APPROVED CODE OF PRACTICE

Flammable liquids road tank wagons

THE DESIGN AND CONSTRUCTION OF VEHICLES FOR THE BULK TRANSPORTATION OF FLAMMABLE LIQUIDS BY ROAD

May 2019

New Zealand Government

WORKSAFE
Mahi Haumaru Aotearoa

ACKNOWLEDGEMENTS

WorkSafe would like to acknowledge and thank the stakeholders who have contributed to the development of this code of practice.

NOTICE OF APPROVAL

WorkSafe New Zealand leads the national effort to transform New Zealand's health and safety at work and reduce the high death, injury, and illness rates arising from work.

The Code of Practice for the design and construction of vehicles for the bulk transportation of flammable liquids by road sets out WorkSafe's expectations about identifying and controlling the health and safety risks arising from the design and construction of road tank wagons. The code will help persons conducting a business or undertaking (PCBUs) and others to comply with the Health and Safety at Work Act 2015 and the Health and Safety at Work (Hazardous Substances) Regulations 2017.

WorkSafe developed the code with input from tank wagon fabricators, tank wagon operators and compliance certifiers and in consultation with unions and employer organisations.

Accordingly, I, Iain Lees-Galloway, being satisfied that the consultation requirements of section 222(2) of the Health and Safety at Work Act 2015 have been met, approve the Code of Practice for design and construction of vehicles for the bulk transportation of flammable liquids by road under section 222 of the Health and Safety at Work Act 2015.

Hon Iain Lees-Galloway
Minister for Workplace Relations and Safety

FOREWORD

As the Chair of the Board of WorkSafe, I am pleased to introduce this Code of Practice for the design and construction of vehicles for the bulk transportation of flammable liquids (fuels) by road.

Fuel tankers are among the most dangerous vehicles on the road, carrying loads that make them vulnerable to rollover and explosions. It is important that those involved in the design, construction and operation of tankers have access to information on the regulatory requirements and good practice in this area.

This code will help to ensure that this information is available and workers and other persons are given protection against harm to their health, safety, and welfare from work-related risks so far as is reasonably practicable.

Ross Wilson
Chair, WorkSafe New Zealand Board

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1.0 Introduction

IN THIS SECTION:

1.1 Overview

The purpose of this approved code of practice (ACOP) is to provide users with a method of meeting the requirements of Part 16 of the Health and Safety at Work (Hazardous Substances) Regulations 2017 (the Regulations) with a degree of prescription and assistance. It is limited to tank wagons for the transport of bulk flammable liquids by road.

This ACOP has been developed to provide guidance on the design and construction of tanks, tank fittings and tank attachments and also the design, construction and operation of vehicles carrying such tanks, tank fittings and attachments. Operational elements are included only where they relate to the design and construction or support the requirements specified in Part 16 of the Regulations.

It is not the intention of this ACOP to limit innovation and new developments.

1.2 Status of this code

This code has been approved under the Health and Safety at Work Act 2015 (HSWA). It can be used in court as evidence of whether the relevant duties under health and safety law were complied with. Courts may:

- have regard to this code as evidence of what is known about the design and construction of tank wagons for the transport of bulk flammable liquids by road
- rely on the code in determining what is reasonably practicable for the design and construction of tank wagons.

1.3 Scope

The aim of this ACOP is to ensure that bulk flammable liquids are securely contained and safely transported and handled, thereby reducing risk and helping to prevent accidental damage or injury to people, property and the environment.

It is not intended to replace the obligation on the relevant PCBU to make themselves familiar with the Regulations and develop mechanisms and processes to meet the requirements which are appropriate for their workplaces and activities.

This ACOP applies to all substances with hazard classifications 3.1A, 3.1B, 3.1C or 3.1D, as described in the Hazardous Substances (Classification) Notice 2017.

Where transportable containers such as intermediate bulk containers (IBCs) or portable tanks (including ISO tank containers) are mounted on a vehicle and are used to perform the functions of a tank wagon (ie are filled or discharged while mounted on the vehicle) that vehicle is encompassed by this ACOP.

1.4 Limits of this ACOP

This ACOP applies to the design, construction and operation of vehicles which:

- have commenced construction after the date on which this ACOP is approved
- are used for the transportation of flammable liquids with hazard classification 3.1A, 3.1B, 3.1C or 3.1D
- are used to convey these substances in bulk by road, and
- are powered by an internal combustion engine.

It also applies to the design, construction and operation of tank wagons used for refuelling of aircraft as well as those used for the transportation of flammable liquid waste.

This ACOP does not detail the design of large compartment circular tanks for tank wagons.

This ACOP does not encompass the requirements for tank wagons with a capacity less than 2,000 L apart from:

- tank trailers
- tanks fitted to utility vehicles which have a capacity of less than 450 L and transport low-hazard hazardous substances.

This ACOP does not detail the requirements of legislation other than Part 16 of the Regulations. Compliance with this ACOP does not remove the requirement to comply with other sections of HSWA or regulations made under that Act, or other legislation such as the Heavy Motor Vehicle Regulations 1974, Land Transport Rule: Vehicle Dimensions and Mass 2016 and other Land Transport Rules applying to vehicles and drivers.

This ACOP does not encompass the design of IBCs or portable tanks. These are to comply with chapter 6.5 and chapter 6.7 of the United Nations (UN) Model Regulations.

1.5 Audience

This ACOP is designed primarily for PCBUs:

- who design tanks for road tank wagons
- who construct tanks for road tank wagons
- who design tank wagons or parts of a road tank wagon
- who construct tank wagons or parts of a road tank wagon
- with management or control of a road tank wagon.

The Regulations and this ACOP refer to ‘a relevant PCBU’.

A relevant PCBU is a PCBU who:

a. has the ability to control or influence a matter that is the subject of a duty under the Regulations, or

b. would have that ability but for an agreement or arrangement purporting to limit or remove that ability.

1.6 Interpretations

Where any term used is not defined in this list of interpretations, the meaning of that term shall be as defined by the Regulations. Where there is a conflict in a term, the definition in the Regulations shall prevail.

Approved fabricator

A fabricator who is approved by WorkSafe to manufacture one or more tank wagon designs. The application form for approval as a tank wagon fabricator is available from the WorkSafe website: worksafe.govt.nz

Baffle

A partition in a compartment of a tank, that is not liquid-tight but which limits the surge of the hazardous substance in the compartment.

Bulkhead

A transverse closure forming a liquid-tight division between adjacent compartments of a tank.

Collision bumper

The section of the rear bumper that is designed to meet the requirements set out in this ACOP (see Section 4.4 – Rear-end collision protection).

Head

A closure at the end of a tank and which is liquid-tight.

Large tank wagon

A tank wagon with capacity of at least 2000 L.

Liquids with class 3.1A, 3.1B, 3.1C or 3.1D hazard classification

Liquids, mixtures of liquids, and liquids containing solids in solution and suspension as defined in the Hazardous Substances (Classification) Notice 2017. In each case the flash point is less than or equal to 93°C. For example, petrol, acetone, methanol, and ethanol.

Low-hazard hazardous substance

A hazardous substance with a hazard classification other than class 1, 2.1.1A, 3.1A, 3.1B, 3.1C, 4, 5.1.1A, 5.1.1B, 5.1.1C, 5.1.2A, 5.2, 6.1A, 6.1B, 6.1C, 8.2A, 8.2B, 8.2C or 9.1A.

Tank

An enclosed receptacle permanently fixed to the chassis of a tank wagon used for the transport or storage of liquids with class 3.1A, 3.1B, 3.1C or 3.1D hazard classifications, and includes:

- any compartments and all components or materials (including coatings) necessary for the tank to perform its containment function, and
- all parts affecting the structural integrity of the tank and the means of closing the tank.

A tank for liquid transport may be either of the following:

- a small compartment tank – a tank having one or more compartments, none of which exceed 8,600 L water capacity, or
- a large compartment tank – a tank having one or more compartments, which would not qualify as a small compartment tank.

The vehicle running tank is excluded.

Tank wagon

Any vehicle constructed for the primary purpose of carrying bulk liquids with a class 3.1A, 3.1B, 3.1C or 3.1D hazard classification in a fixed tank, or fixed tanks, by road. Tank wagons may be of one of the following types:

- **Tank truck (rigid)**: A single vehicle having its own means of propulsion, including those which tow a tank trailer.
- **Tank semi-trailer**: A vehicle, including a prime mover, constructed so that, when drawn through a fifth wheel or turntable connection, part of the load rests on the towing vehicle (includes B trains).
- **Tank trailer**: A vehicle which does not have its own means of propulsion, but does not include a tank semi-trailer.
- **Prime mover**: A vehicle used to pull tank semi-trailers carrying liquids with class 3.1A, 3.1B, 3.1C or 3.1D hazard classifications.
- **Aircraft refuelling unit**: A vehicle that is used primarily for refuelling aircraft at airports and which has limited travel on public roads.

Ullage

The air space left when a container is filled to its liquid carrying capacity so that any expansion of the liquid will not cause overflow or excessive hydraulic pressure. The ullage space is to be calculated at 15°C.

1.7 Abbreviations

Abbreviations used in this ACOP include:

AS	Australian Standard
ISO	International Organization for Standardization
NZS	New Zealand Standard
UN	United Nations

1.8 References

AS/NZS 1594:2002 Hot-rolled steel flat products

AS/NZS 1664.1:1997 Aluminium structures – Limit state design

AS/NZS 1664.2:1997 Aluminium structures – Allowable stress design

AS 1210-2010 Pressure vessels

AS 1692:2006 Steel tanks for flammable and combustible liquids

AS 1874:2000 Aluminium and aluminium alloys – Ingots and castings

AS/NZS 3679.1:2016 Structural steel – Part 1: Hot-rolled bars and sections

AS/NZS 3679.2:2016 Structural Steel – Part 2: Welded I sections

AS 3990:1993 Mechanical equipment – Steelwork

AS/NZS 1163:2016 Cold –formed structural steel hollow sections

AS/NZS 1554.1:2014 Structural steel welding – Part 1: Welding of steel structures

AS/NZS 1554.4:2014 Structural steel welding – Part 4: Welding of high strength quenched and tempered steels

AS/NZS 1554.5:2014 Structural steel welding – Part 5: Welding of steel structures subject to high levels of fatigue loading

AS/NZS 1665:2004 Welding of aluminium structures

AS/NZS 1734:1997 Aluminium and aluminium alloys – Flat sheets, coiled sheet and plate

AS/NZS 1866:1997 Aluminium and aluminium alloys – Extruded rod, bar, solid and hollow shapes

AS/NZS 3678:2016 Structural steel – Hot-rolled plates, floorplates and slabs

AS/NZS 4673:2001 Cold-formed stainless steel structures.

AS/NZS 60079.10.1:2009 Explosive atmospheres – Classification of areas – Explosive gas atmospheres

Hazardous Substances at Work (Hazardous Substances) Regulations 2017

Land Transport Rule: Vehicle Dimensions and Mass 2016

Land Transport Rule: Dangerous Goods 2005

NZS 3404:1997 Steel Structures Standard Parts 1 and 2

NZS 5433:2012 Transport of Dangerous Goods on Land: Parts 1 and 2

1.9 Tank wagons limited to carrying substances with 3.1D flammable classification

A relevant PCBU must ensure that tank wagons limited to carrying substances with a 3.1D flammable classification, for example diesel, are constructed according to the Regulations. Appendix C to this ACOP describes how these regulatory requirements may be met.

