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FOURTH EDITION

Draft Zambian Standard

**ROAD TANK VEHICLES FOR PETROLEUM-BASED
FLAMMABLE LIQUIDS - Specification**

ZAMBIA BUREAU OF STANDARD

DATE OF PUBLICATION

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The preparation of this Zambian Standard was undertaken by the Transportation of Petroleum Products Technical Committee (TC7/7) upon which the following organization were represented:

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Industrial Training Centre
Juba Transport Zambia Limited
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Petroleum Transporters Association of Zambia (PTAZ)
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FOREWORD

This National Standard has been prepared by the Transportation of Petroleum Products (TC7/7), in accordance with the procedures of ZABS. All users should ensure that they have the latest edition of this publication as standards are revised from time to time.

No liability shall attach to ZABS or its Director, employees, servants or agents including individual experts and members of its Technical Committees for any personal injury, property damage or other damages of any nature whatsoever, whether direct or indirect, or for costs (including legal fees) and expenses arising out of the publication, use of, or reliance upon this ZABS publication or any other ZABS publication.

Over the past years, technological changes in the Transportation of Petroleum Products have occurred. In endeavouring to match up with the regional and indeed the worldwide advancements, it was necessary to revise and amend ZS 371. The Technical Committee was reconstituted under the auspices of the Zambia Bureau of Standards and facilitated by the Energy Regulation Board.

During the preparation of this standard, the following publications were consulted:

SANS 1518	Transport of dangerous goods — Design, construction, testing, approval and maintenance of road vehicles and portable tanks
SANS 10231	Transport of Dangerous Goods by Road – Operational Requirements
ZS 385-1	The Petroleum Industry - Part 1: Storage and distribution of petroleum products in above ground bulk installations – Code of Practice
ZS 670-1	Transportation of dangerous goods by road, rail, water and air. Part 1 : identification and classification of dangerous goods for transport
ZS 670-2	Transportation of dangerous goods by road, rail, water and air. Part: 2 Marking, labelling, testing and packaging of dangerous goods guidelines for transport in Zambia
ZS 708	Globally Harmonized System of Classification and Labelling of Chemicals

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COMPLIANCE WITH A ZAMBIAN STANDARD DOES NOT OF ITSELF CONFER IMMUNITY FROM LEGAL OBLIGATIONS

ZAMBIA BUREAU OF STANDARDS

Draft Zambian Standard

ROAD TANK VEHICLES FOR PETROLEUM-BASED FLAMMABLE LIQUIDS – Specification

0. INTRODUCTION

This standard cover road tank vehicles that are used predominantly for the transportation of petroleum based flammable liquids. It is assumed that discharge operations are carried out by the driver and take place using gravity or a pump. This standard also makes provision for the commonly used type of road tank vehicle with compartments that are capable of transporting different types of petroleum products.

1. SCOPE

This standard covers the requirements for tank vehicles intended for use on public roads, for transportation, at temperatures below their boiling point, of normally stable petroleum-based flammable liquids. This includes return haulier vehicles designed to carry both petroleum products and dry cargo although not at the same time. Flammable liquids other than hydrocarbons are excluded from this standard.

2. NORMATIVE REFERENCES

The following standards and Legislative documents contain provisions which through reference in this text, constitute provisions of this standard. All standards are subject to revision and since any reference to a standard is deemed to be a reference to the latest edition of that standard, parties to agreements based on this standard are encouraged on currently valid national and international standards which may be obtained from the Zambia Bureau of Standards.

ZS 373-3	Portable Fire Extinguishers – Specification - Part 3: Dry Powder type Fire extinguishers
ZS 385-2	The Petroleum Industry - Part 2: Electrical installations in the distribution and marketing sector– Code of Practice
ZS 402	The classification of hazardous locations and the selection of electrical apparatus for use in such locations.
ZS 437-2	Pneumatic tyres – Specifications
ZS 675	Road Vehicles – Road Speed Limiters – Guidelines
ZS 676	Retro-reflective and fluorescent warning signs for road vehicles
ZS ASTM B209	Standard specification for aluminium alloy, sheet and plate
ZS EN 1011-4	Welding. Recommendations for welding of metallic materials. Arc welding of aluminium and aluminium alloys
ZS EN 13081	Tanks for transport of dangerous goods — Service equipment for tanks — Vapour collection adaptor and coupler
ZS EN 13082	Tanks for transport of dangerous goods — Service equipment for tanks — Vapour transfer valve
ZS EN 13922	Tanks for transport of dangerous goods — Service equipment for tanks — Overfill prevention systems for liquid fuels

