AS 2809.2:2020

Australian STANDARD®

Road tank vehicles for dangerous goods

Part 2: Road tank vehicles for flammable liquids

STANDARDS Australia

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Heavy Vehicle Industry Australia
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National Heavy Vehicle Regulator
SafeWork SA
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Part 2: Road tank vehicles for flammable liquids

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Preface

This Standard was prepared by the Standards Australia Committee ME-057, Road Tank Vehicles for Dangerous Goods, to supersede AS 2809.2—2008, *Road tank vehicles for dangerous goods, Part 2: Tankers for flammable liquids*.

The objective of this Standard is to provide designers, planners, operators and regulators with technical requirements for road tank vehicles, as described in the scope of AS 2809.1, that transport flammable liquids, being dangerous goods of Class 3 or having a subsidiary hazard of Class 3 as defined in the Australian Dangerous Goods (ADG) Code.

AS 2809.1 specifies general requirements for all road tank vehicles. Additional specific requirements applicable to particular road tank vehicles are detailed in the appropriate part of the AS 2809 series on road tank vehicles.

The major changes in this edition are as follows:

(a) Revision of spillage control minimum design requirements.

(b) Revision of propulsion or auxiliary engine exhaust minimum design requirements.

(c) Revision of compartment opening dimensions as referenced in AS 2865.

(d) Duplicate clauses on maintenance and multiple tank types from other parts of the AS 2809 series have been amalgamated in AS 2809.1.

(e) Terms and definitions have been moved to AS 2809.1 as part of improvements and amalgamation to the AS 2809 series.

(f) Design and electrical provisions of Section 2 have been revised and moved to AS 2809.1 as part of improvements and amalgamation to the AS 2809 series.

Authorities and regulations may affect the use of this Standard. Conformance with this Standard does not fulfil all legal obligations. Designers, manufacturers and importers have a legal obligation to ensure, so far as is reasonably practicable, that plant and equipment is without risks to health and safety to workers throughout its life.

The term “informative” is used in Standards to define the application of the appendix to which it applies. An “informative” appendix is only for information and guidance.

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Australian Standard®

Road tank vehicles for dangerous goods

Part 2: Road tank vehicles for flammable liquids

Section 1 Scope and general

1.1 Scope

This Standard specifies requirements for the design, construction, inspection and testing of road tank vehicles for the transport of flammable liquids.

1.2 Application

Road tank vehicles for the transport of flammable liquids shall conform with AS 2809.1. Where any requirement of this Standard differs from a similar requirement in AS 2809.1, this Standard shall take precedence.

1.3 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document:

NOTE Documents referenced for informative purposes are listed in the Bibliography.

AS 1210, *Pressure vessels*

AS 2683, *Hose and hose assemblies for distribution of petroleum and petroleum products (excepting LPG)*

AS 2809.1, *Road tank vehicles for dangerous goods, Part 1: General requirements for all road tank vehicles*

AS 2865, *Confined spaces*

AS 3597, *Structural and pressure vessel steel — Quenched and tempered plate*

AS 3990, *Mechanical equipment — Steelwork*

AS 4100, *Steel structures*

AS/NZS 1554.1, *Structural steel welding, Part 1: Welding of steel structures*

AS/NZS 1554.4, *Structural steel welding, Part 4: Welding of high strength quenched and tempered steels*

AS/NZS 1554.6, *Structural steel welding, Part 6: Welding stainless steels for structural purposes*

AS/NZS 1594, *Hot-rolled steel flat products*

AS/NZS 1664.1, *Aluminium structures, Part 1: Limit state design*

AS/NZS 1664.2, *Aluminium structures, Part 2: Allowable stress design*

AS/NZS 1665, *Welding of aluminium structures*

AS/NZS 1734, *Aluminium and aluminium alloys — Flat sheet, coiled sheet and plate*

AS/NZS 1866, *Aluminium and aluminium alloys — Extruded rod, bar, solid and hollow shapes*

AS/NZS 3678, *Structural steel Hot-rolled plates, floorplates and slabs*

AS/NZS 3679.1, *Structural steel, Part 1: Hot-rolled bars and sections*

AS/NZS 4673, *Cold-formed stainless steel structures*

ASTM A240, *Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications*

NATIONAL TRANSPORT COMMISSION (NTC). *Load Restraint Guide*

UNITED NATIONS ECONOMIC COMMISSION FOR EUROPE (UNECE). *European Agreement concerning the International Carriage of Dangerous Goods by Road (ADR)*

1.4 Terms and definitions

For the purpose of this Standard, the terms and definitions given in AS 2809.1 apply.

1.5 New designs and innovations

This Standard does not prevent the use of designs, materials, methods of assembly, procedures and similar that do not conform with the specific requirements of this Standard, or are not mentioned in it, provided the performance requirements specified herein are met.

1.6 General vehicle requirements

1.6.1 Spillage control

Any hot component shall be protected in the event of spills or leaks, by a shield or deflector.

The spillage hazard requirements of AS 2809.1 Clause 2.1.15 and the following requirements shall apply:

(a) The distance between a spillage shield and any cargo-carrying component shall be not less than 75 mm.

(b) The minimum distance between any hot component and the spillage shield shall be not less than 50 mm.

(c) Either of the dimensions in Items (b) and (c) may be reduced to not less than 25 mm as long as the total between the hot component and cargo carrying component is not reduced below 125 mm.

NOTE Consideration should be given to routing of pipe work away from brakes.

1.6.2 Road tank vehicle propulsion or auxiliary engine exhaust

The engine exhaust system shall conform with the following requirements:

(a) The engine exhaust outlet shall not discharge within 1 m of any cargo connection point, vent or cargo carrying component opening.

(b) No part of an engine exhaust system shall be located within 200 mm of any cargo carrying component.

1.6.3 Combustion cabin heaters

Combustion cabin heaters shall conform with UNECE ADR.

1.6.4 Stowage of hoses and other equipment

All loose accessories and removable equipment that are carried by the road tank vehicle shall be restrained in accordance with the NTC *Load Restraint Guide*.

NOTE See Appendix A for Hazardous Area Classifications.

Section 2 Design, construction, inspection and testing

2.1 Materials

2.1.1 Standards

Materials used in the construction of tanks shall not be of a lesser quality than the grades specified in the following Standards:

(a) Aluminium alloys: AS/NZS 1734 and AS/NZS 1866.

(b) Low carbon steel: AS/NZS 1594, AS/NZS 3678 and AS/NZS 3679.1.

(c) High strength low alloy steel: AS 3597.

(d) Stainless steel: ASTM A240.

2.1.2 Material grades

Materials used in the construction of tanks shall have mechanical properties greater than or equal to those listed in Table 2.1.2.

Table 2.1.2 — Minimum material grades and mechanical properties

	Material			
	Aluminium	**Low carbon steel**	**High strength low alloy steel**	**Stainless steel**
Material grade	AS/NZS 1734 Grade 5454 H32[a]	AS/NZS 3678 Grade 250	AS 3597 Grade 500	ASTM A240 Grade 304
Yield strength (MPa)	180	280	500	205
Ultimate tensile strength (MPa)	250	410	590	515
Elongation (%)	10	22	20	40

[a] Due to the level of deformation required to form heads, bulkheads and baffles, the use of O temper aluminium in the same grade may be used.

2.1.3 Material compatibility

Materials shall be compatible with adjacent materials and cargo and shall be suitable for conditions of use.

2.2 Tank design and construction

2.2.1 Tank shape and size

This Standard covers the following three tank shapes:

(a) Small compartment tank (non-circular or circular cross-section).