1.10 Tank trailers less than 2,000 L

A relevant PCBU must ensure that tank trailers of less than 2,000 L capacity are designed and constructed in accordance with the Regulations. Appendix D to this ACOP describes how these regulatory requirements may be met.

1.11 Vacuum tank wagons

A relevant PCBU must ensure that vacuum tank wagons are designed and operated in accordance with the Regulations. Appendix E to this ACOP describes how these regulatory requirements may be met.

1.12 Tanks fitted to utility vehicles

A relevant PCBU must ensure that tanks fitted to utility vehicles are designed in accordance with the Regulations. Appendix F to this ACOP describes how these regulatory requirements may be met.

1.13 Antecedents

This ACOP supersedes:

- The Flammable Liquids Tank Wagon code for the bulk transport of class 3A dangerous goods by road, published by the Department of Labour Occupational Safety and Health in 1986 with reprints in 1988 and 1989.
- HSNOCOP 6: Code of practice for the design and construction of vehicles for the bulk transport of flammable liquids by road, version 1, approved by the Environmental Protection Authority (EPA) in July 2008.
- HSNOCOP 6 version 2, approved by the EPA in August 2013.
- HSNOCOP 6 version 2.1, approved by the EPA in April 2014.

1.14 Road transport rules and regulations

The relevant PCBU must ensure the vehicle complies with all current New Zealand land transport rules and regulations.

2.0 General requirements for tank wagons

IN THIS SECTION:

2.1 General

A relevant PCBU must ensure that:

- the vehicle is constructed, so far as is reasonably practicable, of fire-resisting materials
- the design of the vehicle provides an integration of the tank supporting members and the vehicle chassis
- the means of securing the tank to the chassis, and in the case of tank trailers or tank semi-trailers, the means of attaching the prime mover to the tank trailer or tank semi-trailer, are designed to withstand the design loads of the Regulations
- the design of the tank wagon is certified by a compliance certifier authorised by WorkSafe for this activity
- the tank wagon is manufactured by an approved fabricator or the constructed tank wagon is issued with a pre-commissioning compliance certificate by a compliance certifier authorised by WorkSafe.

Compatibility

Tank wagons must be designed and constructed to meet the compatibility requirements in regulation 16.4

A relevant PCBU must also ensure that the tank, fittings and any part of the tank wagon that could, in the normal course of operation, come into contact with the substance being carried, are constructed with materials that are compatible with that substance.

If a tank is to be used to carry two or more hazardous substances that are not compatible with each other, the tank must be designed and constructed so that:

- different compartments are separated by a double-wall bulkhead
- each compartment of the tank has a separate filling and discharge system, and each compartment should be accessible through a manhole.

Each manhole must be fitted with a closure capable of passing the tank pressure test.

2.2 Markings

Tank wagons must be marked appropriately, in line with the requirements stated below.

1. A PCBU with management or control of a tank wagon must ensure the tank is marked on the rear and both sides with labels according to the placarding requirements of the Land Transport Rule: Dangerous Goods 2005 and subsequent amendments.
2. In accordance with regulation 16.5 a PCBU with management or control of a tank wagon must ensure that a marking is permanently attached to each tank or tank sub-frame that specifies:
    a. the design compliance certificate number issued by a compliance certifier authorised by WorkSafe for this activity
    b. the recommended operating pressure for each part of the tank and fittings that are intended to operate at different pressures
    c. the maximum filling level of each tank compartment
    d. the maximum density of any liquids to be carried in the tank
    e. the materials used to construct the tank
    f. the date of manufacture of the tank
    g. the manufacturer of the tank
    h. the design record number issued by WorkSafe (or LAB number issued by the Department of Labour if the tank wagon was constructed prior to 1 April 2004).

This marking should be fixed in a place readily accessible for inspection, on the true left hand side near the front of the tank. The information should be stamped, embossed, or applied by suitable means, into the material of the plate in characters at least 5 mm high. The plate should not be painted and the marking should not become obscured. The tank serial number is also to be stamped on a substantial part of the tank structure.

3. Separately from the above, the following are also to be permanently attached:
   a. the name and contact details of the compliance certifier who certified the last in-service compliance certificate for the tank wagon should be permanently attached to each tank or sub-frame. This can be a plate or label
   b. the design record number in letters and numerals 75 mm high, preferably on the front right hand side of the tank
   c. a label of the hazardous substance carried in each compartment. This can be achieved by fitting each compartment outlet with a tumbler incorporating the different hazardous substances carried in that compartment, and
   d. if different hazardous substances are carried in each tank compartment, markings that identify:
      - the hazardous substance contained in each tank compartment
      - the hazardous properties of each substance in each compartment, and
      - the tank filling and connection system to be used if more than one option is available.
4. Subsequent to a pre-commissioning certification, the name and contact details of the compliance certifier who undertook the certification must be attached. This can be a plate or label.

2.3 Electrical wiring

A PCBU with management or control of a tank wagon must ensure that the risk of possible ignition is minimised in accordance with regulation 16.17

To meet this regulatory requirement, large tank wagons must comply with the following regulations:

- Regulation 10.6: Hazardous areas.
- Regulation 10.8: Reducing likelihood of ignition.
- Regulation 10.11: Circumstances involving control of ignition sources.

Delineation of hazardous areas

Hazardous areas are deemed to exist during hazardous substance transfer and for five minutes after.

The hazardous area must be determined according to the area classifications of AS/NZS 60079.10.1:2009 or a relevant safe work instrument that specifies hazardous areas and takes into account the risk of the presence of flammable materials.

> In circumstances where tank wagons are to be used for top loading, particular consideration is required to be given to establish the hazardous areas.

Note: Isolation of the vehicle in accordance with a battery master switch as described below in **Wiring requirements** is deemed to meet the hazardous area requirements.

Wiring requirements

This section sets out suitable electrical wiring requirements for all tank wagons:

a. The nominal voltage should not exceed 48 volts.

b. The electrical wiring is suitable for the electrical load.

c. The conductors are large enough to avoid overheating and the conductors are insulated.

d. All circuits are protected by fuses or automatic circuit breakers, except for:
   - from the battery to the cold start and stopping systems of the engine
   - from the battery to the alternator
   - from the alternator to the fuse or circuit breaker box
   - from the battery to the starter motor
   - from the battery to the power control housing of the endurance braking system (if fitted), if this system is electrical or electromagnetic
   - from the battery to the electrical lifting mechanism for lifting the bogie axle.

e. The electrical installation beyond the rear of the driver's cab is designed, constructed and protected so that:
   - it cannot cause any ignition or short-circuit under normal conditions of use of the vehicle and
   - these risks are minimised in the event of an impact or deformation.

f. The battery is:
   - secured in front of the fire-resistant shield specified in Section 3.6 – Fire-resistant shields
   - carried in a metal box, or
   - secured in a metal frame as close to the cab as possible.

g. The battery terminals are prevented from accidental shorting by an effective acid-resisting insulation cover, held securely in place.

h. The generator/alternator, switches and fuses are carried in front of the fire-resistant shield. Other electrical components may be fitted outside the cab provided the components are rated for the hazardous area they operate in.

   There may be other equipment necessary for the control/propulsion of the vehicle other than that used for the delivery of the substance and which may not be suitable for the hazardous area they operate in. This equipment is acceptable provided it is isolated by the battery master switch when the hazardous areas are present.

i. A battery master switch is provided to enable a means of isolating the electrical supply, for example by means of a double pole switch. The battery master switch is to be provided in a readily accessible position as close to the battery as is practicable. It should be adjacent to the battery and preferably no further than 600 mm from it and should be clearly labelled as to its position. If a single pole switch is used it is to be placed in the supply lead and not in the earth lead.

   The battery master switch is:
   - able to be manually operated externally and also be able to be deactivated from inside the vehicle cab in a position readily accessible to the driver
   - distinctively marked and protected against inadvertent operation by the driver
   - suitable for use in the hazardous area which it is required to operate in for example:
     - be EEx or suitable equivalent, and
     - have a temperature rating T4, T5 or T6

- suitable for equipment group II B or II C
- suitable for the environment that it is required to operate in (ie it will have a casing with protection degree IP65). The cable connections to the switch will also be suitable for the operating environment. It is recommended that they have a protection degree IP54. However, if they are contained in a housing (which may be the battery box) or switches with protection degree IP54 are not available, it is sufficient to protect their connections against short circuits (eg with a secure rubber cap).

The electrical supply may be maintained to certain vehicle accessories (eg operation recorder, computer, radios, clocks,) which cannot be shut off, provided the instrumentation is within the cab and each device is protected by a circuit breaker or fuse. Other electrical components may be fitted outside the cab provided the components are rated for the hazardous area they may operate in.

j. The original wiring installed at the time of manufacture of a cab and chassis is in sound condition and prevents the ingress of vapours, thus removing the potential for them to be a source of ignition. This does not obviate the requirement for the original equipment manufacturer's wiring that is in a hazardous area classified as Zone 1 to meet the requirements of that zonal classification (as qualified by the Notes in para (k)).

k. Electrical wiring added to the original vehicle wiring is insulated from the chassis. The wiring is supported and protected from mechanical damage, chafing and exposure to contact with oil, grease, or petroleum substances, and located so as to avoid damage to insulation from heat. Wiring outside and to the rear of the cab or on a trailer is to be carried in conduit or be double sheathed cable.

l. Junction boxes are to be at least IP65 rated.

m. Any electrical equipment that may be required to be active during hazardous substance transfer and that is located within a hazardous area must be suitable for such an area.

2.4 Trailers

No person should attach a trailer which is not used or is not intended to be used exclusively for transporting substances with a class 3.1 hazard classification to a tank wagon that is, or has been, transporting hazardous substances with a 3.1A or 3.1B hazard classification.

2.5 Illumination

A PCBU with management or control of a tank wagon should ensure that at least one certified flame-proof battery-operated torch is carried in the cab.

2.6 International designs

A relevant PCBU must ensure that:

- if the use of a tank wagon designed and built overseas is contemplated, or
- if the building of a tank wagon in New Zealand to an overseas design is contemplated

details of the proposed design are submitted to a compliance certifier for tank wagon designs, authorised by WorkSafe, to obtain a design compliance certificate.

3.0 Design, construction and installation requirements for large tank wagons

IN THIS SECTION:

3.1 Ability to withstand stress of load, corrosion resistance and tank impact resistance

Large tank wagons must be designed and constructed so that they meet the stress, corrosion resistance and impact resistance requirements in regulations 16.7, 16.10 and 16.11

The following subsections describe how these requirements may be met.

Materials

ALUMINIUM ALLOYS

Thicknesses specified for aluminium alloy sheet are based on aluminium alloy 5454 in the H32 temper condition. This has a tensile strength of 248 MPa unwelded, and a welded tensile strength of 213 MPa. If other alloys with lower welded tensile strength are used, the temper is to be at least H32 or T6 and the shell thickness is to be increased in the ratio 213/welded tensile strength of the alloy used. If the alloys used have a higher welded tensile strength than that of alloy 5454, the thickness may not be decreased, but tempers may be lower than H32, provided that the tensile strength is at least 248 MPa.

Aluminium alloys used in the construction of tanks are not less than the grades specified in the following appropriate Standards (or equivalent):

- AS 1874-2000 Aluminium and aluminium alloys – Ingots and castings.
- AS/NZS 1734:1997 Aluminium and aluminium alloys – Flat sheets, coiled sheet and plate.
- AS/NZS 1866:1997 Aluminium and aluminium alloys – Extruded rod, bar, solid and hollow shapes.