ZS IEC 60529	Degrees of protection provided by enclosures (IP Code)
ZS ISO 3874	Series 1 Freight containers- Handling and securing.
ZS ISO 7638-1	Road vehicles - Connectors for the electrical connection of towing and towed vehicles - Part 1: Connectors for braking systems and running gear of vehicles with 24 V nominal supply voltage
ZS ISO 7638-2	Road vehicles - Connectors for the electrical connection of towing and towed vehicles - Part 2: Connectors for braking systems and running gear of vehicles with 12 V nominal supply voltage
ZS ISO 15614-1	Specification and qualification of welding procedures for metallic materials - Welding procedure test -- Part 1: Arc and gas welding of steels and arc welding of nickel and nickel alloys
ZS 1069	Diesel engines modified for use in hazardous locations (other than in mines)
ZS 1070	High penetration-resistant laminated safety glass for vehicles.
ZS 1071	Uniform provisions concerning the approval of vehicles of categories M, N and O with regard to braking
ZS ISO 9001	Quality Management System – Requirements

The Road Traffic Act No 11 of 2002 and the Road Traffic Act No 8 of 2022

The Public Roads Act No 12 of 2002

The Metrology Act No. 6 of 2017

3. DEFINITIONS

For the purposes of this standard, the following definitions shall apply:

3.1 Acceptable

Fit for purpose, within the law and best practice

3.2 Authorised body

An organisation or person with acceptable qualifications, training and experience to carry out effective repair works on the road tank vehicle.

3.3 Auxiliary engine

An engine that is additional to the main propulsion engine of the road tank vehicle and that can be operated either on or off that vehicle.

3.4 Baffle

A non-liquid tight transverse or longitudinal partition in a tank.

3.5 Bulkhead

A liquid-tight transverse wall between adjacent compartments of a tank.

3.6 Calibration

Set of operations that establish, under specified conditions, the relationship between values of quantities indicated by a measuring instrument or measuring system, or values represented by a material measure or a reference material, and the corresponding values realised by standards

3.7 Compartment

A liquid-tight division of a tank.

3.8 Compartment tank

A tank that has two or more compartments.

3.9 Demountable tank

A tank that is designed to be lifted onto and mounted on a conventional truck that is to be used as a road tank vehicle.

NOTE

A tank that is designed as a full load on rigid chassis, with attachment direct to the chassis in a positive and safe manner is not classified as a demountable tank for the purposes of this standard.

3.10 Double bulkhead

Two bulkheads that are placed in a tank next to each other, to divide the tank into two compartments.

3.11 Endurance braking

Braking system intended to stabilize vehicle speed on a long descent, without the use of service, secondary or parking braking systems.

3.12 Explosion protected

Descriptive of electrical apparatus that is designed and approved for use in hazardous areas in accordance with one of the protection methods described in ZS 402 (or any acceptable equivalent).

3.13 Exposed area

The area of the surface of a tank that is exposed to outside atmosphere direct.

3.14 Head

A liquid-tight transverse closure at the end of a tank.

3.15 Road tank vehicle

A tank truck, tank trailer, or truck-tractor and tank -semi-trailer combination.

3.16 Return Haulier

This is a tank and truck vehicle designed to carry both petroleum products and dry cargo although not at the same time.

Tow Tank Trailer

An unpowered wheeled vehicle equipped with a tank body designed to be coupled to a motorised towing vehicle such as a truck, tractor or utility vehicle via a hitch or drawbar.

3.17 Standard reference conditions

20°C and 101, 325 kPa absolute.

3.18 Tank

A container that has a liquid-full capacity in excess of 500 litres, that is used for transporting petroleum-based flammable liquids and that is mounted permanently or temporarily on a vehicle other than for the purpose of supplying fuel for propulsion of the vehicle.

