tank shall be 40°C, and the cold atmospheric temperature exceeding -10°C (the lowest value of monthly average of lowest daily atmospheric temperature) and the temperature at a fire disaster shall not be taken into consideration.
- (3) Minimum restricted thickness The minimum thickness of the plates to be used for the shell, and heads of the storage tank shall be 6 mm.
- (4) Corrosion allowance The corrosion allowance of 1 mm shall be provided on the surfaces of the shell, heads and other parts of the storage tank which are subjected to pressures contacting with LP gas.
- (5) Earthquake resistance The earthquake resistance of the storage tank shall be confirmed in accordance with Annex.

5.2 Inner volume of storage tank and shape and dimensions of body

5.2.1 Inner volume The inner volume shall be in accordance with the following:

- (1) The inner volume (m³) of the storage tank shall be not smaller than the numerical value obtained by multiplying the nominal storage capacity (t) to each constant given in Table 2 for each design pressure.
- (2) In the calculation of the inner volume of the storage tank, the variation of inner volume due to manhole, drain reservoir, nozzle (nozzle stub), etc. may not be taken into consideration, however, in every case, the inner volume shall satisfy (1) of this clause.

Table 2

Design pressure MPa {kgf/cm ² }	Constant
2.12 {21.6}	2.35
1.77 {18.0}	
1.06 {10.8}	2.09

5.2.2 Shape and dimensions of storage tank body The shape and dimensions of the storage tank body shall be in accordance with the following:

- (1) The shape of the head shall be 2:1 semiellipsoid.
- (2) The dimensions of the storage tank body shall be as given in Table 3 according to the types of the storage tank.

Table 3. Overall lengths of storage tanks (Dimensions between outside surfaces of heads)

Unit: mm

Inner diameter D	Nominal storage capacity (t)							
	10	15	20	30	40	50	60	70
	Inner volume (m ³)							
	23.50	35.25	47.00	70.50	94.00	117.50	141.00	164.50
2 200	6 600	9 700						
2 500	5 250	7 650	10 050	14 850				
2 800			8 150	12 000	15 800			
3 200				9 350	12 300	15 200	18 150	
3 500					10 400	12 850	15 300	17 750

- Remarks 1. For the overall lengths of the storage tanks, the numerical values given in the bold frames are recommended.
2. Since the nominal storage capacity (t) has been based on the LP gas of design pressure (MPa {kgf/cm²}) x 2.12 {21.6} and 1.77 {18.0}, so that the actual storage capacity, in the case of design pressure (MPa {kgf/cm²}) x 1.06 {10.8}, becomes $\frac{2.35}{2.09}$ times.