(b) Large compartment U type tank (unreinforced shell, circular cross-section only).

(c) Large compartment R type tank (reinforced shell, any shape cross-section).

NOTE See Clause 2.2.12 for details on shell reinforcing.

2.2.2 Design criteria

2.2.2.1 General

The design shall allow for the combined effect of pressure (both circumferential and longitudinal stresses), torsion, shear, bending and acceleration of the tank as a whole. The effect of temperature gradients resulting from tank contents and ambient temperature extremes shall also be determined. When dissimilar materials are used, their thermal coefficients shall be used in calculation of thermal stresses.

2.2.2.2 Design loads

The design loads for the tank, tank mounts and attachments shall be not less than 2 g applied along each axis (vertical, longitudinal and lateral). For the tank, this shall include the total tank mass, its accessories, and its cargo when filled to the safe fill level.

The mass of the cargo shall be calculated from its actual density or 1 000 kg/m^3, whichever is the greater.

If a tank design is required to meet the provisions of an additional design code, such as International Maritime Dangerous Goods (IMDG) Code, the specific load cases provided in that code shall also apply.

2.2.2.3 Design pressure

The design pressure shall be the summation of the following:

(a) Pressure due to the liquid head (calculated from its actual density or 1 000 kg/m^3, whichever is the greater).

(b) Vapour pressure (minimum of 20 kPa for small compartment and large compartment R type tanks, or minimum of 30 kPa for large compartment U type tanks).

NOTE Tanks designed to conform with this Standard are free venting. However, they may be subject to pressure cycles depending upon the venting, the product vapour pressure and the operating temperatures. As such, this could require consideration from a fatigue point of view.

2.2.3 Design methods

2.2.3.1 General

The tank design shall be conducted by calculation or finite element analysis. The thickness of the shell, heads, bulkheads and baffles shall be not less than that specified in Table 2.2.12.

2.2.3.2 Calculation

The tank and its supports and connections shall be designed in accordance with AS 3990, AS 4100, AS/NZS 4673 or AS/NZS 1664.1 and AS/NZS 1664.2, as appropriate, with the following qualifications:

(a) *Static strength* — The tank, tank mounts and attachments shall be designed using the design loads and pressures given in Clause 2.2.2. The design loads along each axis shall be considered separately from one another and each shall include the design pressure.

(b) *Fatigue strength* — Unless fatigue resistance has been demonstrated by field experience or supervised tests, fatigue stresses shall be calculated and added to the stress calculated for the stationary vehicle. The calculation shall be based on the following values at constant amplitude where "g" is acceleration due to gravity:

(i) Vertical = 0.6 g.

(ii) Longitudinal = 0.4 g.

(iii) Lateral = 0.4 g.

For aluminium alloy, the applied stresses shall not exceed the allowable stresses given in AS/NZS 1664.1 and AS/NZS 1664.2 for 5×10^6 cycles and the appropriate stress ratios for the design load of the tanker.

For steel, the applied stresses shall not exceed the allowable stresses given in AS 3990 or AS 4100, for the calculated number of cycles and the appropriate stress range.

For stainless steel, the applied stresses shall not exceed the allowable stresses given in AS 3990 or AS 4100 for the calculated number of cycles and the appropriate stress range.

NOTE 1 AS/NZS 1664.1 and AS/NZS 1664.2 give suitable factors of safety for loads that are substantially static loads, i.e. loads that do not repeat themselves for more than 100 000 times in the life of the vehicle, and they also give safe design stresses to cover all fatigue conditions from 100 000 cycles up to 5 000 000 cycles, at which point the endurance limit is virtually reached.

NOTE 2 The values for fatigue factors and load ranges given are for the normal range of operation expected for road tank vehicles, however, the manufacturer needs to be satisfied that they are adequate when designing for off-road and "outback" operation.

2.2.3.3 Finite element analysis

For a tank designed using finite element analysis AS 1210—2010 Appendix I shall be applied with the following qualifications:

(a) *Static strength* — The tank, tank mounts and attachments shall be designed to conform with the static strength requirements of AS 1210—2010 Appendices H and I as appropriate, using the design loads and pressures given in Clause 2.2.2. The design loads along each axis shall be considered separately from one another and each shall include the design pressure.

(b) *Fatigue strength* — The fatigue strength of the tank or component shall be determined using linear elastic finite element analysis in accordance with AS 1210—2010 Appendix M.

Where there is no information regarding the fatigue load cases and number of cycles, the load cases and number of cycles given in AS 1210—2010 Table 3.26.3.8.2. shall be used for the relevant transportation mode.

The peak stress range shall be calculated for the simultaneous application of the three component acceleration loads given in AS 1210—2010 Table 3.26.3.8.2. These loads may be applied as accelerations through the loaded structure's centre of gravity, with the tank restrained appropriately at its support points (e.g. lateral and vertical fixation at wheels and kingpin for the vertical and lateral components, and kingpin only for the axial component of acceleration). The cumulative damage (Miner's summation) for the combined pressure and transportation cyclic loading shall not exceed 1.0.

NOTE 1 Some of the information in this section has been derived from AS 1210—2010 Amendment 2.

NOTE 2 For additional information on fatigue analysis, refer to AS 1210—2010 Appendix M.

NOTE 3 The fatigue load cases and number of cycles are the subject of agreement between the designer and operator.

2.2.4 Corrosion

Where corrosion of the tank can occur, the thicknesses shall be increased sufficiently to ensure that a service life of at least 8 years can be achieved, unless a shorter life is acceptable because of specific conditions.

NOTE Refer to AS 1210—2010 Clause 3.2.4 for more information.

2.2.5 Distribution of loads

The loads from the tank into the supporting structures should be distributed over a wide area to minimize stress concentrations. For guidance on the design of vessel supports, refer to AS 1210—2010 Clause 3.26.10.

2.2.6 Small compartment and large compartment U type tanks

The thickness of the shell, heads, bulkheads and baffles shall be not less than that specified in Table 2.2.12(A). The thicknesses can be increased in cases where additional stresses are applied.

The thicknesses for heads and bulkheads for large compartment U type tanks may be reduced to equal the shell thickness, provided that a calculation for head thickness carried out in accordance with AS 1210 proves that it is safe.

2.2.7 Large compartment R type tanks

2.2.7.1 Shell, heads, bulkheads and baffles

The thickness of the shell (excluding side plates), heads, bulkheads and baffles shall be not less than that specified in Table 2.2.12(A). The thicknesses may be increased in cases where additional stresses are applied. The shell, excluding side plates, shall be in accordance with Table 2.2.12(A) under the small compartment tank columns.

2.2.7.2 Side plates

The side plate for large compartment R type tanks is defined as that section of the shell plate between the horizontal line drawn at the tanker centroid and an arc centred at this horizontal line and extending 40° above and below it.

2.2.7.3 Minimum allowable side plate thickness

The minimum allowable side plate thickness of large compartment R tanks shall be calculated from the following Equation 2.2.7.3:

$$T = \left\{1 + \frac{K\left(G - 8600\right)}{8600}\right\} \chi P \qquad 2.2.7.3$$

where

T = the minimum required side plate thickness in millimetres, (required for the full length of the tank, even if only one compartment is a large compartment R type and others are small compartments)

P = the minimum plate thickness required for any part of the side plate according to Table 2.2.12(A) for small compartment tanks, in millimetres

G = compartment capacity, in litres

K = 0.3

2.2.8 Baffles

Tank baffles shall be fitted to large compartment R type tanks where the length of such a compartment exceeds 2.5 m. The distance between a head or bulkhead and a baffle or between baffles shall not exceed 2.5 m. Baffles may also be fitted to small compartments or large compartment U type tanks.