NOTE

The term "tank" embraces the container and all components and ancillary equipment that affects its structural integrity.

3.19 Tank semi-trailer

A vehicle with a tank mounted on it or built as an integral part of it, and so constructed that, when the semi-trailer is drawn by a truck tractor, through a fifth wheel connection, part of the load rests on the towing vehicle.

NOTE

A tank semi-trailer, when coupled to a truck tractor, is an articulated vehicle.

3.20 Tank trailer

A vehicle with a tank mounted on it or built as an integral part of it and so constructed that when the trailer is drawn by a motor vehicle, practically all its load rests on its own wheels.

3.21 Tank truck

A single, self-propelled motor vehicle with a tank mounted on it.

3.22 Type D vehicle

Vehicle intended for the transportation of flammable, dangerous or self-reactive materials.

3.23 Ullage

That portion of the total-volume capacity of a tank that is not occupied by its liquid contents, expressed as a percentage of the total-volume capacity.

4. SYMBOLS AND ABBREVIATIONS

ASTM - ASTM International, originally known as the American Society for Testing and Materials

kPa – Kilopascal

ISO – International Organisation for Standardization

IEC - International Electrotechnical Commission

IP - Degrees of protection provided by enclosures in accordance with IEC 60529

Min - Minimum

Kg/m³ - Kilograms per cubic metre

5. REGULATIONS

The following Acts and their Regulations are relevant to the transportation of petroleum products:

- a) The Energy Regulation Act, Cap 436
- b) The Factories Act Cap 441 of the Laws of Zambia
- c) The Fire Services Act 1987 (Act 99 of 1987) as amended
- d) The Environmental Management Act No. 12 of 2011 and regulations
- e) The Water Management and Resource
- f) The Occupational Health and Safety Act (No. 36 of 2010) of the Laws of Zambia
- g) International codes, conventions and protocols

6. REQUIREMENTS

6.1 GENERAL REQUIREMENTS

Road tank vehicles and their ancillary equipment shall comply with this standard and all other relevant statutory requirements and regulations. The ancillary requirements on road tank vehicles type D shall include, but not limited to, the items in summary Table 1.

TABLE 1: ANCILLARY REQUIREMENTS ON ROAD TANK VEHICLES

Sub clause	Requirement	Vehicle Type D
6.8.14	Electrical Equipment	
6.8.14.2	Wiring	X
6.8.14.3	Battery Master Switch	X
6.8.14.4	Batteries	X
6.8.14.5	Permanently energized circuits	X
6.8.14.5	Electrical Installation at rear of drivers cabin	X
6.9	Braking Equipment	
6.9.1	General	X
6.9.2	Anti-Lock braking System	X
6.9.3	Endurance braking system	X
6.10	Prevention of Fire risks	
6.10.1	Vehicle cab	X
6.10.2	Fuel Tanks	X
6. 8.2	Engine	X
6. 10.3	Exhaust System	X
6. 10.4	Endurance braking	X
6.10.5	Combustion Heaters	
6.10.5.1	Heaters	X
	Air intake with flame arrestor	X
6.10.3	Exhaust System	X
	Flame arrestors on exhaust	X
6.10.5.2	Operation	X
6.10.5.3	Switching	X
	Recommended Equipment	
6.16	Speed Limiting device	X
	Automatic speed and time recording devices	O
	Real time/Satellite monitoring device	X
	Anti-runaway braking system	X
6.5.4	Vapour recovery system	X
	Overfill protection sensors	X
NOTE: X – Mandatory requirement O – Optional requirement		

TABLE 2: ANCILLARY REQUIREMENTS ON TOW TANK TRAILER

Sub clause	Requirement	Vehicle Type D
6.8.14	Electrical Equipment	

6.8.14.2	Wiring	X
6.8.14.3	Battery Master Switch	O
6.8.14.4	Batteries	O
6.8.14.5	Permanently energized circuits	O
6.8.14.5	Electrical Installation at rear of towing vehicle	X
6.9	Braking Equipment	
6.9.1	General	X
	Recommended Equipment	
	Anti-runaway braking system	X
6.5.4	Fire extinguisher	X
NOTE: X – Mandatory requirement O – Optional requirement		