6. Construction

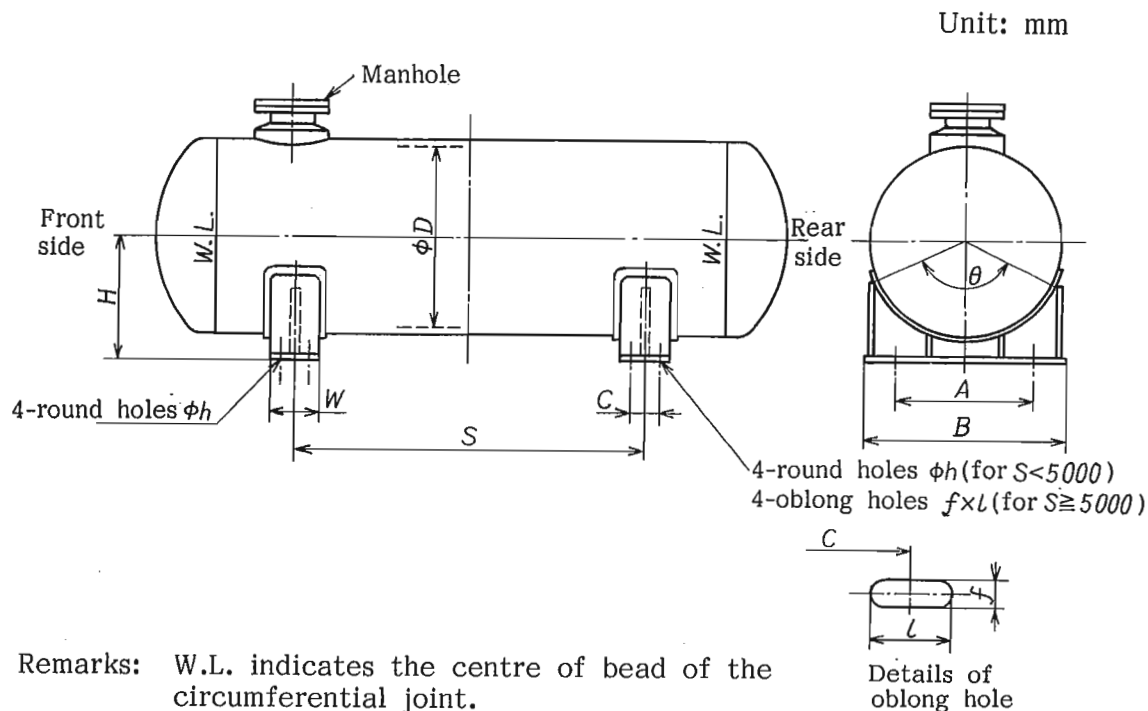
6.1 Construction of each part

6.1.1 Saddles The construction of the saddles which support the storage tank shall be in accordance with the following:

- (1) The dimensions of the supporting interval (S), height (H) and installing part of the saddles shall be respectively in accordance with Fig. 2, according to the types of storage tank.
- (2) In the case where the supporting interval (S) of the saddles is 5 m or over, the rear side saddle of the storage tank shall be so constructed as to be slidable, considering the expansion and contraction due to temperature change (see 13.3).

- (3) In Fig. 2, the supporting angle (θ) of the saddle shall be 120 to 150°, and the wear plate of shell for saddle shall be that which has been fillet-welded continuously with respect to the shell plate.

Fig. 2. Supporting interval and dimensions of saddles



(1) Supporting interval S

Unit: mm

Inner diameter D	Nominal storage capacity (t)							
	10	15	20	30	40	50	60	70
2 200	3 800	6 800						
2 500	2 500	4 500	6 800	11 500				
2 800			4 600	8 300	12 000			
3 200				5 300	8 100	10 900	13 800	
3 500					6 000	8 400	10 700	13 100

- Remarks 1. For the supporting intervals, the numerical values given in the bold frames should be recommendable.
2. This Table shall be those for intervals corresponding to the storage tanks of which sizes are as given in Table 3.

(2) Dimensions of saddle

Unit: mm

Inner diameter D	W	B	H	C	A
2 200	350	2 000	1 250	200	1 700
2 500	350	2 300	1 400	200	2 000
2 800	400	2 600	1 600	200	2 300
3 200	400	3 000	1 800	200	2 700
3 500	400	3 300	1 950	200	3 000

(3) Dimensions for foundation bolts

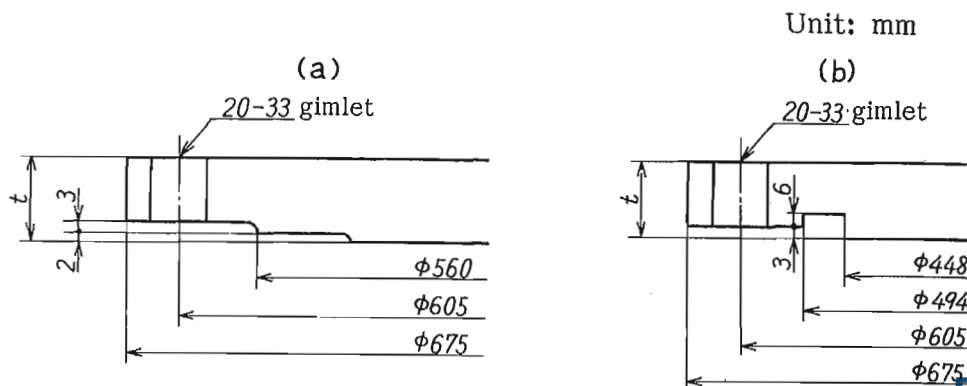
Unit: mm

Nominal strage capacity	Front hole	Rear holes		Nominal diameter of foundation bolt
	ϕh	$S < 5\,000$	$S \geq 5\,000$	
		ϕh	$f \times l$	
30 t or under	40	40	51 × 65	M 30
40 t or over	46	46	63 × 85	M 36