STEEL

Steel is of a quality suitable for the conditions of use and complies with the requirements of the following Standards (or equivalent), as appropriate:

- AS/NZS 4673:2001 Cold-formed stainless steel structures
- AS/NZS 1594: 2002 Hot-rolled steel flat products
- AS/NZS 3679.1: 2016 Structural steel – Part 1: Hot-rolled bars and sections
- AS/NZS 3679.2: 2016 Structural Steel – Part 2: Welded I sections
- AS/NZS 1163: 2016 Cold-formed structural steel hollow sections
- AS/NZS 3678: 2016 Structural steel – Hot-rolled plates, floorplates and slabs.

Tank design and construction

DESIGN ACTIONS

a. The tank and its attachments (not the mountings) are designed to withstand a minimum design action of twice that due to the tank and maximum cargo when upright, inverted or rotated about the longitudinal axis and resting on either side. The density of the cargo or a value of 1,000 kg/m^3, whichever is the greater, is to be used for calculations. The tank must not have any visible leak when in the upright position or must not leak at a rate of more than 0.3 L per day when inverted or rotated 90°. Regulation 16.7

b. The tank, its supports and connections are designed in accordance with:
   - AS/NZS 1664.1:1997 Aluminium structures – Limit state design, or
   - AS/NZS 1664.2:1997 Aluminium structures – Allowable stress design, or
   - AS 3990:1993 - Mechanical equipment – Steelwork, or
   - NZS 3404: Part 1:1997 Steel Structures Standard.

   taking into account the loadings specified in this code.

The applicability of each of these standards is limited to the tank wagon parts that the standard relates to. The parts of the tank wagon that are designed by reference to Table 2 are excluded from the provisions of these standards. Where applicable a vector sum of these loads is to be taken.

c. Stresses due to internal pressures caused by liquid head, plus vapour pressures of 20 kPa, are to be added to the static loading stresses.

d. Loadings caused by the weight of equipment, the reaction at supports and thermal gradients are to be taken into account.

MATERIAL THICKNESS

The thickness of the shell, heads, bulkheads and baffles must be at least more than that specified in Table 2. However, the thicknesses for heads and bulkheads for large compartment tanks may be reduced to not less than the shell thickness, provided that there is a calculation undertaken for head thickness in accordance with AS 1210-2010 and this calculation indicates that it is safe to reduce the thickness.

STIFFENING OF HEADS, BULKHEADS AND BAFFLES

Unless a proven equivalent form of stiffening is provided, the heads, bulkheads and baffles are dished 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, but in any case not less than 100 mm. Dished bulkheads are to be placed with the convex facing forwards, to minimise the effect of braking loads.

CIRCUMFERENTIAL REINFORCEMENT

The tank is reinforced circumferentially by stiffeners, bulkheads or baffles (or in any combination) according to the following requirements:

a. Reinforcements are located so that the maximum unreinforced length does not exceed that specified for the particular shell thickness in Table 2. The exception is where two or more full-length underframe members of an aggregate section modulus of at least 180 x 103 mm^3 about a horizontal axis and a shell thickness of at least that for an unreinforced length over 1.4 m and up to and including 1.5 m of Table 2 are provided. Reinforcements may be up to 2.5 m apart (or an equivalent design that meets all the design loads set out above in Design Actions).

   The section modulus of underframe members does not include any section of the shell and is calculated using the maximum distance from the neutral axis. If the tank is fully supported over its entire length (eg by a vehicle or trailer chassis) the minimum section modulus does not apply.

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

c. Ring stiffeners are 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 formula:

I/C = K * W * L

where:

I/C	section modulus, in cubic millimetres
K	0.0069 for all steels or 0.01186 for all aluminium alloys
W	Tank width or diameter, in millimetres
L	Ring spacing (ie 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 paragraph d below, the maximum portion of the shell which may be used as part of the ring for computing the section modulus is as described in Table 1.

d. The welding that attaches stiffening members is not to be less than 50% of the total circumference and no unwelded length of the joint is to exceed 40 times the shell thickness.

NUMBER OF CIRCUMFERENTIAL RING STIFFENERS TO TANK SHELL WELDS	DISTANCE BETWEEN PARALLEL CIRCUMFERENTIAL RING STIFFENER TO SHELL WELDS	MAXIMUM SHELL SECTION CREDIT
1	–	20t
2	Less than 20t	d + 20t
2	20t or more	40t

t = shell thickness d = distance between parallel circumferential ring stiffener to shell weld

TABLE 1: Parts of shell in ring stiffener

TANK DETAILS		Minimum Nominal Thickness (mm) for non-circular tanks												
Rated capacity per metre of tank length (L/m)	Maximum shell radius (m)	Unreinforced length of shell (m) for small compartments									Bulkhead and baffle thickness (mm)		Head thickness (mm)	
		0.9 or less			Over 0.9 and up to and including 1.4			Over 1.4 and up to and including 1.5						
		MS	HSLA SS	AL	MS	HSLA SS	AL	MS	HSLA SS	AL	MS HSLA SS	AL	MS HSLA SS	AL
1400 or less L/m	≤1.8	2.0	1.6	2.2	2.0	1.6	2.2	2.0	1.8	2.4	2.0	4.0	2.5	4.4
	>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				
Over 1400 up to and including 2100 L/m	≤1.8	2.0	1.6	2.2	2.0	1.8	2.4	2.4	2.0	2.8	2.5	4.4	3.0	5.0
	>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				
Over 2100 up to and including 2700 L/m	≤1.8	2.0	1.8	2.4	2.4	2.0	2.8	2.8	2.4	3.0	3.0	5.0	3.0	5.5
	>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	3.2	4.4				
	>3.2	3.0	2.8	3.8	3.5	3.0	4.4	4.0	3.5	5.0				
Over 2700 L/m	≤1.8	2.4	2.0	2.8	2.8	2.4	3.0	3.0	2.8	3.8	3.2	5.5	3.0	6.0
	>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				

MS = Mild Steel HSLA = High Strength Low Alloy Steel SS = Austenitic Stainless Steel AL = Aluminium Alloy

TABLE 2: Minimum plate thickness

FLAT SHELL SECTIONS

e. Flat shell sections are allowed between the valences at the top of the tank only under the following conditions:
   - Stiffeners of the same material as the shell are welded across the tank for the full width of the flat section. The recommended size is 75 mm deep by 5 mm thick and spaced such that unsupported shell length does not exceed 700 mm. In this case this section of the shell will not be considered in minimum shell thickness determination.
   - With no stiffeners the shell is considered as having infinite radius at that section for minimum thickness determination (ie shell radius > 3.2 m).
   - It is shown that the flat section has stiffness equal to a stiffened plate or curved plate (equivalent radius).

ACCESS THROUGH BAFFLES

f. A baffle has a manhole sized opening where no other means exists for gaining access to tank space on both sides of the baffle.

DISTRIBUTION OF LOADS

g. The loads from supports are to be taken on stiffening members and are to be distributed as widely as possible through pads, gussets and the like.

SEPARATION OF LIQUIDS

h. Internal bulkheads are welded from both sides to minimise fatigue damage as well as increase bending strength in an accident.

i Internal bulkheads of dished and flanged type may be welded on one side at the toe of the flange.

j. Sealing rings are acceptable only where it is impractical to weld the bulkhead to the outer shell.

ENCLOSED AIR SPACES

k. The air spaces between double bulkheads, or internal or external ring stiffeners, are provided with screwed openings for venting and draining. Any such openings on the upper surface of the tank are to be plugged.

COMPONENT ATTACHMENT

l. Auxiliary components and accessories are attached to the roll-over coaming, sub-frame or skirting wherever practicable. Where attachment to the tank shell is unavoidable, the following requirements apply:
   - The design of the component and/or its method of attachment is such that the component will break away before damage is caused to the shell.
   - The attachment is to a mounting pad welded to the tank.
   - A mounting pad is no thicker than the shell at that point, and extends at least 25 mm beyond the perimeter of the component attachment, and is shaped to avoid concentrations at sharp corners.
   - The means of attachment needs to avoid pockets which could initiate corrosion. The welding of the pad to the tank needs to be continuous unless a gap for drainage is provided at the bottom. A tell-tale, which is plugged, needs to be provided where such a drainage gap is not provided.

Note: For light boxes (ie boxes used for affixing lights) mounted on the rear tank bulkhead, the breakaway requirement does not apply.

ROLL-OVER PROTECTION

Every tank is provided with roll-over protection, which complies with the following requirements:

a. A guard in the form of inverted U coamings, the space between which is closed by valances level with the top of the coamings at the front, and at least 50 mm high at the rear.

b. Any guard projects at least 20 mm above the top of the fittings which it protects.

c. The material of the guard is compatible with the tank shell.

d. The thickness of the material of the U coamings and valences is not less than 5 mm for aluminium, 3 mm for mild steel, 2.5 mm for high strength low alloy steel or stainless steel.

e. Any air space enclosed inside a coaming or guard has openings to permit draining and purging before repair. When the enclosed space is used to transfer vapour, the openings are plugged.

f. The tank coaming is fitted with drains to prevent liquid from collecting on top of the tank. Drains discharge clear of, and below, the engine and exhaust system.

WELDING

All welding of components for structural or pressure purposes in building any new, or in modifying any existing vehicle for use as a tank wagon, is carried out in accordance with recognised good practice including:

a. Welding of steel is in accordance with AS/NZS 1554 Structural Steel Welding parts 1, 4 and 5 (or equivalent) as appropriate. This includes all requirements for qualification of welding personnel.

b. All welding of aluminium components complies with AS/NZ 1665 Welding of aluminium structures (or equivalent). This includes all requirements for qualification of welding personnel.

c. Fusion welding of steels is carried out by welders qualified in accordance with AS/NZS 2980.

d. Inspection of the welding is carried out in accordance with the welding specification (AS/NZS 1554 or AS/NZS 1665 as relevant) including:
   - verification of material
   - verification of filler material
   - qualification of welding procedures
   - qualification of welders to the above procedures
   - inspection of production welds, including a minimum of 5% x-ray.

e. Review of the x-rays required by item d. above, is carried out by qualified personnel. In particular, the personnel should hold recognisable qualifications in the appropriate area and have a testing laboratory registration under International Accreditation New Zealand (IANZ), or equivalent. New aluminium tank wagons are inspected to weld quality class B.

f. As part of the approval of each unit, certification that this testing has been carried out and passed is to be made available to a compliance certifier authorised by WorkSafe.
   - The documents from the above inspections are to be available to the compliance certifier and to WorkSafe inspectors at any time.
   - An independent inspector or inspection agency may be required, at the cost of the PCBU with management or control of the tank, to check the welding or construction if the compliance certifier considers that some aspects do not conform to the requirements of the Regulations.

3.2 Pressure resistance

Large tank wagons must be designed and constructed so that they meet the pressure resistance requirements in regulation 16.8

The following subsections describe how these requirements may be met.

Vents

Each tank compartment is provided with normal venting and emergency venting to relieve vapour to avoid the build-up of excessive pressure. The vents must be suitable for the substance being carried. The vents and their installation need to comply with the following requirements:

a. Each vent is marked with the manufacturer's name, model identification, discharge capacity and related pressure.
b. The discharge capacity of each model and type of vent is determined before use.
c. Vents are designed and installed to prevent leakage of liquid past the vent in the event of surge or vehicle roll-over.
d. The exit of a vent except an emergency vent is covered with wire gauze of 500 micro-metres nominal aperture.
e. Each vent communicates with the vapour space.
f. Shut-off valves are not installed between the tank opening and the vent.
g. Vents are mounted, shielded, or drained, so as to prevent the accumulation of water and to thereby ensure that freezing will not impair the operation of the vent.