Tank compartments discharge valves shall be colour-tagged to identify product loaded and minimize the possibility of cross contamination. The international petroleum colour coding scheme shall apply as shown below:

PRODUCT

IDENTIFICATION COLOUR MARK

a) Unleaded Petrol

Green



b) Automotive Gas Oil (AGO)

Purple



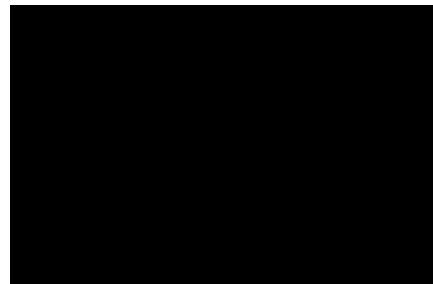
- c) Illuminating (Paraffin) Kerosene

Blue



- d) Jet A-1

Black



6.2 MATERIALS

6.2.1 Metals for tanks

Tanks shall be constructed of an aluminium alloy, a low carbon steel, a high-strength low carbon steel, a high-strength low alloy steel, or a stainless steel as required. The metal shall be free from rust, scale, cracks, laminations and surface blemishes, and shall comply with the appropriate requirements given in 6.2.1.1 to 6.2.1.3.

6.2.1.1 Aluminium alloys

An aluminium alloy shall comply with requirements as follows:

- a) Sheets and plates - grade 5454 of ZS ASTM B209 or equivalent standards,
- b) Extrusions - ZS EN 755 Part 2 or equivalent in the extrusions
- c) Castings - as given in Tables 2 and 3

TABLE 2: CHEMICAL COMPOSITION

Alloy No.	Nominal composition	Chemical Composition		
		Material/metal	Min	Max
44100	Al-Si12 (Fe)	Si	10.5	13.5
		Fe	-	0.65
		Cu	-	0.15
		Mn	-	0.55
		Mg	-	0.10
		Cr	-	-
		Ni	-	0.10
		Zn	-	0.15
		Pb	-	0.10
		Sn	-	-
		Ti	-	0.20
		Others	-	0.05
			-	0.15
		Al	Rem	

NOTE

- When recording the results of chemical analysis, the number representing the result for any value specified in this standard shall be expressed to the same number of decimal places as the corresponding number in this standard. The following rounding up rules shall be applied:
 - when the number immediately after the last number to be retained is less than 5, then the last number to be retained remains unchanged;
 - when the number immediately after the last number to be retained is greater than, or equal to, 5 and is followed by at least one number other than zero, the last number to be retained is increased by one; and
 - when the number immediately after the last number to be retained is equal to 5 and is followed by zeros only, the last number to be retained remains unchanged when it is an even number, and is increased by one when it is an odd number.
- Analysis for elements other than those specifically mentioned in the table shall be made when their presence is suspected or indicated to be in the excess of the values given in column 15. (See also footnote 3.)
- If a melt has been subjected to special treatment such as
 - modifying/refining the eutectic of Al-Si alloys with sodium or strontium;
 - grain refining of the matrix (aluminium solid solution) with boron or titanium salt compounds, or
 - refining of the primary silicon in hypereutectic Al-Si alloys by transforming the primary silicon from a lamellar form to a granular form with phosphorus, then the level of these additional elements is **not** limited by the specified values for other elements and shall be as agreed upon (see annex A).
- Aluminium content indicated as "Rem" (i.e. remainder), is determined by difference from 100 %.
- P – Piston alloys.

TABLE 3: MECHANICAL PROPERTIES

Alloy No.	Nominal composition	Condition (temperature)	Minimum tensile strength <i>RM</i> <i>MPa</i>		Minimum elongation on gauge length (5.65√S ₀) %	
			Sand Cast	Gravity die cast	Sand Cast	Gravity die cast
44100	Al-Si12 (Fe)	F	150	170	4	7
Note						
1. P – Piston alloys.						

6.2.1.2 Steel

A suitable low carbon or high-strength low alloy steel shall be of weldable quality and shall have physical properties at least equal to the appropriate minima given in Table 4.