6.1.2 Manhole and cover plate of manhole The manhole and cover plate of manhole shall be in accordance with the following:

- (1) For the flange of manhole, that of nominal pressure 20 K and nominal diameter 450 of JIS B 2220 shall be used. However, in case where this is not available, a flange shall be used after conforming that it has necessary strength, carrying out the stress calculation in accordance with Annex 2 (stress-calculation method of flange) of JIS B 8243.
- (2) The hole reinforcement of the reinforcing material type manhole shall be in accordance with 8. (openings and reinforcements thereof and attaching of piping) of JIS B 8243.
- (3) The shapes and dimensions of the cover plates of manhole shall be in accordance with Fig. 3.

Fig. 3. Cover plates of manhole

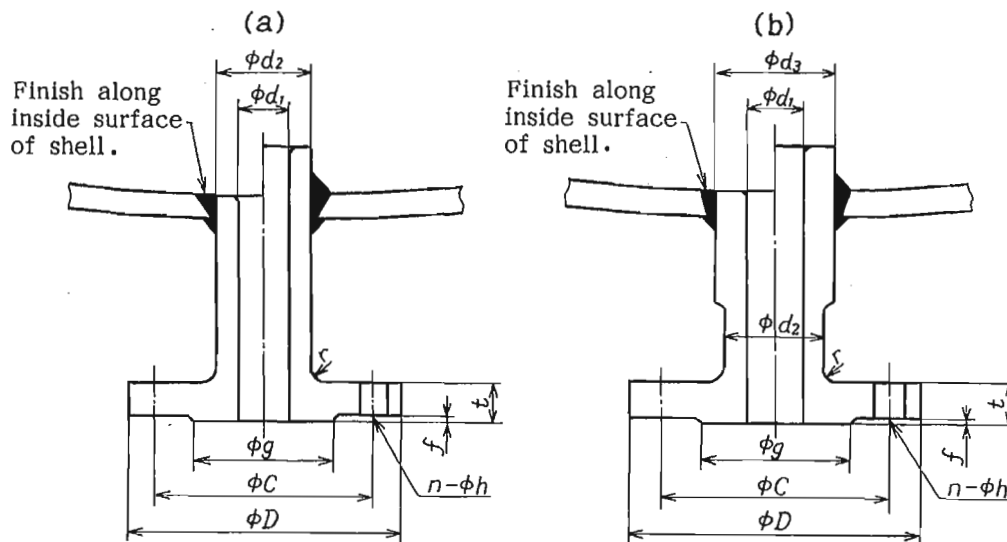


Remarks: The thickness t shall be calculated in accordance with 5.9 (strength of unstayed flat plate) of JIS B 8243.

- (4) The attaching position of manhole shall be at the front side of the crest part of the storage tank.

6.1.3 Shape and dimensions of nozzle (nozzle stub) The shape and dimensions of the nozzle (nozzle stub) shall be any one of (a) or (b) of Fig. 4, according to respective uses. In case where (a) is insufficient in strength in the reinforcement calculation of the nozzle (nozzle stub), (b) shall be used.

Fig. 4. Shapes and dimensions of nozzle (nozzle stub)



Unit: mm

Nominal diameter of nozzle (nozzle stub)	d_1	d_2	D	t	r	f	g	C	n	h	d_3
15A	15	37	95	14	5	1	52	70	4	15	By the calculation of nozzle reinforcement
25A	25	49	125	16	5	1	70	90	4	19	
40A	40	66	140	18	5	2	85	105	4	19	
50A	50	78	155	18	6	2	100	120	8	19	
80A	80	112	200	22	6	2	135	160	8	23	
100A	100	135	225	24	6	2	160	185	8	23	
450A	430	508	675	48	12	3	560	605	20	33	