Taking the percentage area of baffles as the area of the baffle compared to the cross-sectional area of the tank, the minimum area of a single baffle may be determined by reference to Figure 2.2.8. Where multiple baffles are required to satisfy the 2.5 m spacing requirements for baffles, heads or bulkheads, these baffles shall be not less than the maximum specified area of 70 %.

As an alternative to using the graph in Figure 2.2.8 for compartments with only one baffle, the minimum baffle percentage area may be determined by using the following Equation 2.2.8:

$$A = 28 \times L \qquad 2.2.8$$

where

A = minimum baffle percentage area

L = distance between the baffle and the furthermost head or bulkhead in the compartment, in metres

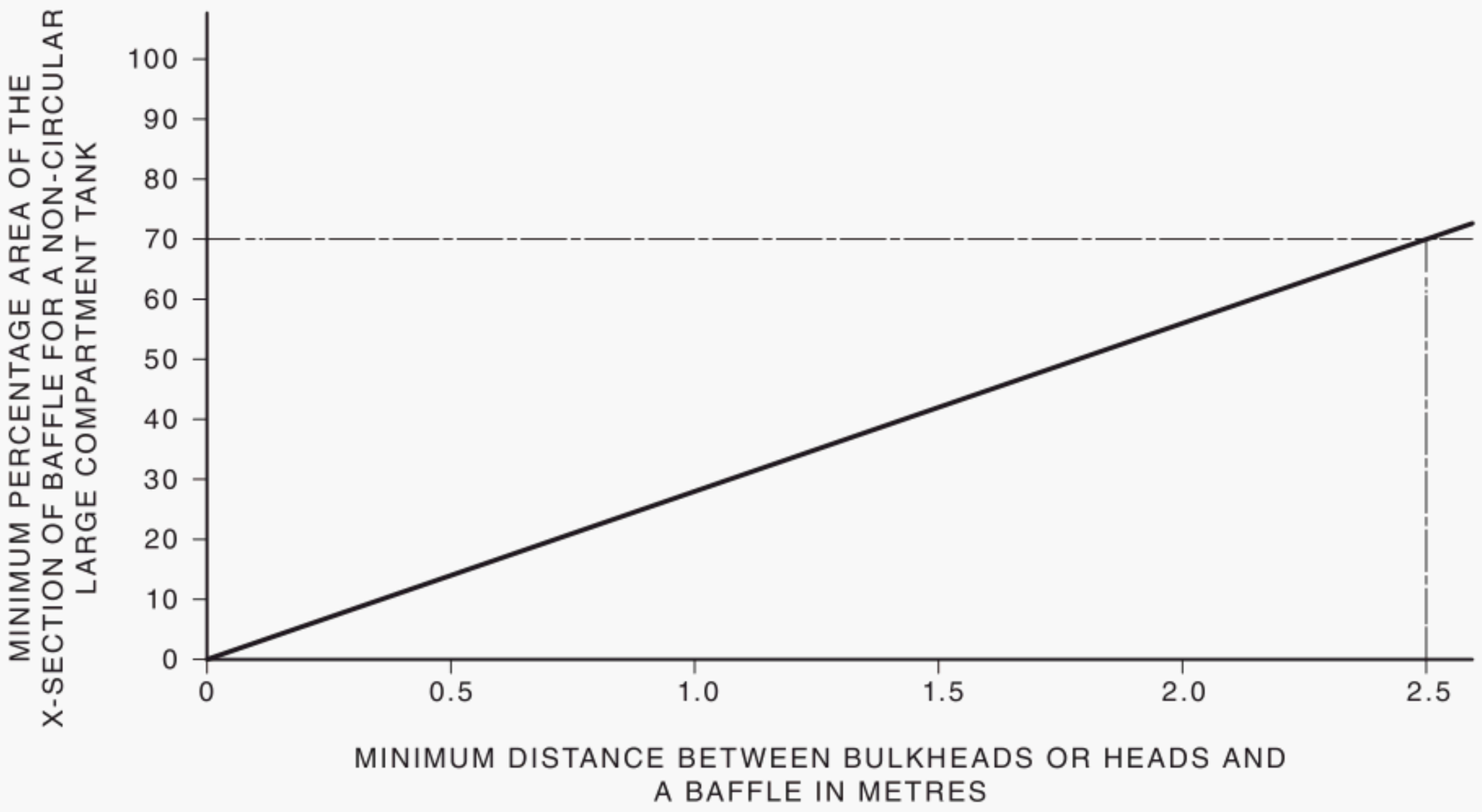


Figure 2.2.8 — Graph to determine minimum distances between bulkheads or heads and baffles

2.2.9 Access through baffles

A baffle shall have a manhole of dimensions in accordance with AS 2865 where no other means exist for gaining access to tank space on both sides of the baffle.

Where more than one baffle is fitted to a compartment, the manholes should be offset relative to each other to minimize the effect of forward surge during braking.

2.2.10 Capacity centre

Where curved heads, bulkheads, and baffles are used, the distance between baffles, or the distance between a baffle and a head or bulkhead shall be made from the capacity centre of the baffle, head or bulkhead. The capacity centre is the centroid of a segment formed when the baffle, head or bulkhead is viewed in plan.

2.2.11 Stiffening of heads, bulkheads and baffles

Unless a proven equivalent form of stiffening is provided, the following requirements shall apply:

(a) Heads, bulkheads and baffles for small compartment and large compartment R type tanks shall be dished or curved to a depth, exclusive of any flange, of not less than 80 mm per metre of depth of the minor axis of the tank cross-section. The amount of dishing shall be not less than 100 mm.

(b) Heads, bulkheads and baffles for large compartment U type tanks shall be dished or curved to a depth, exclusive of the flange, of not less than 250 mm, with a knuckle radius of not less than 50 mm.

(c) If bulkheads or heads or baffles are partly or wholly made up of two structurally connected walls, the minimum thickness of each wall is 60 % of the thickness of a single-walled bulkhead, head or baffle as listed in Table 2.2.12(A).

NOTE 1 Dished or curved bulkheads and baffles should be arranged with the convex surface facing forward to minimize the effect of forward surge during braking.

NOTE 2 For certain corrosive cargo, it is sometimes desirable to attach baffles to the shell by mounting pads rather than directly.

2.2.12 Shell reinforcement

Where required by Table 2.2.12(A) the tank shall be reinforced circumferentially by ring stiffeners, bulkheads or baffles (or in any combination) in accordance with the following requirements:

(a) Reinforcements shall be located so that the maximum unreinforced length (L) does not exceed that specified for the particular shell thickness in accordance with Table 2.2.12(A).

(b) Reinforcements shall be located within 25 mm of points where the longitudinal alignment of shell sheets change direction by more than 10°, unless otherwise reinforced sufficiently to keep stresses within the specified limits.

(c) Ring stiffeners shall be continuous and have a section modulus about the neutral axis of the ring section parallel to the shell not less than that determined from the following Equation 2.2.12:

$$Z = KbL \qquad 2.2.12$$

where

Z = section modulus, in millimetres cubed

K = 0.0069 for all steels

= 0.01186 for all aluminium alloys

b = tank width or diameter, in millimetres

L = ring spacing, i.e. the maximum distance from the midpoint of the unsupported shell on one side of the ring stiffener to the midpoint of the unsupported shell on the opposite side of the ring stiffener, in millimetres

Where a ring stiffener is welded to the shell in accordance with Item (d) below, the maximum portion of the shell which can be used as part of the ring for computing the section modulus shall be as described in Table 2.2.12(B).