TABLE 4- MINIMUM MECHANICAL PROPERTIES OF STEEL (OTHER THAN STAINLESS STEEL)

Mechanical property	Low carbon steel	High-strength low alloy steel
Yield stress, MPa, min	172	310
Ultimate tensile strength MPa, min	310	414
Elongation $5.65\sqrt{S_0}$ %, min	20	25
Impact resistance ¹⁾ at -20°C, J, min	20	20
¹⁾ Charpy V-notch		

6.2.1.3 Stainless Steel

A stainless steel shall comply with the requirements for one of the following grades of AISI steels (or acceptable equivalent):

304, 304L, 310, 316, 316L, 317, 317L, 321 or 347.

NOTE

The attention of purchasers is drawn to the advisability of using (to avoid carbide precipitation) one of the low carbon grades or one of the stabilised grades.

6.2.2 Pipes, fittings and other ancillary equipment

Materials for pipes, fittings, valves, manifolds, etc shall be of a suitable material that is compatible with the material of the tank and with the flammable liquid that is to be transported in the tank.

6.2.3 Gasket joint rings and other components

Gasket joints and components designed to come into contact with the flammable liquid shall be of a suitable material that is compatible with the flammable liquid that is to be transported in the tank, preferably, cork and asbestos materials or an approved gasket material.

6.2.4 Other materials

Components that do not come into contact with the flammable liquid may be of any material of adequate strength and that is acceptable for the required duty.

NOTE: Consideration should be given to the effects of galvanic corrosion when dissimilar metals (especially when one of these is aluminium or an aluminium alloy) are used in combination.

6.3 TANK DESIGN

6.3.1 General

A tank and its ancillary equipment shall have been designed in accordance with sound engineering principles, due consideration having been given to expected road conditions.

6.3.2 Capacity

The tank, which may be of the single-compartment or multi-compartment type, shall have a total-volume capacity (including ullage of between 2.5% and 5% of that capacity at 47°C of the liquid) as required. In addition, the total-volume capacity of a tank calculated on the liquid density of the product that is to be transported shall be such that when the road tank vehicle is fully loaded, its mass does not exceed the appropriate requirements of the Road Traffic Act No 11 of 2002 and the Public Roads Act No 12 of 2002.

The volumetric quantity carried in the compartment shall be as calibrated and/ verified by Zambia Metrology Agency and the ullage mark sealed.

The Zambia Metrology Agency shall conduct tank calibration and issue a certificate at least once a year or during the following instances;

- a) After the ullage marks or dip stick have been disturbed
- b) After major repairs have been carried out on the tank
- c) After vehicle combination changes
- d) After any damage to the shell of the tank
- e) After any change of ownership

The ullage mark shall be sealed with Zambia Metrology Agency seals and shall be tamper proof.

6.3.3 Shape

The tank may be of circular, elliptical or any other acceptable cross-section and shall be self-draining.

6.3.4 Maximum stress value

The maximum calculated stress value of a tank (including all stresses given in 6.3.5 to 6.3.7) shall not exceed 20% of the tensile strength of the material used for its construction.

6.3.5 Design pressure

The design pressure shall be at least 23 kPa plus the pressure exerted by the static head of liquid in the fully loaded tank in the normal position. This shall be based on the greater of the density at 20°C of the flammable liquid for which the tank is being designed or 865kg/m³.

6.3.6 Dynamic loading

Each tank and its components and ancillary equipment shall be designed to withstand dynamic loading in all directions and for all load configurations. The total dynamic loading shall be deduced by +

multiplying the static loads in question by the following acceleration factors considered individually:

- a) 2g in the direction of travel;
- b) 1g in the vertically upwards direction;
- c) 2g in the vertically downwards direction and
- d) 1g in the transverse horizontal direction

Where, g is acceleration due to gravity

Note: For the safety factors in a) to d) above, the safety devices discussed in 6.5 shall apply.

6.3.7 Additional loads

The following additional loads shall be taken into account and where applicable, a vector summation of all the loads under dynamic loading conditions shall be made:

- a) superimposed loads such as operating equipment, insulation, linings, hose tubes, cabinets and piping.
- b) reactions at supporting lugs and at saddles or other supports; and
- c) differential thermal expansion of dissimilar metals

6.3.8 Distribution of loads

The loads from supports shall be borne by bulkheads, baffles or ring stiffeners and shall be distributed as widely over the members as is practicable by using pads, gussets or other appropriate means of avoiding stress concentration.