Normal venting

Normal venting includes the provision of a pressure vent and a vacuum vent in accordance with the following requirements:

a. The clear area through any pressure or vacuum vent should not be less than 280 mm^2. The pressure opening setting does not exceed 17 kPa and the vacuum vent opening setting does not exceed a vacuum of 3 kPa (ie – 3kPa pressure).
b. If a bypass or pilot bleed device is incorporated in the vent, the clear area through the most restricted portion shall not exceed 15 mm^2.
c. When tilted to any angle exceeding 90° from the vertical, the pressure vent opens at a minimum of 30 kPa or will lock shut (including any bypass or pilot bleed device).

Emergency venting

Emergency venting for protection against fire exposure may be incorporated into the vent valve and is to comprise a pressure vent with the following features:

a. The emergency vent commences to open at a pressure no higher than 30 kPa and is to be fully open at no higher than 45 kPa.
b. The total emergency venting capacity of each tank compartment is not less than that specified in Table 3. Flow rating pressure is to be the 'vent fully open' value of 45 kPa.
c. The capacity of the vents when fully open (ie at a pressure of 45 kPa) may be used when determining what vents to use.

EXPOSED AREA OF TANK COMPARTMENT (m^2)	MINIMUM EMERGENCY VENT CAPACITY (m^3 free air/h)	EXPOSED AREA OF TANK COMPARTMENT (m^2)	MINIMUM EMERGENCY VENT CAPACITY (m^3 free air/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

TABLE 3:
Minimum emergency vent capacity

Notes:

1. Free air measured under IGU standard conditions.
2. The requirements for intermediate sizes can be determined by interpolation.

LOADING AND UNLOADING PROTECTION

Unless provision is made to fill through the hatch, provision is to be made to enable each tank compartment to be loaded or unloaded with the hatch cover closed by providing sufficient liquid-venting capacity to discharge the whole of the liquid delivery rate of the pump, and sufficient air inflow capacity to match the liquid withdrawal rate.

The pressure limit of 45 kPa and the vacuum limit of 7 kPa (ie -7 kPa pressure) are not to be exceeded.

3.3 Fatigue resistance

Large tank wagons must be designed and constructed so that they meet the fatigue resistance requirements in regulation 16.9

The tank must be designed and constructed so it is able to withstand fatigue stresses from movement while in transit produced by 5 million cycles at the following amplitudes:

- vertical 0.6 g x M
- longitudinal 0.4 g x M
- lateral 0.4 g x M.

Explanation: This provides an oscillating vertical load case of ±0.6 g x M about an all up vertical load case.

The calculation must be applied to all load cases including:

- at the maximum load configuration, in which case M is the sum of the mass of the empty tank (including the fittings but excluding the chassis) plus the mass of the contents (assuming the tank is 100% full using the density of the contents or a density of 1,000 kg/m^3, whichever is the greater)
- at the minimum load configuration, in which case M is the mass of the empty tank (including the fittings but excluding the chassis) only
- in the load configuration of some full compartments and some empty compartments, in which case M is the sum of the mass of the empty tank plus the mass of the contents (assuming the tank is partially full using the density of the contents or a density of 1,000 kg/m, whichever is the greater).

As an alternative to calculation, fatigue resistance may be demonstrated by field experience or supervised tests.

3.4 Fittings

Fittings impact resistance

The fittings on a tank positioned below the upper liquid level of a full tank are designed, constructed, and installed to ensure that if the fittings are damaged or broken off there is no visible leakage of the liquid from the tank in accordance with regulation 16.12

Handrails

A relevant PCBU needs to ensure that, where handrails are fitted to a tank wagon, the attachment to the tank complies with Section 3.1 – Tank design and construction – Component Attachment and the design minimises puncturing of the tank in the event of roll-over.

3.5 Maximum compartment size

In accordance with regulation 16.13 a relevant PCBU must ensure that all tank wagons, apart from aircraft refuelling units, do not have compartments with a liquid carrying capacity greater than 10,000 L (ie they must not have a total volumetric capacity greater than 10,500 L when the allowance for ullage is included).

The ullage space of each compartment of the tank wagon needs to have:

- a minimum ullage of 2%, and
- a maximum ullage of 5% or 350 L (whichever is greater).

Note: Petroleum supply companies in New Zealand have minimum ullage requirements that are required to be met if the vehicle is to have a Safe Load Pass.

The tank is to be made in accordance with best known and available practices in addition to the other applicable tank specification requirements.

3.6 Emergency preparedness

In accordance with the requirements of regulation 16.14 a relevant PCBU must ensure that:

- the tank wagon is designed, constructed, and operated so that if a fire occurs in the load tank the driver of the tank wagon is protected for at least 1 minute.
- the means of motive power or propulsion of the tank wagon is designed and constructed so that, if a fire occurs, the driver of the tank wagon is protected for at least 1 minute.

– in addition to the normal means of tank closure, the tank wagon also has an automatic heat-activated closing device installed, which closes at a temperature of not more than 80% of the auto-ignition temperature of the liquid at the tank outlets, for every valve that is used for transferring liquids from the tank.

The following subsections describe how these requirements may be met.

Fire-resistant shields

The person in the driver's cab must be protected for one minute from the heat of a fire in the load tank or in the means of propulsion of the tank wagon. The person operating the tank wagon must not be subjected to a level of heat that exceeds 2.56 kW/m^2.

Fibreglass cabs are not considered to provide this level of protection unless it can be demonstrated that the requirement is complied with.

Steel and aluminium cabs are deemed to comply with this requirement.

SPARK-IGNITION ENGINES

The engine is screened from the load tank by a fire-resistant shield carried down to at least the bottom of the load tank or chassis, whichever is lower and up to at least the top of the tank. If the roof of the cab is made out of fire-resisting materials and without opening, the fire-resistant shield needs to only reach the top of the cab. The resistant shield may be the rear wall of the cab.

COMPRESSION-IGNITION ENGINES

Where the engine is not fully covered by the cab, and the cab rear wall is the fire-resistant shield, the engine is protected from vertical spillage from the load tank by a fire-resisting shield situated not less than 50 mm from the engine. This must be in place at all times during operation.

Cab rear windows

The windows fitted in the rear wall of the cab are securely clipped with substantial stainless steel clips and fixings at 300 mm centres or fitted with fire-resisting framing. The window clips are to be fixed in such a way that the window remains in place in the event of a fire. The windows, if plain glass, are to be replaced with wired glass or other recognised type of heat resisting material, and are not to be capable of being opened. Curved corner windows in vehicle cabs further than 2 m from the load tank are not considered as being in the rear wall of the cab.

Vents

The roof vents and rear cab air discharge vents, if capable of being opened, are fitted with 500 micro-metres nominal aperture gauzes or sealed closed. Where vents are installed in the fire-resistant shield that forms part of the rear of the cab and the vents may be compromised by the action of a fire, they are, in addition to having a 500 micro-metre gauze fitted, to be shielded against the action of fire or vented to the side of the vehicle.

Vehicle roll-over

If the tank wagon is designed to convey hazardous substances of classes 3.1A, 3.1B or 3.1C with a capacity greater than 10,000 L, a cut-out device should be fitted so, that in the event of a roll-over, the engine and all power sources are shut down. The device is to activate the battery isolation switch and is to be able to be tested without rolling the vehicle. The device should trigger when the vertical angle of the tank wagon exceeds 45 degrees to the vertical.

This requirement is restricted to tank wagons with power sources; it is not a requirement of a tank trailer.

Valves

An internal valve complying with Section 3.7 – Valves below is to be installed.

3.7 Loss minimisation while transferring liquids

In accordance with the requirements of regulation 16.15 a relevant PCBU must ensure that:

- the tank is designed and constructed with at least two independently operating means, of shutting off the flow of a liquid or a gas during a transfer of the liquid from the tank
- the means of shutting off the flow of the liquid can:
  - be activated by the person transferring the liquid or gas from the tank within 10 seconds, and
  - shut off the flow of the liquid or gas within 3 seconds of the means being activated
- at least 1 means of shutting off the flow of a liquid must shut off the flow at the tank wall and at least 1 other means must shut off the flow at the delivery connection
- if a pump is installed as part of the tank wagon equipment for the transfer of the liquid from the tank, an additional means of shutting off the pump is designed, constructed, and installed so that it can be activated within 5 seconds by the person transferring the liquid.

The following subsections show how these requirements may be met.

Valves

Each liquid discharge opening is provided with an internal shut-off valve and an external shut-off valve, suitable for service at the piping design pressure.

The internal shut-off valve complies with the following requirements:

a. The valve seat is located inside the tank or within the tank flange or its companion flange. 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 safe functioning of the internal valve is not impaired.

b. An internal shut-off valve which is bottom-operated incorporates, in addition to the normal means of closure, an automatic heat-actuated closing device. This closing device becomes effective at a temperature not more than 80% of the auto-ignition temperature of the liquid being carried to respond to a fire in the vicinity of the tank outlets. Nylon or plastic pneumatic line to the internal shut-off valve is deemed to meet this requirement.

c. A tank designed for bottom loading incorporates a downward direction liquid flow deflector above the internal shut-off valve. Any such protective device is designed to avoid the spraying of liquid during filling.

d. The valve needs to be capable of being manually closed from a position remote from the delivery hose connection.

The external shut-off valve is a quick-shut type suitable for the hazardous substances and pressures involved. It is mounted in a readily accessible position. The valve or pipe outlet is fitted with a cap. In all cases, external delivery pipes and valves are protected from damage.

Drive away protection

The PCBU must ensure the tank wagon does not move when the transfer of hazardous substances is taking place.

External immobilisation devices, including devices such as wheel chocks, are not to be the primary means of immobilisation.

A tank wagon:

1. designed to convey hazardous substances of classes 3.1A, 3.1B or 3.1C
2. designed with an aggregate capacity greater than 10,000 L, and
3. designed to load at a gantry or discharge in bulk (ie with a hose connected between the tank wagon and the receiving tank)

should be fitted with a means of immobilisation. This must be constructed and installed so that it cannot operate while the road vehicle is being normally driven.

Overfill protection

Tank wagons are to be equipped with overfill protection. For those tank wagons that load at the gantries of the major oil companies, industry compatible overfill protection is required to be fitted.

Those vehicles fitted with overfill protection should have the system interconnected with the vents of the tanks to ensure that the vents are open, thereby preventing the tank from becoming over pressurised during the filling operation.

Location of controls

Power driven pumps need to be provided with controls which comply with the following requirements:

a. Controls that are clearly marked, easily accessible, and located in a position remote from the pump.

b. An emergency stop for the engine or motor provided with dual controls, operable from inside the cab and at a point remote from the cab. All such devices are clearly identified and easily accessible. The emergency stop shuts off the fuel to the engine. This must be able to be activated within 5 seconds by the person transferring the liquid or gas and is able to shut off the pump within 3 seconds.

An electrical master switch is one way of meeting this requirement, provided it shuts off the fuel supply to the engine.