(d) The welding which attaches stiffening members, shall be not less than 50 % of the total length (or circumference) of the member. No unwelded length of the joint shall exceed 40 times the shell thickness.

Table 2.2.12(A) — Minimum plate thickness (cargo density ≤ 1 000 kg/m^3)

Tank details			Minimum nominal thickness mm																	
			Shell										Bulkheads and baffles		Head		Heads, bulkheads and baffles	
			Small compartment tanks									Large compartment U type tanks		Small compartment and large compartment R type tanks				Large compartment U type tanks	
			Unreinforced length of shell[a] (L) m																	
Rated capacity per metre of tank length L/m	Shell radius (maximum) m		≤ 0.9			> 0.9 ≤ 1.4			> 1.4 ≤ 2.5											
			LCS	HSLA SS	AL	LCS	HSLA SS	AL	LCS	HSLA SS	AL	LCS HSLA SS	AL	LCS HSLA SS	AL	LCS HSLA SS	AL	LCS HSLA SS	AL
≤ 1 400	≤ 1.8		2.0	1.6	2.2	2.0	1.6	2.2	2.0	1.8	2.4	5.0	6.0	2.0	4.0	2.5	4.4	6.0	8.0
	> 1.8	≤ 2.3	2.0	1.6	2.2	2.0	1.8	2.4	2.4	2.0	2.8								
	> 2.3	≤ 3.2	2.0	1.8	2.4	2.4	2.0	2.8	2.8	2.4	3.0								
	> 3.2		2.4	2.0	2.8	2.8	2.4	3.0	3.0	2.8	3.8								
> 1 400 ≤ 2 100	≤ 1.8		2.0	1.6	2.2	2.0	1.8	2.4	2.4	2.0	2.8	5.0	6.0	2.5	4.4	3.0	5.0	6.0	8.0
	> 1.8	≤ 2.3	2.0	1.8	2.4	2.4	2.0	2.8	2.8	2.4	3.0								
	> 2.3	≤ 3.2	2.4	2.0	2.8	2.8	2.4	3.0	3.0	2.8	3.8								
	> 3.2		2.8	2.4	3.0	3.0	2.8	3.8	3.5	3.0	4.4								
> 2 100 ≤ 2 700	≤ 1.8		2.0	1.8	2.4	2.4	2.0	2.8	2.8	2.4	3.0	5.0	6.0	3.0	5.0	3.0	5.5	6.0	8.0
	> 1.8	≤ 2.3	2.4	2.0	2.8	2.8	2.4	3.0	3.0	2.8	3.8								
	> 2.3	≤ 3.2	2.8	2.4	3.0	3.0	2.8	3.8	3.5	3.0	4.4								
	> 3.2		3.0	2.8	3.8	3.5	3.0	4.4	4.0	3.5	5.0								
> 2 700	≤ 1.8		2.4	2.0	2.8	2.8	2.4	3.0	3.0	2.8	3.8	5.0	6.0	3.0	5.5	3.0	6.0	6.0	8.0
	> 1.8	≤ 2.3	2.8	2.4	3.0	3.0	2.8	3.8	3.5	3.0	4.4								
	> 2.3	≤ 3.2	3.0	2.8	3.8	3.5	3.0	4.4	4.0	3.5	5.0								
	> 3.2		3.5	3.0	4.4	4.0	3.5	5.0	4.0	4.0	5.5								

Table 2.2.12(A) *(continued)*

Tank details		Minimum nominal thickness mm																	
		Shell											Bulkheads and baffles		Head		Heads, bulkheads and baffles		
		Small compartment tanks									Large compartment U type tanks		Small compartment and large compartment R type tanks				Large compartment U type tanks		
		Unreinforced length of shell[a] (*L*) m																	
Rated capacity per metre of tank length L/m	Shell radius (maximum) m	≤ 0.9			> 0.9 ≤ 1.4			> 1.4 ≤ 2.5			LCS HSLA SS	AL	LCS HSLA SS	AL	LCS HSLA SS	AL	LCS HSLA SS	AL
		LCS	HSLA SS	AL	LCS	HSLA SS	AL	LCS	HSLA SS	AL								

Key

AL = aluminium

LCS = low carbon steel

HSLA = high strength low alloy steel

SS = austenitic stainless steel

Large compartment U type tank = unreinforced shell, circular cross-section only

Large compartment R type tank = reinforced shell, any shape cross-section

[a] Distance between heads, bulkheads, baffles, or ring stiffeners.

NOTE 1 The material thickness values in Table 2.2.12(A) are nominal and are subject to manufacturing tolerances.

NOTE 2 A reduction in material thickness in service should be subject to engineering assessment.

Table 2.2.12(B) — Portion of tank shell contributing to ring stiffener section modulus

Number of circumferential ring stiffener to tank shell welds	Distance between parallel circumferential ring stiffener to tank shell welds	Maximum shell section credit
1	—	20 t
2	< 20 t	s + 20 t
2	> 20 t	40 t
Key t = shell thickness, in millimetres s = distance between parallel circumferential ring stiffener to shell welds, in millimetres		

2.2.13 Separation of liquids

Where it is necessary to prevent contact between liquids in adjoining compartments, one of the following shall be provided:

(a) A double-wall bulkhead or two bulkheads having the convex sides facing each other.

(b) A single-wall bulkhead with a cleaning ring.

(c) A single-wall bulkhead welded on both sides.

2.2.14 Enclosed air spaces

The air spaces between double bulkheads, within cleaning rings, within internal or external ring stiffeners and under mounting pads shall be provided with screwed openings for venting and draining. Any such openings on the upper surfaces of the tank shall be plugged to prevent water or foreign matter from entering. Openings on the lower surfaces of the tank shall be left unplugged so that leaks are visible.

Any other air space where product or vapour could be present shall also be provided with screwed openings to allow purging before repairs are undertaken.

Where the enclosed space is used to transfer vapour, the openings shall be plugged.

NOTE Care should be taken during design and fabrication to ensure air spaces are not inadvertently connected with one another.

2.2.15 Component attachment

The attachment of components and accessories to the tank shell or head shall be avoided where possible. Where this is unavoidable, the following requirements shall apply:

(a) The design shall be such that the component or its method of attachment will break before damage is caused to the shell or head that may result in loss of containment.

(b) The attachment shall be via a doubling/mounting pad welded to the tank as follows:

(i) The mounting pad shall be no thicker than the tank shell or head at the point of attachment. It shall extend at least 25 mm beyond the perimeter of the component attachment, and be shaped to avoid stress concentrations.

(ii) The means of attachment shall not create pockets which could initiate corrosion or retain cargo. The welding of the pad to the tank shall be continuous unless a gap for drainage is provided at the bottom. A tell-tale hole shall be provided where such

a drainage gap is not provided. The tell-tale hole shall be unplugged if on a lower surface, but remain plugged if on any other surface.

(c) The mounting bracket shall be no thicker than the tank shell or head at the point of attachment.

NOTE Mandatory lighting mounting brackets may be welded directly to the tank shell adjacent to the enclosed air space within the cleaning rings.

2.2.16 Roll-over protection

Hatches and fittings on top of the tank shall be protected with roll-over protection which conform with the following requirements, as appropriate:

(a) For small compartment and large compartment R type tanks, the roll-over protection shall comprise a guard in the form of inverted U-coamings and valances. The thickness of the coaming and valances shall be not less than the values given in Table 2.2.16. The space between the U-coamings shall be closed by valances level with the top of the coaming at the front, and at least 50 mm high at the rear. The front valance shall have a rearward facing return of a minimum of 25 mm.