6.3.9 Towing

For tank trailers the calculated D-value of the Tow-eye and the Tow- hitch shall always be less than that of the actual rating on the Tow-eye. The tow-eye and the tow hitch shall both be supplied by an approved supplier.

6.3.10 Shell, heads, bulkheads and baffles

6.3.10.1 Thickness of the shell, heads, bulkheads and baffles

Thickness of the shell, the heads and where fitted, the bulkheads and baffles shall be:

- a) such that, under dynamic loading conditions, the maximum stress value given in 6.3.4 is not exceeded and
- b) not less than the relevant minimum given in Table 3 or 4 as appropriate and in no case except at the knuckle-radius, shall the thickness of a tank head be less than the thickness of the shell.

NOTES

1. The material thickness given in Tables 2 and 3 are based on a liquid density of 865 kg/m³. Where the liquid density of the flammable liquid to be conveyed in the tank exceeds 865 kg/m³, the thickness of the shell will have to be proportionally increased.

2. Where an aluminium alloy is used for the construction of a head, bulkhead, baffle or ring stiffener it shall be in the O (annealed) or stronger temper. A shell shall be constructed of material with properties at least equal to grade 5454 of ZS ASTM B209 in the H32 or H34 tempers, or where lower tensile strength tempers are used, the minimum thickness of shell material given in Table 2 shall be proportionally increased.
3. Consideration should be given to the loss of strength of an aluminium alloy in the welded condition (see 6.4.2.3)

6.3.10.2 Stiffening of heads, bulkheads and baffles

Unless a proven equivalent form of stiffening is provided the following requirement shall apply:
Heads, bulkheads and baffles for all tanks shall be dished to a depth, exclusive of any flange of at least 120 mm/m of the depth of the minor axis of the tank cross section.

TABLE 5 - MINIMUM THICKNESS OF SHELL MATERIAL¹⁾

Rated Capacity V l/m of tank length	Maximum shell radius	Maximum thickness d mm								
		L ≤ 0.9m			0.9m < L ≤ 1.4m			1.4m < L ≤ 1.5m		
	m	LCS	SS HSLA	AL	LCS	SS HSLA	AL	LCS	SS HSLA	AL
V ≤ 1 400	1.8 ≤ R	2.0	1.6	2.2	2.0	1.6	2.2	2.0	1.8	2.4
	1.8 < R ≤ 2.3	2.0	1.6	2.4	2.0	1.8	2.4	2.8	2.0	2.8
	2.3 < R ≤ 3.2	2.4	1.8	2.8	2.4	2.0	2.8	3.0	2.4	3.0
	3.2 < R		2.0		2.8	2.4	3.0		2.8	3.8
1 400 < V ≤ 2 100	1.8 ≤ R	2.0	1.6	2.2	2.0	1.8	2.4	2.4	2.0	2.8
	1.8 < R ≤ 2.3	2.0	1.8	2.4	2.4	2.0	2.8	2.8	2.4	3.0
	2.3 < R ≤ 3.2	2.4	2.0	2.8	2.8	2.4	3.0	3.0	2.8	3.8
	3.2 < R	2.8	2.4	3.0	3.0	2.8	3.8	3.5	3.0	4.4
2 100 < V ≤ 2 700	1.8 ≤ R	2.0	1.8	2.4	2.4	2.0	2.8	2.8	2.4	3.0
	1.8 < R ≤ 2.3	2.4	2.0	2.8	2.8	2.4	3.0	3.0	2.8	3.8
	2.3 < R ≤ 3.2	2.8	2.4	3.0	3.0	2.8	3.8	3.5	3.0	4.4
	3.2 < R	3.0	2.8	3.8	3.5	3.0	4.4	4.0	3.5	5.0
V > 2 700	1.8 ≤ R	2.4	2.0	2.8	2.8	2.4	3.0	3.0	2.8	3.8
	1.8 < R ≤ 2.3	2.8	2.4	3.0	3.0	2.8	3.8	3.5	3.0	4.4
	2.3 < R ≤ 3.2	3.0	2.8	3.8	3.5	3.0	4.4	4.0	3.5	5.0
	3.2 < R	3.5	3.0	4.4	4.0	3.5	5.0	4.0	4.0	5.5

¹⁾ The minimum thickness given in the table can be less than those required in terms of 5.3.10.1(a).