3.8 Attachment of tank to chassis

In accordance with the requirements of regulation 16.16 a relevant PCBU must ensure that a tank is designed and constructed so that the attachment of the tank to the chassis of the tank wagon is able to resist the following forces:

Vertically up	1 g x M
Vertically down	2 g x M
Lateral	1 g x M
Longitudinal	2 g x M

Where:

g = acceleration constant due to gravity (9.81 m/s^2)

M = weight of tank, contents, and fittings (but excluding chassis).

- The mass of the cargo is calculated from its density and volume. The density is taken as the density of the cargo or 1,000 kg/m^3, whichever is the greater.
- A limit state or allowable stress method of design must be used.

This section shows how these requirements may be met.

A relevant PCBU ensures that the tank is designed and constructed so that:

a. a clearance of not less than 100 mm is provided between the back of the cab and the tank. Any fittings carried in this space will not compromise the integrity of the load tank. For articulated vehicles, the clearance is to be achieved at all angular positions.

b. fatigue of the tank wagon chassis mountings is included in the design of the tank wagon (ie by reducing areas of stress concentration) in accordance with the provisions of Section 10 of NZS 3404:1997 Part 1 or similar standard.

c. if mountings of tanks are provided by twist locks and the twist locks are used to provide vertical restraint, then they are selected to meet a vertically up strength requirement that is twice the strength requirement listed above. This rating of the twist lock is to be certificated. The twist locks are to be examined at 12 monthly intervals for mechanical defects and replaced if a defect is noted. The design number of twist locks must be in use.

d. the electrical resistance between the tank and the tractor chassis, prime mover chassis, or trailer under carriage and between the tank and connection of tank wagon pipe work to the delivery hose does not exceed 10 ohms. The resistance between all other conductive parts of the vehicle and the tank is not to exceed 1 Megohm.

3.9 Minimising risk of possible ignition

A PCBU with management or control of the tank wagon must ensure that the tank wagon complies with the requirements set out in regulations 10.6, 10.8 and 10.11

As required by regulation 16.17 the PCBU must ensure that the electrical resistance between the tank of the tank wagon and any equipment or part of equipment permanently attached to any part of that tank wagon, including the chassis, does not exceed 10 Ω.

The following subsections describe how these requirements may be met.

Exhaust and intake

For spark-ignition engines, the exhaust discharges horizontally in front of the front wheels.

For compression-ignition engines, the exhaust is to discharge horizontally in front of the front wheels or vertically behind the cab. If the exhaust is located vertically behind the cab then:

- if it is closer than 800 mm horizontally to the load tank, it is to be shielded to prevent spillage onto the exhaust system. The shield is to be at least 50 mm away from any hot part of the exhaust system and at least 75 mm away from the load tank
- any openings or perforations for ventilation are to be located on the side remote from the load tank
- if it is closer than 2 m to any opening to the load tank, it is to terminate at least 75 mm above the valance.

The exhaust system is free from leaks and be located so as to minimise the accumulation of oil or grease, and be designed so it inhibits the ejection of sparks.

If it is necessary for a section of the exhaust to run beneath a tank, that section of the exhaust must be shielded.

Note: Turbochargers under normal conditions are considered to inhibit sparks.

Air intakes behind the cab of compression-ignition engines terminate above the level of the cab. Air intakes in front of the cab are free in regards to position but no part of the opening are to be lower to the ground than 1.5 m. Tilt cab flexible couplings or boots are acceptable but where these are less than 1.5 m from the ground level they are to be sealed and clipped (or provided with an alternative mechanism that is at least equivalent). These flexible couplings or boots should be included in the three-monthly vehicle inspections as referenced in Appendix A.

In circumstances whereby the air intake is at the front of the cab and it is not possible to get access to the tilt cab flexible coupling or boot, an engine strangler is to be provided.

At least one means of bonding the load tank or vehicle to any container, to or from which transfer of liquid is made, is provided. It is to be located as far from flammable vapour emergence points as practicable, and in a convenient location for the operator. Additional bonding points are permissible.

For aircraft refuelling units only, the exhaust may discharge immediately behind the left front wheel provided the following requirements are met:

a. The refuelling unit has a compression-ignition engine.
b. The engine is equipped with a turbo and a catalytic converter in the exhaust.
c. The exhaust discharge is not in Zone 0 or Zone 1 hazardous area.
d. The left hand side of the vehicle is not the operational side of the vehicle.
e. The vehicle is not a twin steer vehicle.
f. The exhaust discharge is either clear of passenger entry/exits or precautions are taken to prevent persons from being harmed by the exhaust.
g. The exhaust discharge is angled downward from the horizontal.
h. The refuelling unit does not load at a gantry which also loads classes 3.1A or 3.1B in that bay of the gantry or adjacent bays.
i. The refuelling unit is limited to the conveyance of Jet A-1 (HSR001049) only.
j. The refuelling unit is domiciled at an airport for the refuelling of aircraft at that airport.

Repairs and servicing of tank wagons

A PCBU may service tank wagons that are gas-freed at any location or in any building, subject to Section 5.3.

A PCBU may take tank wagons that are not gas-freed into a building for repairs, vehicle inspection or servicing, including maintenance, but not hot work, provided that:

a. The tank wagon load tank does not vent inside the building. For non-emergencies the tank is to be drained and all valves and vents closed and sealed. For emergency repairs all valves and vents must be closed and sealed.
b. The tank wagon is not located where it can be subject to heating.
c. The room is well vented to the outside of the building.
d. Hazardous areas are delineated in accordance with the provisions of AS/NZS 60079.10.1:2009 and all electrical equipment is rated accordingly or disconnected.
e. All other sources of ignition are excluded to 8 m laterally from the tank wagon.
f. The building is constructed of fire-resisting materials or there is a sprinkler system installed.
g. For emergency repairs the driver or other responsible representative of the owner remains with the vehicle until the repair is completed.

A PCBU may service tank wagons outside a building provided that:

a. The tank is drained and valves closed or sealed.
b. No hot work is undertaken on the tank wagon.
c. Hazardous areas are delineated in accordance with the provisions of AS/NZS 60079.10.1.
d. There is no source of ignition within the delineated hazardous areas unless they comply with requirements for use in hazardous areas or are disconnected.

Hot work on tank wagons that have not been gas-freed (ie have been drained with valves closed and sealed) must only be undertaken when suitable processes are in place (eg a suitable hot work permit procedure).

Emergency repairs

A PCBU may carry out emergency repairs not involving the load tank in a building if:

- it is not practical to do work otherwise
- the vehicle remains in the building for the minimum period of time
- the vehicle does not remain in the building overnight
- the PCBU with management or control of the building is given written notice of the presence of liquids with class 3.1A, 3.1B, 3.1C or 3.1D hazard classification in the building
- the building is adequately ventilated.

Emergency repairs or operations (where the tank wagon cannot be moved) may be carried out at other locations provided no source of ignition is permitted within 8 m.

3.10 Pipework and pipe fittings

To meet the regulatory requirements, all pipework and pipe fittings are to be designed and constructed in accordance with the following requirements, as appropriate.

Strength of piping

The piping and associated fittings are designed for the pressure to which they may be subjected in-service, and are designed and supported to allow for expansion, contraction and vibration. Unrestrained slip joints are not to be used for this purpose.

Discharge piping

Discharge piping is to be located so that it is protected from damage that could occur in the normal operation of the tank wagon.

Hoses and hose couplings

Hoses are not to be used in the section of piping between the tank's internal valve and the first valve outside the tank (unless the tank wagon is an aircraft refuelling unit or a vehicle that is built to Appendix C).

Any hose or coupling used is designed for a working pressure not less than 20% in excess of the design pressure of the system and is designed so that there will be no leakage when connected.

Where unloading by pressure is permitted, hoses are designed to withstand a bursting pressure of 690 kPa, or two times the maximum pressure it could be subject to in use, whichever is the greater. The hoses are to be properly maintained and checked frequently.

Tank fill pipework

The pipework used for filling the tank is to be sized to avoid the generation of static electricity. Where the tank is bottom loaded and the fill rate at maximum flow is 2,500 L per minute, the diameter of the pipework used for filling the tank is not to be less than 100 mm diameter.

Pipes passing through the tank shell

Pipes passing through the tank shell are to be minimised. Such pipework is to be:

a. limited to pipes draining the valance, providing a conduit for wiring and vapour recovery

b. placed and designed in such a way as to minimise the risk of damage to the shell when external forces are applied to the pipe or shell. Pipes with an internal diameter exceeding 55 mm, with a length outside the shell of more than 50 mm at any place, are to be designed such that, in the event of accidental damage to the pipe outside the tank, the external section of the pipe breaks away without damaging the shell. The wall thickness of pipes is to be not less than the thickness shown in Table 4, or the thickness of the shell, whichever is the lower. Open pipes passing through the shell and that are not used for drainage are to extend outside the shell for a minimum length of 20 mm.

INTERNAL DIAMETER (mm)	MILD STEEL (mm)	AUSTENITIC STAINLESS STEEL (mm)	ALUMINIUM ALLOY (mm)
≤ 55	3.0	2.5	3.0
> 55	4.0	3.0	5.0

TABLE 4: Minimum thickness of pipes passing through the shell

The installation of the pipes is as follows:

a. The position of the pipe is determined to ensure minimal flexing of the pipe/tank barrel interface.

b. The pipe is restricted to being positioned immediately in front of or behind a bulkhead. It is to terminate as close as practical to the bulkhead and to terminate no greater than 500 mm from the bulkhead.

c. At the exit to the tank barrel floor the stress management is to preclude the possibility of any cracks (eg by the provision of an appropriate doubler).

d. Inside the barrel the pipe is to be provisioned with suitable bends so as to reduce the stiffness and allow the pipe to flex along with any flexing of the tank barrel.

e. The vent pipe is provided with a shear groove approximately 20 mm below the tank barrel skin.

3.11 Pumps

To meet the regulatory requirements, all pumps should be designed and constructed in accordance with the following requirements, as appropriate.

Suitability

A pump intended for handling the tank wagon's cargo must be suitable for use with that cargo, and for the required flow rates and pressures.

Pressure regulation

A pumping system is provided with automatic means to ensure that the design pressure of any component is not exceeded.

Electric pump motors

An electric motor driving a pump must be certified suitable for use in Class 1, Zone 1, hazardous areas.

Engine driven pumps

A spark-ignition engine must not be used for pumping. Auxiliary engine powered pumps must not be used unless full compliance with Section 3.9 – Exhaust and intake above can be met. Any such engine is not to be fitted with any electrical equipment. A compression-ignition propulsion engine of the tank wagon may be used to drive a pump.

Shielding of pump shaft

The pump shaft between the pump and the engine is shielded to prevent leakage from the pump seal from dripping or being thrown onto hot parts of the engine. Materials used in the shielding are of a type that will not create sparks when struck.

3.12 Filling tank wagons

A worker must ensure that a tank or a tank compartment is not filled to a level beyond the maximum filling level as prescribed in regulation 16.39

The provisions for filling the tank should comply with the following requirements:

a. The fill tube of a top-filled tank is to terminate not more than 50 mm or less than 35 mm from the bottom of the tank, and is stayed.

b. The fill tube is to 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 which is fitted with gauze as required by Section 3.2 – Vents d. above.

c. The vent is to be shrouded to redirect liquid down the fill pipe.

d. The bottom end of the tube is to be cut square and the flow of liquid from the pipe is to be directed away from any objects which might cause the liquid to spray.

Liquid level indicating system

A liquid level indicating system should be installed.