Table 2.2.16 — Thickness of material for U-coamings and valances

Type of tank	Thickness mm		
	Aluminium	Low carbon steel	High strength low alloy or stainless steel
Large compartment U type tank	6	5	5
Small compartment and large compartment R type tank	5	3	2.5

(b) For large compartment U type tanks, the roll-over protection shall consist of one of the following:

(i) Guards.

(ii) A dome or domes attached to the tank.

(iii) Locating the hatches or fittings within the body of the tank.

(iv) "U" coamings and valances as described in Table 2.2.16.

(c) Any guards or domes not specifically defined in Items (a) and (b)(iv) above shall be designed and installed to withstand a load of twice the mass of the loaded tank, in any direction without failure. These design loads shall be determined independently. The calculation of strength shall be based on the ultimate tensile strength of the material. If two or more guards are provided, the load shall be proportioned between them.

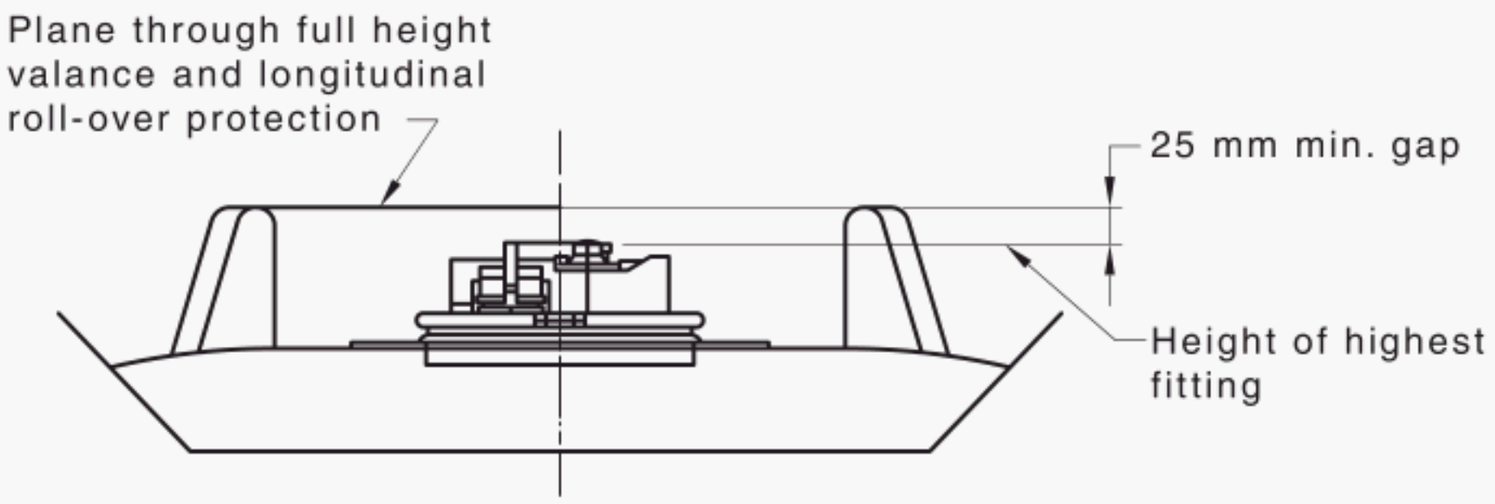
(d) For demountable tanks, the protection shall comprise one of the options allowed in Item (a) or Item (b) as appropriate, except where the capacity is less than 2 500 L. In this case, a vertical metal strip not less than 4.5 mm thick surrounding the fittings shall be used.

(e) Any guard, dome, or coaming, shall project at least 25 mm above the top of the hatch or fitting which it protects.

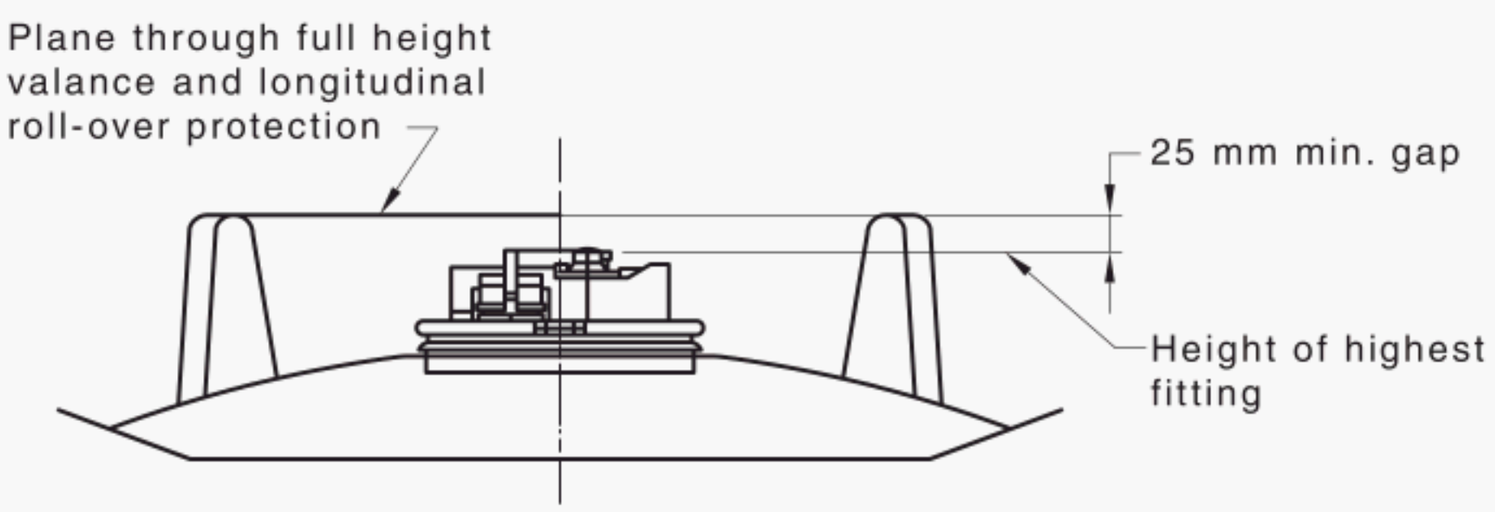
NOTE Acceptable details for this projection are shown in Figure 2.2.16.

(f) The material of a guard or dome shall be compatible with that of the tank shell.