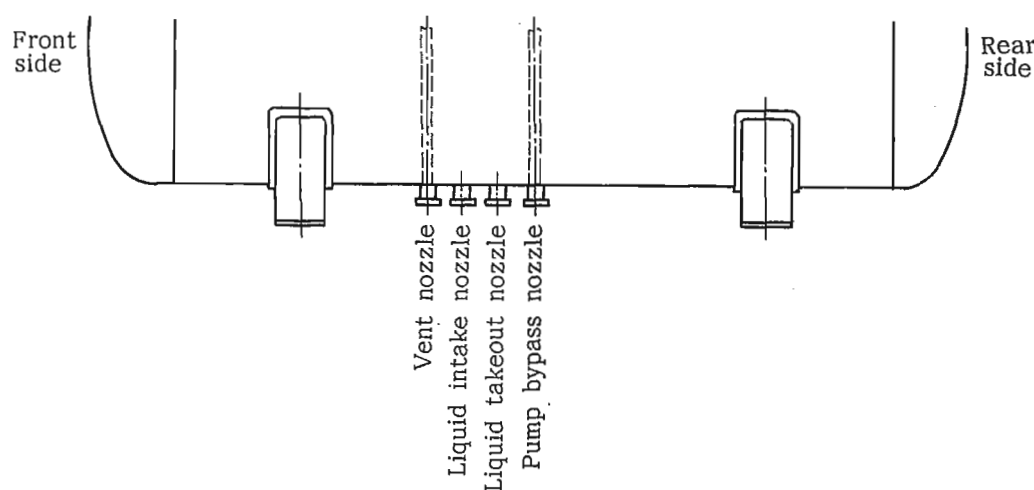
Remarks: The dimensions of flange shall be those of the nominal diameter 20K of JIS B 2210.

6.1.4 Nozzles (nozzle stubs) to be installed between saddles Respective nozzles (nozzle stubs) for ventilation, liquid intake, liquid takeout and pump bypass shall be installed between the saddles.

(1) Positions and nominal diameters for nozzles (nozzle stubs)

- (a) The arrangement of the nozzles (nozzle tubes) shall be in the order of respective nozzles (nozzle stubs) for ventilation, liquid intake, liquid takeout and pump bypass from the front side of the storage tank. However, the liquid intake nozzle and liquid takeout nozzle may change the order thereof each other.
- (b) In Fig. 5, each nominal diameter of nozzle (nozzle stub) shall be determined for each nominal storage capacity of the storage tank.
- (c) In Fig. 5, the positions of nozzles to be installed between the saddles shall be established avoiding the circumferential joint and longitudinal joint.

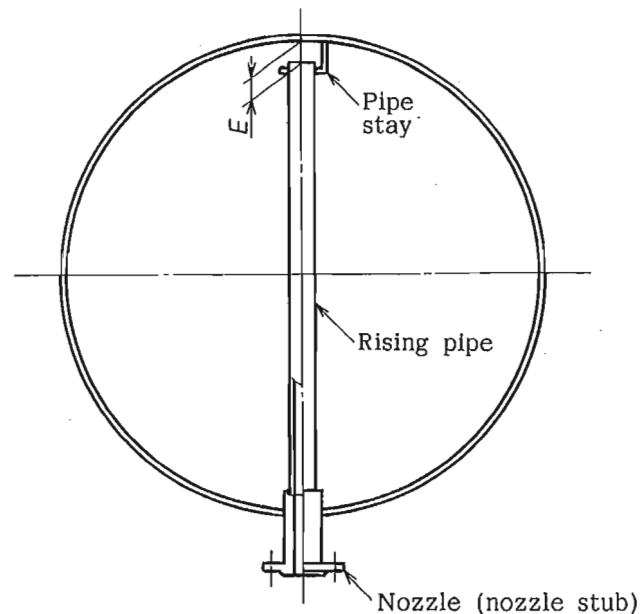
Fig. 5. Nozzles (nozzle stub) to be installed between the saddles



Type of nozzle (nozzle stub)	Nominal storage capacities	
	30 t or under	40 t or over
	Dimensions	
	Nominal diameter of nozzle (nozzle stub)	Nominal diameter of nozzle (nozzle stub)
Ventilation nozzle	25A	25A
Liquid intake nozzle	50A	80A
Liquid takeout nozzle	50A	80A
Pump bypass nozzle	40A	50A

- (2) The vent nozzle and pump bypass nozzle shall be in accordance with the following:
- (a) A rising pipe shall be provided in order to connect the nozzle (nozzle stub) and gas phase part of the storage tank (see Fig. 6).
 - (b) The rising pipe shall be welded with the nozzle (nozzle stub), and a pipe stay shall be provided on its top.
 - (c) The dimension E of Fig. 6 should preferably be 0.5 to 2 times the bore of the nozzle (nozzle stub).