Where the liquid level indicating system is provided by a dip stick, the system is to include the following:

a. A graduated non-ferrous dip stick which measures by contacting the bottom of the tank and which is provided with a tubular dip tube. The dip tube is to terminate not more than 50 mm from the bottom of the tank and is to be stayed.

b. A pressure equalizing hole that connects the upper end of the dip tube with the upper tank space. The hole is to be covered by an anti-flash gauze of 500 micro-metres nominal aperture.

c. Unless the dip stick is top hung, a durable striker pad of a thickness not less than that of the tank shell or 5 mm, whichever is the greater, and of the same material as the shell is welded to the tank bottom below the dip opening.

d. An electronic level monitoring gauge, suitably rated for the hazardous area it is operating in, may be fitted in lieu of a conventional dipstick providing this meets the relevant New Zealand Trade Measurement and electrical requirements.

4.0 Requirements for large tank wagons

IN THIS SECTION:

4.1 Fuel tanks

As required by regulation 16.19 a relevant PCBU must ensure that the fuel system and fuel tank of the tank wagon are designed, constructed, and installed so that fuel is not lost at the rate of more than 0.003 L per minute when:

- the fuel system or fuel tank is exposed to heat radiation of 10 kW/m^2 for at least 1 minute, or
- the tank wagon rolls over.

This section sets out a means of meeting this requirement.

The fuel tank of the vehicle is located so as to minimise mechanical damage and the spread of fire. All piping is to enter through the top of the tank. In the case of vehicles fitted with dual fuel tanks, the manufacturer's interconnecting piping will be acceptable.

If mounted in a vulnerable position, the fuel tank is protected from mechanical damage. If the tank is constructed of aluminium with shell thickness less than 5 mm thick or constructed of steel with shell thickness less than 3 mm thick, then a guard is fitted unless the tank has an equivalent level of protection as specified in Appendix G of this ACOP. The guard takes the form of a metal plate of above minimum thicknesses covering vulnerable surfaces of the tank. The protection provided to the fuel tank is attached securely to the vehicle (and not the fuel tank) unless it is not practicable to do so.

The tank must have its filling hole fitted with a secure closure and not leak.

For spark-ignition engines, a clearly indicated and readily accessible means of cutting off the fuel supply to the engine is fitted where the fuel is supplied to the engine by gravity.

4.2 Stability and manoeuvrability

As required by regulation 16.20 a relevant PCBU must ensure that the tank wagon is designed and constructed so that when the tank is full it will not roll over when subjected to any of the following:

- a static roll threshold of at least 0.45 g
- a maximum dynamic load transfer ratio of 0.6
- a high speed transient off-tracking of 0.8 m.

For these purposes:

- Static roll threshold means the maximum level of steady turning lateral acceleration a vehicle can tolerate without roll-over, which is calculated as a proportion of g.
- Dynamic load transfer ratio means the ratio calculated by simulating the vehicle combination in a lane-changing manoeuvre in accordance with the process set out in the 3 seconds and 90 km/h option provided in SAE J2179:2000-09.
- High speed transient off-tracking means the maximum lateral offset of the rear axis path (usually the trailer) with respect to the path of the steer axle determined during the lane change manoeuvre set out in SAE J2179:2000-09 (3 seconds and 90 km/h option).
- SAE J2179:2000-09 means the Society of Automotive Engineers standard SAE J2179 on A Test Evaluating the Rearward Amplification of Multi-Articulated Vehicles, issued in September 1993.
- g means the gravitational acceleration constant due to gravity.

The high speed transient off-tracking is only applicable to tank wagons with multiple articulated joints (ie B trains and truck/trailer combinations) and is therefore not required for other vehicles. Actual vehicle testing is not required –

compliance with the standard may be through estimation by a person experienced in this field, calculation or modelling. Vehicles which are designed to the NZTA pro-forma requirements (ie high productivity motor vehicles) meet the requirements of SAE J2179:2000-9 by virtue of compliance with the pro-forma.

Tank trailer and tank semi-trailer requirements

A tank trailer of more than 2,000 L capacity is to have two or more axles.

Fifth wheel couplings for tank semi-trailers should be of a type which transmit a portion of the roll motion of the tank semi-trailer to the prime mover (under normal operations). In particular, tank semi-trailers are not be fitted with unrestricted double oscillating fifth wheels.

No person shall attach a tank trailer or semi-trailer with a capacity of more than 10,000 L and containing a hazardous substance with class 3.1A or 3.1B hazard classification to any tank wagon unless that tank wagon is designed for use in transporting hazardous substances of classes 3.1A or 3.1B hazard classification.

4.3 Longitudinal surging

As required by regulation 16.21 a relevant PCBU must ensure that a road tank wagon with a compartment size of more than 8,600 L is designed and constructed so that, under a deceleration force of twice the gravitational force, 50% or less of the force generated by the compartment filled to 65% of capacity is applied to the foremost wall of the compartment.

Large compartment non-circular tanks – baffles percentage area

Tank baffles are to be fitted to large compartments of non-circular tanks. Where the length of such compartment exceeds 2.5 m, the distance between a head or bulkhead and a baffle is not to exceed 2.5 m. The minimum baffle percentage area is to be calculated as 28 times the distance in metres between the baffle and the furthermost head or bulkhead in the compartment.

4.4 Collision protection

Rear-end collision protection

As required by regulation 16.22 a relevant PCBU must ensure that a road tank wagon with a rear bumper which is designed and constructed to withstand a static load uniformly distributed across the central 1.5 m of the rear of the road tank wagon at an elevation at least 500 mm and not more than 1,000 mm above the ground. Such an impact on the rear bumper must not cause the liquid to leak from the tank at a rate of more than 0.1 L per minute.

This subsection provides information about how these requirements may be met.

Every tank wagon is provided with rear-end collision protection (collision bumper) in accordance with the following requirements:

a. The impact surface of the rear-end collision protection is not less than 150 mm behind the vertical plane of the rearmost head and is not less than 50 mm behind any other item located behind the tank rear elevation.
b. The inner face (ie front face) of the rear-end collision protection allows at least 150 mm clearance from any component or fitting below the bottom surface of the tank sub-frame, which may contain liquid during loading, discharge or conveyance. The rear-end collision protection must be attached to the sub-frame of the tank wagon or the chassis of the vehicle. It must not be attached directly to the tank.

c. The rear-end collision protection is a minimum of 1.5 m wide, 750 mm either side of the centre of the tank. The full width of the rear-end collision protection is not less than:
   - 1.5 m
   - 95% of the maximum width of the tank, or
   - 95% of the maximum width of the vehicle,

   whichever is the greater. Additional sections beyond the rear-end collision protection may extend to the full width of the tank and carry lights or other equipment.

d. The rear-end collision protection is positioned at a height to resist the horizontal load applied at an elevation at least 500 mm and not more than 1000 mm above the ground level.

e. The rear-end collision protection is to designed to withstand a static horizontal load equal to 40,000 kg or twice the mass of the fully loaded tank wagon, whichever is the lesser, and uniformly distributed over the central 1.5 m section of the rear-end collision protection. A limit state or alternative method of design can be used in accordance with NZS 3404:1997.Part 1.

f. The outer section of the bumper, which extends outside the 1.5 m rear-end collision protection, and which may be used to carry lights, does not have to comply with the strength requirements in paragraph (e). Notwithstanding this, within the practical limits of the tank wagon configuration, the outer section of the bumpers on tank wagons is to be designed to withstand impacts that may be expected to occur in daily service.

An energy absorbing bumper may be used providing it is suitable for the vehicle involved and provided that its deformation under full deflection would not result in any damage to the tank or its fittings.

Rear run-under by small vehicle

As required by regulation 16.23 a relevant PCBU must ensure that each road tank wagon is designed and constructed with a bumper or similar structure that meets the following requirements:

a. The rear run-under protection is positioned at a height to resist a horizontal load applied not less than 300 mm and not greater than 500 mm from ground level.

b. The impact surface of the rear run-under bumper is vertically in-line (ie within 100 mm forward or backward) with the impact surface of the collision bumper.

c. The rear run-under bumper is designed to withstand a static horizontal load distributed evenly across the central 1.5 m of at least:
   i. 10 tonnes, if the weight of the laden tank is less than 10 tonnes
   ii. 20 tonnes, if the weight of the laden tank is more than 20 tonnes, or
   iii. the weight of the laden tank, if that weight is at least 10 tonnes and not more than 20 tonnes.

Rear bumper requirements

Where it is practical, one bumper may serve as both a collision bumper and run-under bumper, in which case it needs to meet the requirements of sections Rear-end collision protection and Rear run-under by small vehicle separately.

All bumper dimensions are to be taken in the unladen state.

Side run-under protection

If side under run protection is fitted, attachment is to be made to the vehicle chassis and not directly to the tank.

4.5 Road clearance

Tank components and protection devices located between any two adjacent axles of a tank wagon or tank wagon combination should have a ground clearance of not less than:

- 40 mm for each metre between such axle centres, and
- 350 mm when unladen (except for aircraft refuelling units).

Tank filling and discharge connections which are rigidly attached to the tank should not extend lower than 40 mm below the plane through the centre line of the axles (except for aircraft refuelling units).

4.6 Fire extinguishing equipment

This section sets out the type and number of fire extinguishers that a PCBU with management or control of a road tank wagon that carries flammable liquids must ensure is carried in accordance with the requirements of regulation 16.42

The type and number of fire extinguishers to be fitted to the vehicle are as per Table 5.

Fire extinguishers must be installed so they are:

- mounted securely by means of a quick-release attachment, and
- located so as to be clearly visible and readily accessible for use, but remote from the hose connection points.

Note: The quick-release of a fire extinguisher is deemed to be removal and ready for use within 10 seconds of commencing the release of the extinguisher from the vehicle.

Where two fire extinguishers are fitted to any tank wagon, one is to be located on the left hand side of the tank wagon, with the other on the right hand side of the vehicle towards the front of the vehicle. If it is not practicable to locate the latter extinguisher towards the front of the vehicle, it is to be located in a position that is still readily accessible by the driver.

Note: For the purpose of this requirement, an additional towed tank trailer, each additional B-Train tank and similar combination is treated as being an individual vehicle and thus requires an additional complement of extinguishers.

The fire extinguishing medium must be compatible with the substance being transported.

APPLICATION	MINIMUM REQUIREMENT
In every vehicle cab	One 30B extinguisher
Each tank which exceeds 2,000 L capacity and which carries a class 3.1 A-D Flammable cargo	2 x 30B or 1 x 60B extinguisher

TABLE 5:
Type and number of fire extinguishers

5.0 Inspection, certification and testing

IN THIS SECTION:

5.1 Inspection

A PCBU with management or control of a road tank wagon needs to ensure that regular inspections of tank wagons are carried out in accordance with Appendix A: Certification, inspection and testing. Records of the inspection, and any necessary rectifications, need to be kept by the PCBU. Alternative inspection procedures and frequencies may be used provided they cover the requirements of the Regulations.

5.2 Testing

Tanks

As required by regulation 16.34 a relevant PCBU must ensure that a tank or an individual tank compartment will not leak, crack or suffer any permanent distortion, or show evidence of impending failure after application of one of the following tests for 10 minutes:

a. a hydrostatic test: when filled with water at a temperature of not more than 38°C, conducted at 1.5 times the design pressure (**Note**: the water may be pressurised by air over the top of the water.)

b. a pneumatic test at 1.25 times the design pressure. The adjacent compartments are to be empty and at atmospheric pressure. The air pressure will be held and the entire surface of all joints that are under pressure are to be coated with a solution of soap and water, heavy oil, or other material that is suitable to detect foaming or bubbling, which indicates the presence of leaks, or

c. a pressure test specified in a relevant safe work instrument.