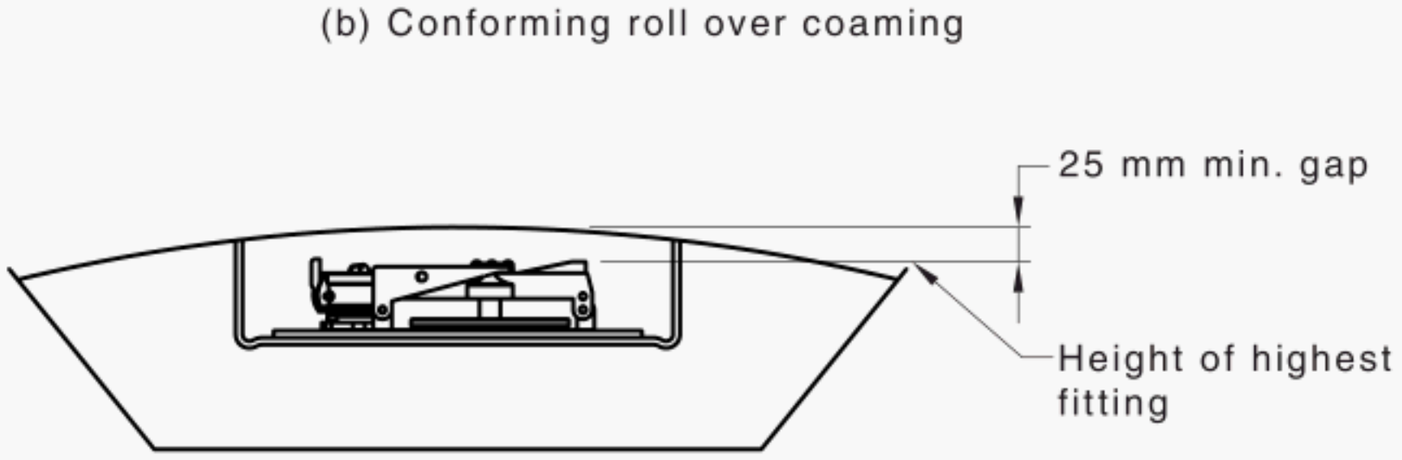
(g) Drains shall be fitted to prevent liquid from collecting on top of the tank. They shall discharge to the ground, clear of equipment and areas where water or product can pool.



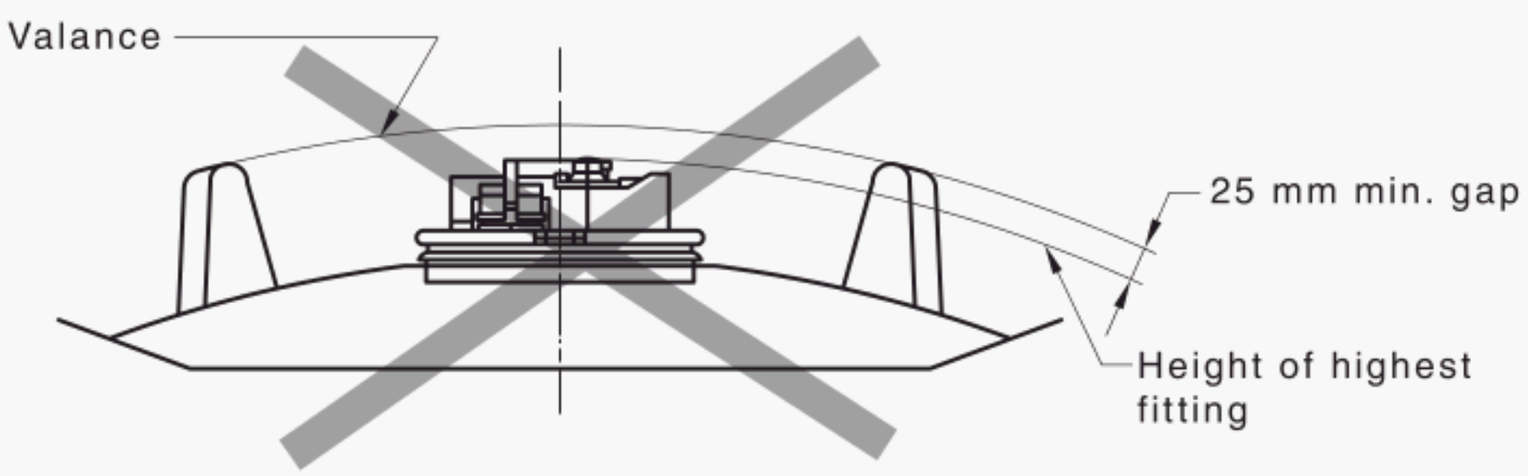
(a) Conforming roll over coaming



(b) Conforming roll over coaming



(c) Conforming integrated manway



(d) Non-conforming roll over coaming

Figure 2.2.16 — Example of heights for roll-over protection

2.2.17 Welding

Welding of structural joints or the attachments of accessories, mounting pads, etc. shall conform with the following standards as appropriate:

(a) AS/NZS 1554.1 — Welding of steel structures.

(b) AS/NZS 1554.4 — Welding of high strength quenched and tempered steels.

(c) AS/NZS 1554.6 — Welding stainless steel for structural purposes.

(d) AS/NZS 1665 — Welding of aluminium structures.

2.2.18 Weld categories

2.2.18.1 Aluminium structures

Aluminium structure weld categories shall be as follows:

(a) Butt welds in tank shell plates and bulkheads shall be full penetration conforming to Weld Category B.

(b) Fillet welds to the tank shell shall conform to Weld Category B.

2.2.18.2 Low carbon steel structures

Low carbon steel structure weld categories shall be as follows:

(a) Butt welds in tank shell plates and bulkheads shall be full penetration conforming to Weld Category SP.

(b) Fillet welds to the tank shell shall conform to Weld Category SP.

2.2.18.3 High strength low alloy steel structures

High strength low alloy steel structure weld categories shall be as follows:

(a) Butt welds in tank shell plates and bulkheads shall be full penetration conforming to Weld Category SP.

(b) Fillet welds to the tank shell shall conform to Weld Category SP.

2.2.18.4 Stainless steel structures

Stainless steel structure weld categories shall be as follows:

(a) Butt welds in tank shell plates and bulkheads shall be full penetration conforming to Weld Category 1C.

(b) Fillet welds to the tank shell shall conform to Weld Category 1C.

NOTE Where the cargo is corrosive, the surface condition and surface finish categories of the welds should be reviewed and updated as necessary.

2.2.18.5 All other welds

All other welds shall be designed for the application by a competent person.

2.3 Compartment openings, valves and vents

2.3.1 General

Every opening to the liquid space of a tank shall be provided with an effective means of closure in accordance with one of the requirements of this Clause (2.3), as appropriate.

2.3.2 Compartment openings

Each compartment shall be accessible through an opening of dimensions in accordance with AS 2865 to allow a person to pass through to carry out inspections or maintenance work. Any such opening shall be fitted with a closure.

Except for bolted flange covers designed and manufactured in accordance with AS 1210, all closures for openings into tank compartments, used for access or for maintenance work, and any equipment, such as pressure and vacuum vents and other fittings, shall be regarded as hatch assemblies, and be subject to a drop test (refer to AS 2809.1 Appendix B).

Hatch coamings shall extend no further than 25 mm into tank vapour space unless fitted with a bleed hole into the vapour space.

2.3.3 Valves

Each liquid discharge opening shall be provided with an internal shut-off valve and an external shut-off valve. At the end of the opening a protective cap linked by a tether shall be fitted. These fittings shall be suitable for service at the piping design pressure. The internal shut-off valve shall conform with the following requirements:

(a) The internal shut-off valve seat shall be located inside the tank or within the tank flange or its companion flange.

NOTE The remainder of the valve may be either inside or outside the tank shell, provided that in the event of accidental damage to any associated external fittings, the internal shut-off valve remains intact to minimize loss of cargo.

(b) An internal shut-off valve which is bottom-operated shall incorporate an automatic heat-actuated closing device which will become effective at a temperature of not more than 120 °C, arranged to respond to a fire near the tank outlets.

(c) A tank designed for bottom loading shall incorporate a downward-direction liquid flow deflector above the internal shut-off valve.

(d) A system for opening and closing the internal valves and vapour vents of each compartment shall be interconnected with the road tank vehicle park brake interlock system (see AS 2809.1), to prevent it from being driven or moved while the internal shut-off valves and vapour vents are open.

(e) An internal shut-off valve which is pneumatically-operated shall incorporate a device to enable manual opening if a pneumatic system is inoperable.