Legend:

L indicates distance between heads, bulkheads, baffles or ring stiffeners

LCS indicates low carbon steel

SS indicates austenitic stainless steel

HSLA indicates high-strength low alloy steel

AL indicates aluminium alloy

TABLE 6 - MINIMUM THICKNESS OF HEADS¹⁾, BULKHEADS AND BAFFLES

Rated Capacity V	Minimum thickness		
	Mm		
l/m of tank Length	LCS	SS HSLA	AL
V ≤ 1 400	2.0	1.8	2.4
1 400 < V ≤ 2 100	2.4	2.0	2.8
2 100 < V ≤ 2 700	2.8	2.4	3.0
V > 2 700	3.0	2.8	3.8
¹⁾ The minimum thickness given in the table can be less than those required in terms of 5.3.10.1 (a). Legend: LCS indicates low carbon steel SS indicates austenitic stainless steel HSLA indicates high-strength low alloy steel AL indicates aluminium alloy			

6.3.11 Circumferential reinforcement

6.3.11.1 Double bulkheads, where fitted, shall be separated by means of an air space that is vented and provided with drainage facilities (see 6.3.11.2)

6.3.11.2 Each ring stiffener shall be continuous around the circumference of the shell and where an air space is enclosed; the space shall be vented and provided with drainage facilities.

6.3.11.3 Baffles shall be adequately vented on the horizontal and vertical structure.

A ring stiffener shall have a section modulus about the neutral axis of the ring section parallel to the shell that is at least equal to the value calculated by the following formula:

$$I/C = KWL$$

Where:

- I/C is the section modulus in cubic millimetres
- K is 0.0069 of low carbon, high-strength low alloy, and austenitic stainless steel and 0.01186 for aluminium alloys
- W is the width or diameter of the tank in millimeters and
- L is the ring spacing (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 6.4.3 a portion of the shell may be used as part of the ring section modulus. The portion of the shell used in this calculation shall not exceed the relevant maximum given in column 3 of Table 5.

TABLE 7 - CIRCUMFERENTIAL RING STIFFENERS: SHELL SECTION CREDIT THAT MAY BE INCLUDED IN RING SECTION MODULUS

Number of welds between ring stiffener and shell	Distance t between parallel ring stiffener to shell welds	Shell section credit, max
1	-	20 d
2	Less than 20 d	d + 20 d
3	More than or equal to 20 d	40 d
d is the shell thickness in millimetres; and t is the distance between parallel circumferential ring stiffener - to shell welds in millimetres.		

6.4 CONSTRUCTION

6.4.1 General

All welding shall be carried out by a welder certified by EIZ for locally manufactured road tank vehicles, or relevant certifying authorities for imported road tank vehicles. The welding procedure used shall be such as to ensure that the filler metal, the heat affected zone and the surrounding parent metal are free from cracks, unacceptable cavities and trapped slag, and when relevant, acceptable free from tungsten inclusions. Butt welds shall have complete penetration. Fillet welds shall have a leg length at least equal to the thickness of the thinner of the parts being joined.

NOTE

The welding of aluminium alloys should be carried out in accordance with ZS EN 1011-4 (or equivalent standards).

6.4.2 Welding

6.4.2.1 Welds in steel and stainless steel

The mechanical properties of welded joints shall be equal to at least 85% of (and the corrosion resistance at least equal to) the minimum specified for the parent metal.

6.4.2.2 Welds in aluminium alloys

When subjected to transverse tensile test, a weld joint in an aluminium alloy, with the reinforcement removed shall have a tensile strength of at least the relevant value given below.

In the case of a joint between two dissimilar alloys, the tensile strength shall be at least that of the alloy that has the lower tensile strength.