In these tests the following is applicable:

- Each compartment is to be tested individually and adjacent compartments are to be:
  - empty in both cases, and
  - at atmospheric pressure.
- Relief devices which could prevent the test pressure from being reached are to be inoperative during testing.

A vapour-recovery transfer system and a coaming that is part of a vapour-recovery system are not to leak when subjected to a pressure of 35 kPa with the pressure maintained without leaks for 10 minutes.

Piping

A relevant PCBU needs to ensure that piping systems are tested according to the following:

a. A piping system subject to pumping pressure is tested to a pressure 1.5 times the maximum working pressure.

b. Piping and in-line valves are tested at a pressure of 200 kPa before attachment to the tank.

5.3 Major repairs to tank wagons

Major modifications or repairs affecting the structural integrity of any tank used for conveying liquids with class 3.1A, 3.1B, 3.1C or 3.1D hazard classification in bulk may only be carried out after a tank wagon design compliance certificate has been issued by a WorkSafe-authorised compliance certifier.

A major repair or modification is defined as altering the sub-frame, and or, tank, and includes remounting of tanks (where the structural integrity of the tank is changed).

Repairs must be carried out only when the tank has been rendered free of flammable liquid and gas.

The completed tank wagon is to undergo a pre-commissioning inspection prior to returning to service.

Appendices

IN THIS SECTION:

Appendix A: Certification, inspection and testing

The following actions must be undertaken by a PCBU with management or control of a tank wagon or their agent.

Design certification

The design of any new tank wagon or the assessment of any existing vehicle which is undergoing major modification, for use under this ACOP is to be carried out by a competent[1] person with relevant experience in the road transport industry. Except for tank wagons that will carry only low-hazard hazardous substances and which are less than 450 L capacity, the PCBU who designs or constructs a tank wagon or part of a tank wagon must obtain a design compliance certificate from a WorkSafe-authorised compliance certifier. This certificate may be issued with conditions.

The PCBU seeking the approval of the compliance certifier will be expected to provide the following information:

a. Two copies of the general assembly drawing of the tank wagon for which approval is sought. This drawing needs to show all major dimensions.
b. In the case of new designs, two copies of the working drawings to be used in the construction of the tank wagon. In the case of assessments of existing designs, a copy of the assessment report and two copies of any drawing showing any modifications are to be made before the tank wagon enters service.
c. The design calculations for the collision bumper.
d. The design calculations for the tank mounting arrangements.
e. The static roll threshold criteria assessment.
f. The VIN (Vehicle Identification Number) or the manufacturer's job number and, if available, the registration number and fleet number of the vehicle concerned.
g. The identification of the person responsible for the design or assessments.

Once the compliance certificate for the design is issued, a copy of this compliance certificate and the design information (including the drawings) is to be forwarded to WorkSafe who will issue a record number in the form 'TAN XXX'. If this design is to be used for other vehicles that have tanks 2,000 L or larger, these are to be designated by separate numbers.

Pre-commissioning certification

Before the tank wagon enters service, a pre-commissioning compliance certificate issued by a compliance certifier authorised by WorkSafe must be obtained by a relevant PCBU. The tank wagon needs to undergo an inspection which will include:

a. obtaining a written declaration from the manufacturer responsible for the supervision and construction of the tank wagon stating that the tank wagon has been constructed according to the approved design and drawings and is in accordance with the Regulations (refer to the Manufacturer's Declaration included in Appendix B).
b. reviewing the documentation, certificates and declarations of conformity of the equipment and systems, including the electrical systems, installed in New Zealand to verify they are compliant with requisite standards.
c. verifying that it complies with this ACOP.

[1] In this context a competent person means a chartered professional engineer or similarly qualified person familiar with the design and construction of road transport vehicles.

A pre-commissioning compliance certificate is not required for a tank wagon with a tank capacity of:

- less than 450 L and which carries a low-hazard hazardous substance, or
- less than 2,000 L and which is manufactured by an approved fabricator in accordance with the terms and conditions of the approved fabricator's approval.

In-service certification

The PCBU must obtain an in-service compliance certificate issued by a compliance certifier authorised by WorkSafe for all tank wagons other than those with a tank capacity of less than 2,000 L that contain a low-hazard hazardous substance ie a class 3.1D substance.

There are two types of in-service compliance checks:

1. **Visual inspection**
   An in-service compliance certificate may be issued by a compliance certifier for a tank wagon if the compliance certifier, after completing an external visual inspection of the tank's compartments, is satisfied that the tank wagon and tank comply with the requirements for:
   - corrosion resistance
   - loss minimisation while transferring liquids or gases
   - rear-end collision protection
   - rear run-under by small vehicle.
2. **Full inspection**
   An in-service compliance certificate may be issued by a compliance certifier if the compliance certifier is satisfied that the tank wagon and tank comply with requirements for:
   - marking
   - ability to withstand stress of load—tank upright/inverted
   - corrosion resistance
   - minimising risk of possible ignition
   - rear-end collision protection
   - rear run-under
   - emergency preparedness (≥2,000 L)
   - loss minimisation during transfer of liquids or gases (≥2,000 L)
   - fuel tank requirements (≥2,000 L).

A PCBU with management or control of a tank wagon must obtain in-service compliance certificates at intervals of not more than two years. Regulation 16.36

However, an in-service compliance certificate based on a visual inspection (1 above) must not be issued unless a pre-commissioning compliance certificate or a compliance certificate following a full inspection (2 above) or a pre-commissioning compliance certificate has been issued for the tank wagon within the past four years. Regulation 16.36

Inspection

All records of inspection required by this ACOP are to be kept by the PCBU with management or control of a tank wagon or their agent for inspection as required by the WorkSafe-authorised compliance certifier.

EVERY THREE MONTHS

An inspection should be carried out by a competent person[2] for all tank wagons other than those with a tank capacity of less than 2,000 L that contain a 3.1D substance. This will include inspection of:

- any flexible hoses used in the transfer system for damage and wear and for electrical conductivity (if applicable), and
- any earthing straps for continuity and serviceability, and
- the intake flexible coupling (where applicable).

PERIODIC INSPECTION AS SPECIFIED BY THE LAND TRANSPORT REGULATOR

Vehicles are to be presented to a vehicle testing station for a certificate of fitness inspection at periods set by the land transport regulator.

AT 10 YEARS FROM CONSTRUCTION

At 10 years from construction and at intervals of five years thereafter, an internal inspection is to be undertaken with each compartment pressure tested.

Test method

If there is any reason to suspect a leak, or the vehicle is involved in any significant accident, or if repairs are carried out to the tank, each affected compartment needs to be tested by one of the following methods:

a. Pressurised to the design pressure with inert gas (unless the tank has been gas-freed in which case air may be used) while the adjacent compartments are empty and at atmospheric pressure. The pressure shall be held for at least ten minutes and the entire surface of all joints that are under pressure are to be coated with a solution of soap and water, heavy oil, or other material that is suitable to detect foaming or bubbling, which indicates the presence of leaks, or

b. Pressurised as specified in Section 5.2 above.

Any pressure relief devices which could prevent the test pressure being attained shall be rendered inoperative during testing.

Where the PCBU repairs tanks which fail the above tests, the tests are to be repeated. The tank wagon is not to be put into service until such testing confirms there is no leakage.

In circumstances whereby these inspection procedures are unable to be used alternative inspection procedures may be used provided that they are approved by the compliance certifier issuing the compliance certificate for the tank wagon.

[2] A person suitably experienced in the servicing of tank wagons

Appendix B: Manufacturer's declaration

Flammable liquid tank wagons

I

certify that I have design checked/inspected the following:

Vehicle:
Owner:
Type of vehicle:
Hazardous substances:
Registration number:
Fleet number:
Tank number:
Capacity:
Drawings:

I declare that I have made such detailed examinations and checks as I considered necessary and it is my opinion that:

1. The design is in accordance with the Health and Safety at Work (Hazardous Substances) Regulations 2017 (the Regulations) and has been issued the registration number
2. The construction is in accordance with good and widely accepted engineering practice and the design as shown on the drawing list attached.
3. An inspection has been carried out and the requirements of the Regulations have been met.
4. I have witnessed and/or verified non-destructive testing/ hydro testing in accordance with the requirements of the Regulations.
5. This tank wagon is subject to additional conditions as follows:

Signed:
For and on behalf of:

Therefore I recommend that this tank wagon be approved for transport of hazardous substances with class 3.1A, 3.1B, 3.1C and/or 3.1D (strike out which is not applicable) flammable classifications under the Health and Safety at Work (Hazardous Substances) Regulations 2017.

Appendix C: Tank wagons for carrying 3.1D flammable liquids

This Appendix covers tank wagons carrying hazardous substances of hazard classification 3.1D, defined in the Hazardous Substances (Classification) Notice 2017 as liquids that have a flash point greater than 60°C but less than or equal to 93°C.

Tank wagons that will be loading at vehicle loading gantries that also load substances with 2.1.1A, 2.1.1B, 2.1.2A, 3.1A, 3.1B or 3.1C hazard classifications, either in the same loading bay or adjacent loading bays, need to be constructed in accordance with the provisions of this ACOP as if the tank wagon is intended to be utilised for transporting substances with 2.1.1A, 2.1.1B, 2.1.2A, 3.1A, 3.1B or 3.1C hazard classifications.

Tank wagons that do not load at vehicle loading gantries that also load substances with a 2.1.1A, 2.1.1B, 2.1.2A, 3.1A, 3.1B or 3.1C hazard classifications, either in the same loading bay or adjacent loading bays, are to be constructed in accordance with this ACOP except for the following:

- electrical wiring
- vehicle roll-over
- exhaust and intake
- pipework and fittings
- engine driven pumps
- emergency vents.

Appendix D: Tank trailers less than 2,000 litres capacity

This Appendix is applicable to tank trailers that carry a flammable liquid and have a water capacity less than 2,000 L.

A relevant PCBU must ensure that the tank trailer complies with the requirements set out in the following regulations that apply to large tank wagons:

- Regulation 16.7 Ability to withstand stress of load
- Regulation 16.8 Pressure Resistance
- Regulation 16.10 Corrosion Resistance
- Regulation 16.16 Attachment of tank to chassis
- Regulation 16.17 Minimising risk of possible ignition
- Regulation 16.20 Stability and manoeuvrability
- Regulation 16.22 Rear-end collision protection

Tank trailers must also comply with the following regulations:

- Regulation 16.26 Tank trailer impact resistance
- Regulation 16.27 Tank trailer fittings impact resistance
- Regulation 16.28 Tank trailer rear run-under protection

The requirements of the Regulations can be met by complying with the following:

1. The tank is designed and constructed to sound engineering principles.
2. A horizontal cylindrical tank that is constructed as a Category 2 tank in accordance with AS 1692:2006 Steel tanks for flammable and combustible liquids is and which has a minimum shell thickness of:
   - not less than 4 mm when constructed from aluminium, or
   - 3 mm when constructed from low carbon steel, or
   - 2.5 mm shell thickness when constructed of stainless steel,

   is deemed to meet the sound engineering principles requirement.
3. Tanks of other shapes (eg rectangular) must be individually designed to meet the loads during service. It may be necessary to stiffen the flat plates.
4. The end plates have a minimum thickness of 5 mm (without stiffeners) when constructed from aluminium or low carbon steel or 4 mm (without stiffeners) when constructed from stainless steel.
5. Trailer tanks greater than 1,200 L capacity are fitted with a baffle.
6. The tank is fixed to a chassis such that under foreseeable operating conditions the tank will remain attached to the chassis and comply with regulation 16.20
7. Each compartment of the tank is able to contain the substance carried when it is subject to an internal pressure of 35 kPa. The tank meets this requirement if each compartment, when subject to a hydrostatic pressure of at least 35 kPa or the design pressure, whichever is greater, for at least ten minutes, with adjacent compartments empty and at atmospheric pressure: the compartment does not leak, or show any other evidence of failure.
8. Corrosion is to be taken into account when designing a tank. With the corrosion expected from its normal working life, the tank must still meet the stress, pressure and fatigue resistance that it was originally designed for.
9. Tanks are to comply with the venting requirements in Section 3.2 – Vents of this ACOP. Notwithstanding this, tanks used for substances with a flammable hazard classification of 3.1D only, are not required to meet the provisions of Section 3.2 – Emergency venting of this ACOP.