2.3.4 Vents

Each tank compartment shall be provided with normal venting in accordance with Clause 2.3.6 and emergency venting in accordance with Clause 2.3.7. The vents and their installation shall conform with the following requirements:

(a) Each vent shall be marked with the manufacturer's name, model identification, discharge capacity and related pressure.

(b) The discharge capacity of each model and type of vent shall be determined before use.

NOTE AS 1271 and API 2000 provide methods for determining flow rating.

(c) Vents shall be designed and fitted, as far as is practical, in the centre of compartments to minimize the discharge of product through the vent in the event of surge or vehicle roll-over. A vent shall be deemed to conform with this requirement if it does not leak after the application of the tests specified in AS 2809.1 Appendix B.

(d) The outlet of each pressure and vacuum vent shall be covered with stainless steel wire gauze of 425 µm to 600 µm aperture.

(e) Each vent shall be connected to the vapour space.

(f) Shut-off valves shall not be installed between the tank opening and the vent.

(g) Vents shall be mounted, shielded, or drained, so that, where any accumulation of water becomes frozen, the operation of the vent will not be impaired.

2.3.5 Normal venting

The normal venting provision shall consist of a free vent, a pressure vent and a vacuum vent, in accordance with the following requirements:

(a) The free venting provision shall be either a separate vent or be incorporated in the pressure vent as a bypass or a pilot bleed device. The clear area through the most restricted portion of the free vent shall not exceed 15 mm^2. The free vent shall lock shut when tilted to an angle not less than 30° and not more than 60° from the vertical, and remain shut at any angle exceeding 60° from the vertical.

(b) The clear area through any pressure or vacuum vent shall be not less than 280 mm^2.

(c) The pressure and vacuum vent opening settings shall be in accordance with Table 2.3.5.

(d) When tilted to an angle not less than 30° and not more than 90° from the vertical, the pressure vent shall open at the pressure specified in Table 2.3.5, or lock shut. The higher-pressure or lock-shut function shall remain in operation at any angle exceeding 90° from the vertical.

(e) The pressure vent shall be either pressure-operated or be interlocked with the tank-loading device. Any interconnection arrangement which opens the vent when the internal shut-off valve is opened shall incorporate an external means of disengaging the interconnection provision.

Table 2.3.5 — Vent design and operating pressures

Function	Pressure[a] kPa	
	Small compartment and large compartment R type tank	Large compartment U type tank
Design vapour pressure	20	30
Design vacuum	Not specified	Not specified
Pressure vent opens —		
(a) in upright position	15 +2, −5	30 +2 −5
(b) when tilted in accordance with Clause 2.3.5(d)	30 ± 4, or lock shut	45 ± 4, or lock shut
Emergency vent opens (upright and at any angle other than upright)	30 ± 4	45 ± 4
Vacuum vent opens	−2 ± 2	−2 ± 2

[a] Free air measured under standard temperature and pressure conditions (101.3 kPa and 15.6 °C).

2.3.6 Emergency venting

Emergency venting for protection against exposure to fire or extreme heat shall comprise of a pressure vent which conforms with the following requirements:

(a) The pressures at which an emergency vent starts to open and is fully open shall be in accordance with Table 2.3.5.

(b) The total emergency venting capacity of each tank compartment shall be not less than that specified in Table 2.3.6. Flow rating pressures shall be the "Emergency vent opens" value specified in Table 2.3.5.

Table 2.3.6 — Minimum emergency vent capacity

Internal area of tank compartment m^2	Minimum emergency vent capacity[a] m^3/h	Internal area of tank compartment m^2	Minimum emergency vent capacity m^3/h
2	480	30	6 650
3	720	35	7 260
4	960	40	7 830
5	1 200	45	8 370
6	1 440	50	8 880
7	1 680	55	9 370
8	1 920	60	9 840
9	2 160	65	10 300
10	2 400	70	10 700
12	2 880	75	11 200
14	3 360	80	11 600
16	3 840	85	12 000
18	4 320	90	12 400
20	4 800	95	12 800
25	6 000	100	13 200

[a] Free air measured under standard temperature and pressure conditions (101.3 kPa and 15.6 °C).

NOTE Interpolate for intermediate sizes.

2.3.7 Loading protection

A tank which is intended to be loaded with the hatch covers closed shall be provided with sufficient venting capacity to discharge the whole of the liquid delivery rate of the pump, and with sufficient air inflow capacity to match the liquid withdrawal rate. A means shall also be provided to prevent loading if the vapour vents remain closed on the compartment being loaded. A tank designed for bottom loading shall be provided with protection against overfilling. Where such a protection system uses probes or sensors that are designed to be removable without tools, then these probes or sensors shall be fitted with an interlock to ensure that the probe or sensor is in place before loading can commence.

2.4 Filling and dipping provisions

2.4.1 Filling tube

Where a top-filled tank is fitted with a filling tube, the following requirements shall apply:

(a) The filling tube shall terminate not more than 50 mm and not less than 35 mm from the bottom of the tank, and be stayed.

(b) The filling tube shall be connected to the vapour space of the tank by a pressure equalizing hole not less than 3 mm diameter or the equivalent in area, and be fitted with gauze as required by Clause 2.4.2(a).

(c) The vent shall be shrouded to re-direct liquid down the filling tube.

(d) The bottom end of the filling tube shall be cut to an angle of approximately 45°, and the flow of liquid from it shall be directed away from any objects which might cause the liquid to spray.

(e) The filling tube closure shall not leak after the application of the drop test specified in AS 2809.1 Appendix B.

2.4.2 Dip stick

Any dip stick indicating system shall conform with the following requirements:

(a) A dip stick which measures by contacting the bottom of the tank shall be provided with a tubular dip tube. A pressure-equalizing hole shall connect the upper end of the dip tube with the upper tank space. The hole shall be covered by a stainless steel wire gauze of 425 µm to 600 µm aperture.

(b) Where the dip stick contacts the bottom of the tank, a durable striker pad of thickness not less than that of the tank shell or 5 mm, whichever is the greater, shall be attached firmly to the tank bottom below the dip opening.

(c) The dip tube shall terminate not more than 50 mm from the bottom of the tank, and be stayed.

(d) The dip tube closure shall not leak after the application of the drop test specified in AS 2809.1 Appendix B.

(e) The dip tube shall be made from a non-sparking material, e.g. aluminium.

2.5 Pipework and pipe fittings

2.5.1 Suitability

Pipes and fittings used for handling the tanker's cargo shall also be suitable for the required flow rates and pressures.

2.5.2 Strength of piping

Piping, associated fittings and flexible connections shall be designed to withstand the pressure defined in Clause 2.8.2.

2.5.3 Provisions for movement

Pipes and fittings shall be designed and supported to allow for expansion, contraction, vibration, and, where necessary, movement.

2.5.4 Hoses and hose couplings

Hoses shall be constructed in accordance with AS 2683. Hose shall not be used in that section of piping which is between the tank's internal valve and the first valve outside the tank.

2.6 Electrical bonding

The electrical resistance between the tank and the tanker chassis, or trailer undercarriage, and between the tank and the connection of the tanker pipework to the delivery hose, shall not exceed 10 ohms.

2.7 Earthing point

One or more earthing points shall be provided to meet one of the following:

(a) Non-corrodible bare metal lug(s) as an integral part of the tank or tanker.

(b) The tanker incorporates an earth wire reel system in accordance with AS 2809.1.

Earthing lugs shall be in a position convenient for the operator and be as far away as practicable from points where cargo flammable vapour may emerge. Earthing lugs shall not be within the space enclosed by the rollover coamings.