Fig. 6. Rising pipe

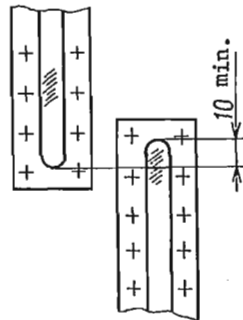


6.1.5 Level gauge equipment The level gauge equipment shall be in accordance with the following:

- (1) Level gauge The level gauge shall be in accordance with the following:
- (a) The level gauge shall generally be a flat shaped reflection type glass level gauge, and individual gauges shall be arranged zigzag with the overlapped dimension as given in Fig. 7, so that over the entire range from the bottom surface to the liquid surface level of 90 % or over the inner volume of the storage tank can be visible.

Fig. 7. Overlapping of level gauges

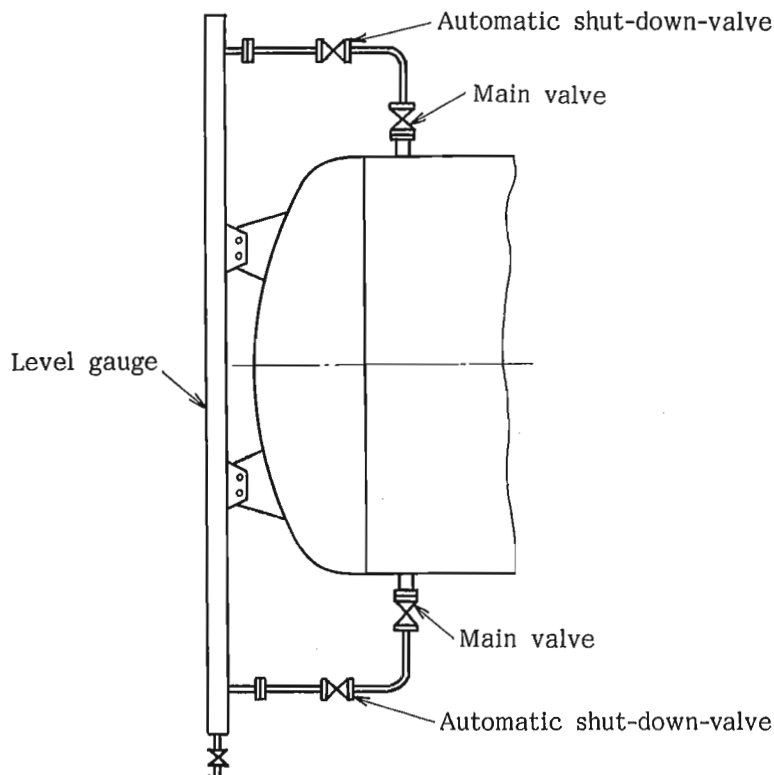
Unit: mm



- (b) The glass to be used for the level gauge shall be that of symbol B or P of JIS B 8211, or that equal to or superior to these in quality.
 - (c) The scale plate of the level gauge shall be inscribed with graduation lines per 1 cm, taking the bottom surface of the storage tank as zero, and a marking shall be made at the position of 90 % the inner volume of the storage tank.
- (2) Level gauge nozzle The level gauge nozzle shall be in accordance with the following:
- (a) The nominal diameter of the nozzle (nozzle stub) shall be 15A.
 - (b) The shape of the nozzle (nozzle stub) shall be in accordance with Fig. 4.
 - (c) The nozzle (nozzle stub) shall be provided with a main valve.
- (3) Attaching positions The attaching positions shall be in accordance with the following:
- (a) The level meter shall be attached to the front side of the head of the storage tank, and be firmly fixed to the storage tank.
 - (b) The attaching positions of the level gauge nozzles shall be the top part and bottom part of the shell near the head of the front side of the storage tank.
 - (c) The level gauge and the level gauge nozzles shall be connected by pipings, and automatic shut-down-valves shall be provided at the positions near the base-valves (see Fig. 8).