10. Trailer tanks are to comply with the stability requirements of Section 4.2 of this ACOP, that is, the tank trailer is to be designed and constructed so that when the tank is full it will not roll over when subjected to a static roll threshold of at least 0.45 g.
11. Trailer tanks are to be constructed with rear bumper protection fitted in accordance with the following requirements:
    - If the width of the tank is less than 1.5 m, the width of the bumper is to be not less than the width of the tank, or if the tank is 1.5 m or greater, the width of the bumper is not to be less than 1.5 m.
    - The bottom surface of the bumper is not less than 500 mm and the top surface not more than 600 mm from ground level.
    - The bumper can withstand a static load equal to the laden weight of the road tank trailer.

    Alternatively the trailer tanks may be constructed to comply with both regulation 16.22 (rear-end collision protection) and regulation 16.28 (rear run-under protection).
12. All tank fittings are protected from damage in an accident (ie by coamings or shields).
13. All connections to the tank are above the safe fill level.
14. The tank outlet pipes should have shut-off valves fitted as close as practical to the tank. The valve(s) are to be readily operatable in an emergency.
    - In the case of a trailer tank with a lockable shield, the valves are shut unless liquid transfer is taking place.
    - A trailer tank fitted with a motorised pump has an anti-siphon valve fitted.
15. All wiring is to be installed and protected in a manner which precludes damage and sparking. With the exception of tank trailers, no electrical wiring or fittings are to be attached to the tank.
16. The vehicle exhaust is positioned so as to avoid impingement by any spillage which may emanate from the tank or its fittings. In no case is the exhaust to terminate closer than 1.6 m from the tank or 2 m from any tank opening unless it is effectively screened from spillage.
17. The tank is marked or labelled in accordance with the provisions of Section 2.2 of this ACOP.
18. A 30B fire extinguisher should be carried in the vehicle. This may be carried in the towing vehicle.
19. Trailer tanks designed to carry hazardous substances with 3.1A, 3.1B or 3.1C hazard classifications are to have tandem axles with braking on at least the first axle.
20. Single axle tank trailers are to have a means of stabilising when detached from the towing vehicle.
21. Tanks used to convey substances with 3.1A, 3.1B or 3.1C flammable classifications are:
    - fitted with bonding reels
    - if equipped with a pump that is powered by a piston engine, diesel driven and fitted with a spark arrestor
    - fitted with roll-over protection valves.

Appendix E: Vacuum tank wagons

Conditions of use

This Appendix specifies the requirements for vehicles used in the recovery, transportation and disposal of material containing substances with class 3.1A, 3.1B or 3.1C hazard classification where inclusion of solids, such as gravel, litter etc prevent the use of conventional liquid removal.

Under no circumstances are these vehicles to be used for the bulk distribution of substances with 3.1 hazard classification.

Design

A relevant PCBU needs to ensure that a road tank wagon fully complies with the provisions of this ACOP with the following amendments:

a. Maximum water capacity is restricted to 10,000 L with a maximum of 5% ullage.
b. The tank is so designed to meet both the requirements of this ACOP and the internal pressure generated under vacuum. The minimum thickness for the shell and bulkheads to be no less than 4 mm for mild steel and 6 mm for aluminium. The tank is to have a circular cross-section and the maximum shell radius may not exceed 950 mm. The unreinforced length restrictions do not apply.
c. The maximum inlet size is 80 mm nominal bore.
d. The unit is to be bottom loaded only and not carry any provision for top loading.

The vacuum system is to be water ring only.

a. The ring water is to be replaced after each unloading to prevent build-up of hydrocarbons.
b. The vent from the liquid ring vacuum pump is to discharge in a manner that minimises potential ignition.

The auxiliary engine to power the vacuum pump needs to comply with the following:

a. The engine is fitted with a method of strangling the engine. This could take the form of a valve which closes the air intake passage to the engine, in which case account needs to be taken of the effects of vacuum on the intake piping and other passages (such as pump breather pipes) through which air may pass to the air intake of the engine. A CO_2 fire extinguisher of not less than 2.7 kg may be used as a strangler provided that the extinguisher is a 100 percent discharge type and is arranged to discharge into the air intake close to the intake manifold.
b. The engine is fitted with an appropriate electrical isolation switch and wired as per this ACOP.
c. The engine is shielded from the load tank to prevent spillage onto the hot surfaces of the engine.
d. The air cleaner terminates at least 80 mm above the roll-over coaming on the tank.
e. The exhaust is fitted with a spark arrestor and terminates at least 80 mm above the roll-over coaming on the tank. Fuel tanks need to comply with the provisions of this ACOP.
f. The tank is be fitted with an isolation valve in the inlet line to prevent the hazardous substance or vapour returning to the pumping system. This valve needs to be automatically activated when the prime mover is started and remain closed during transportation.
g. The tank is fitted with a device to relieve the vacuum from the tank during transportation. This device is to be set at a vacuum not exceeding 7 kPa (ie -7kPa pressure).
h. The tank is to be fitted with a pressure relief vent the opening setting of which does not exceed 17 kPa.

Operation

The PCBU with management or control of a tank wagon needs to ensure that the unit:

- is to be used only by competent persons who are fully conversant with all operating procedures and emergency procedures
- carries a minimum of four approved safety cones which are to be used to isolate the vehicle from the public during filling and discharging operations
- is equipped with a suitable means of earthing the vehicle during filling and discharge to eliminate the build-up of static electricity
- carries an emergency spill response kit and operators are trained in its use.

The vehicle needs to:

- comply with the fire extinguisher provisions of this ACOP
- carry a minimum of two large standalone signs which are to be placed at a minimum of 10 m from the vehicle. The signs are to convey the following:

> **DANGER FLAMMABLE LIQUIDS**
>
> **NO SMOKING OR SOURCES OF IGNITION WITHIN 15 M OF VEHICLE**
>
> **PLEASE KEEP CLEAR**

The tank needs to be marked on the rear and both sides with a flammable liquid diamond, minimum dimensions 400 mm x 400 mm. The label is to incorporate the words 'No Sources of Ignition within 8 m'. Note: The requirements in relation to placarding are as required by the Land Transport Rule: Dangerous Goods 2005 (Rule 45001/1).

A certification plate of a compatible material to the tank not subject to corrosion needs to be permanently fixed to the tank or tank runners and bear the following minimum information:

a. the tank manufacturer's name
b. date of manufacture
c. the design compliance certificate number
d. the recommended operating pressure
e. the maximum filling level
f. the maximum density of any liquids to be carried in the tank
g. the materials used to construct the tank
h. a tank wagon record number allocated by WorkSafe.

This plate needs be affixed in a place readily accessible for inspection preferably on the true left side near the front of the tank. The information is to be stamped, embossed, or applied by other suitable means into the material of the plate in characters at least 5 mm high. The plate must not be painted so as to obscure the marking thereon.

The tank serial number should also be stamped on a substantial part of the tank structure.

Appendix F: Tanks fitted to utility vehicles

This Appendix is applicable to tanks fitted to utility vehicles and which are:

- used to transport low-hazard hazardous substances, and
- less than 450 L capacity.

A relevant PCBU needs to ensure that the following requirements are met:

1. The tank is designed and constructed to sound engineering principles. A horizontal cylindrical tank that is constructed as a Category 2 tank in accordance with AS 1692:2006 Steel tanks for flammable and combustible liquids is deemed to meet this requirement.
2. The tank has a minimum shell thickness of:
   - not less than 4 mm when constructed from aluminium, or
   - 3 mm when constructed from low carbon steel, or
   - 2.5 mm shell thickness when constructed of stainless steel.
3. The tank is fixed to the tray of the utility vehicle in compliance with the requirements of Section 3.8 of this ACOP.
4. Each compartment of the tank is able to contain the substance carried when it is subject to an internal pressure of 35 kPa. The tank meets this requirement if each compartment, when subject to a hydrostatic pressure of at least 35 kPa or the design pressure, whichever is greater, for at least ten minutes, with adjacent compartments empty and at atmospheric pressure: the compartment does not leak, crack or suffer any permanent distortion, or show evidence of impending failure.
5. Corrosion is taken into account when designing a tank. With the corrosion expected from its normal working life, the tank must still meet the stress, pressure and fatigue resistance that it was originally designed for.
6. All connections to the tank are above the safe fill level.
7. The tank outlet pipes has shut-off valves fitted as close as practical to the tank. The valve(s) are to be readily operable in an emergency.
8. The tank is marked or labelled in accordance with the provisions of Section 2.2 of this ACOP.
9. At a minimum, a 30B fire extinguisher is carried in the vehicle.

Appendix G: Vehicle fuel tank construction and testing

This Appendix outlines the conditions under which a vehicle fuel tank may be tested as alternative to providing a protection guard (see Section 4.1 of this ACOP). These requirements are based on those of the US Federal Highway Administration (Section 393.67) and only apply to side-mounted vehicle fuel tanks containing vehicle fuel (diesel and petrol) at normal atmospheric pressure and temperature.

Construction requirements

a. All joints are closed by welding such that they are sealed.
b. Drains and bottom fittings do not project more than 25 mm from the bottom of the tank.
c. All fittings are installed via flanges, nozzles or spuds welded into the tank.
d. A fuel tank with a capacity greater than 100 L has a vent to prevent over pressurisation during a fire.
e. The tank is equipped with a non-spill air vent.
f. The tank is marked with liquid capacity, date of manufacture and reference to acceptance under this ACOP.

Testing requirements

PRESSURE TEST

The tank and fittings need to be capable of withstanding a pressure of 150% of a minimum of the pressure reached during venting or 500 kPa without leakage.

LEAK TEST

The tank needs to be filled, with feed outlet sealed, and rotated about any axis without any leakage.

DROP TEST

Fill tank with quantity of water having a weight equal to the weight of the fuel load.

a. Drop the tank from a minimum height of 9 m onto an unyielding surface so that it lands squarely on one corner. Tank and fittings are to be leak-free.
b. Drop the tank from a minimum height of 3 m onto an unyielding surface so that it lands squarely on its fill pipe. Tank and fittings are to be leak-free.

Disclaimer

This publication provides general guidance. It is not possible for WorkSafe to address every situation that could occur in every workplace. This means that you will need to think about this guidance and how to apply it to your particular circumstances.

WorkSafe regularly reviews and revises guidance to ensure that it is up-to-date. If you are reading a printed copy of this guidance, please check worksafe.govt.nz to confirm that your copy is the current version.

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