2.8 Pressure testing as part of commissioning

2.8.1 Tanks

A tank or an individual tank compartment shall not leak, distort, or show evidence of impending failure when —

(a) filled with a test medium, the temperature of which does not exceed 38 °C; and

(b) hydrostatically pressurized, with pressure maintained for a minimum of 10 min, to —

  (i) 30 kPa for small and large compartment R type tanks; or

  (ii) 45 kPa for large compartment U type tanks.

Each compartment shall be tested individually with adjacent compartments empty and at atmospheric pressure. Relief devices which may prevent the test pressure being reached shall be made inoperative during testing.

The vapour-recovery transfer system shall not leak when subjected to a pressure of 30 kPa and the pressure maintained for a minimum of 10 min.

2.8.2 Piping

Piping systems shall be tested in accordance with the following:

(a) A piping system subject to pumping pressure shall be tested to a pressure 1.5 times the maximum working pressure or 200 kPa, whichever is the greater.

(b) Valves, manifolds, piping, and fittings in a bottom-loading system which can be subjected to surge pressures due to the closure of a pressure balanced internal shut-off valve in the system shall be tested to 1 600 kPa.

All tests designated in Items (a) and (b) shall have the test pressure maintained for a minimum of 10 min without any leakage occurring.

Appendix A
(informative)

Hazardous area classifications

A.1 General

The hazardous area classification for a tanker may vary based on a number of factors including aspects which are outlined below:

(a) Type of cargo(s) the tanker will carry — Tankers with petrol type cargos may be classified with larger hazardous areas than those dedicated for cargos with higher flash points such as jet fuel.

(b) Nature of operations — Classification may vary for cargo loading and unloading.

(c) Features on the tanker — Tankers with cargo pumps or sampling systems may have different zones to tankers without these features.

A.2 Classifications

Particular aspects of the hazardous area classification such as the applicable equipment group and temperature class also need to be defined based on both the cargo being transported and the zones the tanker may be exposed to during loading and unloading operations.

Guidance on the classification of hazardous areas can be found in AS/NZS 60079.10.1 and relevant properties of liquids in AS/NZS 80079.20.1. However, since these variances may lead to different classifications for different tankers, hazardous area classifications are not covered in this Standard.

AS/NZS 60079.14 also provides for equipment that is not suitable for the classified hazardous area to be isolated during the period that the equipment may be exposed to the hazard.

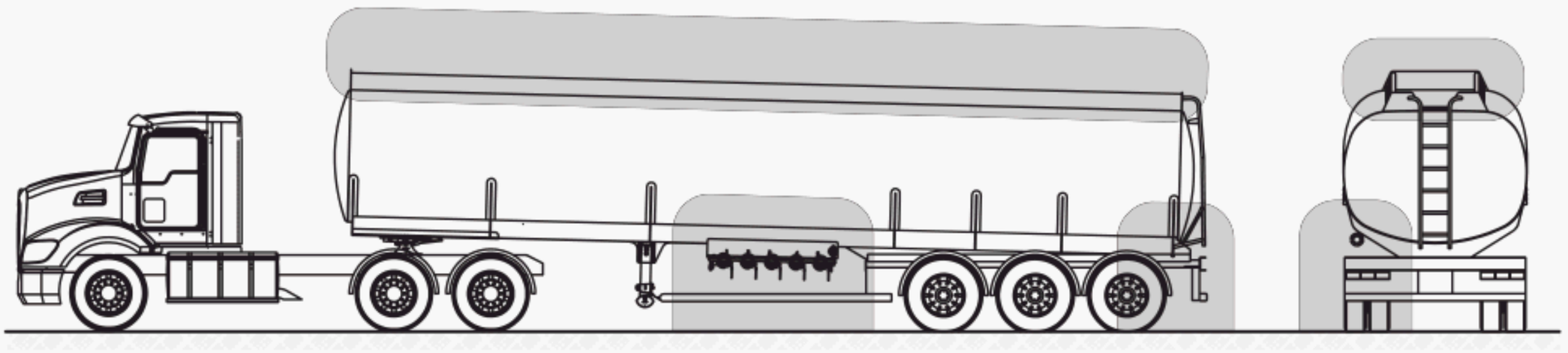
Notwithstanding the potential variances in hazardous area classification, it is common practice for equipment on tankers to be suitable for the following hazardous areas:

(a) Within tanks — Zone 0.

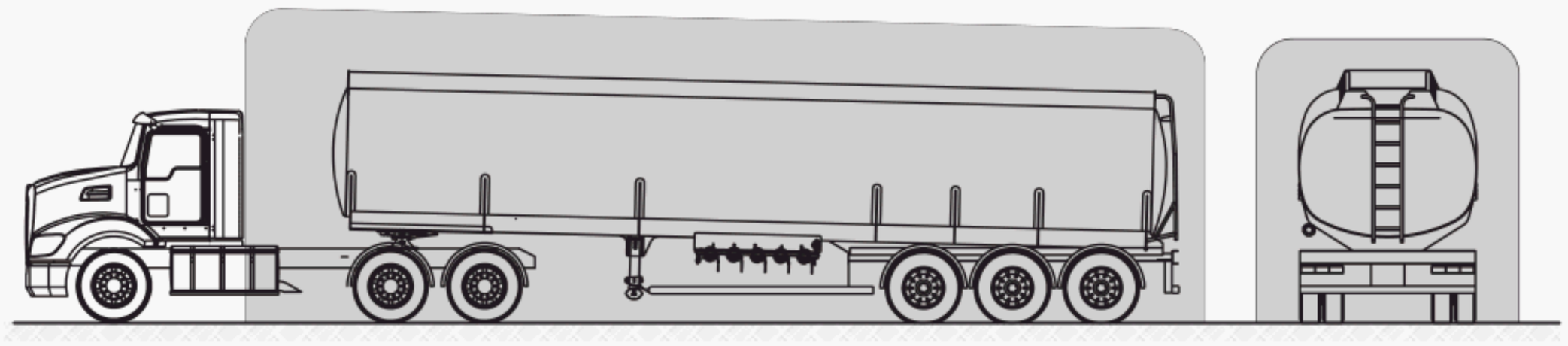
(b) Within 0.5 m of rollover coamings — Zone 1.

(c) Within 1 m of cargo connections, sample points, down to ground level — Zone 1.

NOTE Examples of Zone 1 hazardous areas are shown in Figure A.



(a) During bottom loading and unloading of bulk flammable liquids



(b) During top loading and for 5 minutes after completion of loading

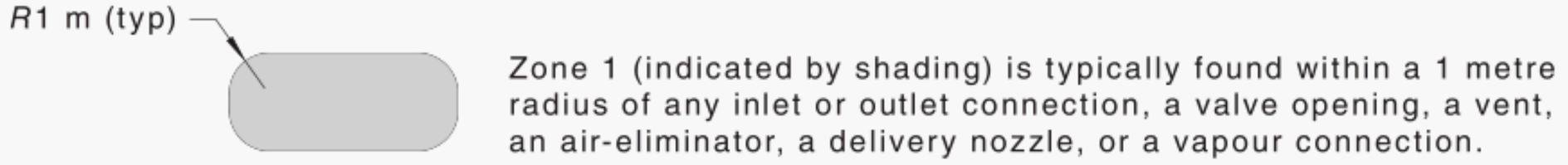


Figure A — Examples of hazardous area during loading and unloading of bulk flammable liquids

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NATIONAL TRANSPORT COMMISSION. Australian Dangerous Goods (ADG) Code

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