Furthermore, the piping shall be STPG 370 15A schedule 80 of JIS G 3454.

Fig. 8. Attaching of level gauge



6.1.6 Pressure gauge equipment The pressure gauge equipment shall be in accordance with the following:

- (1) Pressure gauge The pressure gauge shall be in accordance with the following:
 - (a) The pressure gauge shall be that conforming to JIS B 7505, or that having performances equal to or superior to this in quality.
 - (b) The maximum indication of scale shall be 3.43 MPa {35 kgf/cm²} where the LP gas of 1. (1) or (2) is stored, and be 1.96 MPa {20 kgf/cm²} where 1. (3) is stored.
 - (c) The scale plate of the Bourdon-tube pressure gauge should preferably be 150 mm in nominal diameter.
 - (d) The dimension of the connecting screw thread of the Bourdon-tube pressure gauge shall be G¹/₂ of JIS B 0202.
 - (e) The pressure gauge shall be that conforming to the requirements of the "Measurement Law".
- (2) Pressure gauge nozzle The pressure gauge nozzle shall be in accordance with the following:
 - (a) The nominal diameter of the nozzle (nozzle stub) shall be 15A.

- (b) The shape of the nozzle (nozzle stub) shall be in accordance with Fig. 4.

In addition, a rising pipe shall be provided in order to interconnect the nozzle (nozzle stub) with the gas phase part of storage tank (see Fig. 6).

- (c) A pipe stay shall be provided at the upper part of the rising pipe.
- (d) The nozzle (nozzle stub) shall be provided with a main valve.
- (3) Attaching position The attaching position shall be in accordance with the following:
- (a) The pressure gauge shall be attached to a conspicuous place at the front side of the storage tank, and an eave shall be provided at the upper part.
- (b) The attaching position of the pressure gauge nozzle shall be the lower part of the shell near the head of the front side of the storage tank.
- (c) The pressure gauge, and pressure gauge nozzle shall be connected with piping.

Furthermore, the piping shall be STPG 370 15A schedule 80 of JIS G 3454 or SUS 304 TP of JIS G 3459.

6.1.7 Thermometer equipment The thermometer equipment shall be in accordance with the following:

- (1) Thermometer The thermometer shall be in accordance with the following:
- (a) The thermometer shall be that conforming to JIS B 7528, or that having performances equal to or superior to this.
- (b) The indication range of scale should preferably be -20°C to 80°C .
- (c) The scale plate of the thermometer should preferably be 150 mm in nominal diameter.
- (d) It shall be that which is provided with a placing needle or marking at the point of 40°C .
- (e) The dimension of attaching screw thread shall be $R\frac{3}{4}$ or $R\frac{1}{2}$ of JIS B 0203.
- (f) Upon request of the user, it shall be the thermometer in accordance with the requirements of Measurement Law.
- (2) Thermometer nozzle The thermometer nozzle shall be of completely air-tight construction with protective tube.

- (3) Attaching position The attaching position shall be in accordance with the following:

- (a) The attaching position of the thermometer shall be the conspicuous place at the front side of storage tank, and an eave shall be provided at the upper part.

Furthermore, in this case, it should be preferable to constitute an integrated eave by attaching this side by side with the pressure gauge given in 6.1.6.

- (b) The attaching position of the thermometer nozzle shall be the lower part of the shell near the head of the front side of storage tank.

- 6.1.8 Safety valve equipment The safety valve equipment shall be in accordance with the following:

- (1) Safety valve The safety valve shall be in accordance with the following:

- (1.1) The type of safety valve shall be the spring safety valve in accordance with JIS B 8210, and be any one of the lift style or whole quantity style.
- (1.2) The safety valve which satisfies the required relieving capacity given in Table 4 shall be attached.

Furthermore, in the case where the required blowing-out quantity is allowed to satisfy by two or more of safety valves, the safety valves shall be the same type and the same bore, and should preferably be attached separately.