TABLE 8: TENSILE STRENGTH OF WELD JOINTS IN ALUMINIUM ALLOYS

Alloy designation	Ultimate tensile strength MPa, min
5083	275
5251	160
5454	215
6061	165 ¹⁾
6063	120 ¹⁾
6082	165 ¹⁾
¹⁾ These values are for material welded in the TF condition after natural ageing for 3 days. Where; TF is the Temper Designation of Aluminium, and F As fabricated, applies to products in which no thermal treatments or strain-hardening methods are used to shape the product	

6.4.3 Baffle and ring stiffener joints

A baffle (or baffle-attaching ring) or a ring stiffener used for tank reinforcement (see 6.3.11) shall be fully welded around the circumference of the tank.

6.4.4 Overturn protection

Each closure for opening (but not limited to) manhole, fill or inspection openings and each valve fitting, pressure relief device, vapour recovery stop valve or the filling retaining located within the upper two-thirds of a cargo tank circumference (or cross-section perimeter in the case of non-circular tanks) shall be protected by being enclosed inside the body of the tank or by being enclosed inside an overturn damage protection device or being 125% as strong as such damage protection device would be.

- 6.4.4.1** An overturn damage protection device on a road tank shall be designed and installed to withstand any load normal (perpendicular to the tank surface) or tangential (in any direction perpendicular to the normal load) to the tank shell, applied anywhere over the protected part of the tank and equal to at least twice the weight of the load tank vehicle. The design shall be based on the ultimate strength of the material used.

These design loads may be considered independently. If more than one overturn protection device is used, each device shall be capable of carrying its proportionate share of the applicable loads and in each case at least a quarter of the applicable total tangential load. The design shall by means of calculations, tests, or a combination of test and calculations be proven capable of carrying the applicable loads. Deformation of the damage protection device is acceptable provided that the devices being protected are not damaged.

- 6.4.4.2** An overturn damage protection device that would otherwise allow the accumulation of liquid on the top of the tank shall be provided with drain that directs the liquid to a safe point of discharge, away from any structural component of the road tank vehicle.

- 6.4.4.3** The overturn damage protection device shall be so constructed to at least 60 mm above the manhole covers.

6.4.5 Manholes and Fill openings

Each tank compartment shall be provided with a manhole of diameter at least 400 mm, or with a 400 mm X 300 mm oval manhole. The manhole cover can be fitted with a hatch for opening and filling. The manhole cover and when relevant the hatch closure, shall not leak or fail when the tank is subjected to the test given in 8.2. The manhole shall always be in the centre.

6.5 FITTINGS AND ATTACHMENTS

6.5.1 General

All attachments to a tank shall be made from materials that are compatible with the material of the tank. The filling and discharge devices (including flanges and threaded plugs) and any protective caps shall be capable of being secured against unintended opening.

6.5.2 Valves

6.5.2.1 Design and mounting

Each liquid discharge opening shall be provided with a spring-loaded valve that opens towards the tank interior and is of a type that, when de-energised, will close automatically (fail safe). The valve seat shall be located within the mounting pad and the valve stem shall not be attached to the actuator.

The valve assembly shall be of a design such that in the event of an accident the actuator and the outlet pipe can break away, causing the valve to close automatically (fail safe). Alternatively, where the valves do not have a breakaway section, they shall be adequately protected by an under-rail damage protection device.

The offloading valves shall be fitted on the left side of the tank

6.5.2.2 Controls

Valve actuators shall be operated by spring-loaded mechanical levers, hydraulic or pneumatic means, with controls designed to give rapid response. An additional spring loaded mechanical lever, hydraulic or pneumatic control (emergency trip) shall be situated in a position away from any discharge point, and an acceptable means of automatically closing the valve(s) in the event of a fire shall be provided.

6.5.3 Vents

Each tank compartment shall be provided with at least one pressure-and-vacuum vent that is so designed as to prevent loss of liquid through the vent owing to surge or to the vehicle's overturning. The vent(s) shall be mounted, shielded and drained in such a manner as to prevent the accumulation of water. The exit of all vents other than emergency vents shall be secured in a safe manner.

6.5.3.1 Normal vents

A normal vent shall have an unrestricted outlet area of at least 280mm². When tested in accordance with 8.5.2.3 the vent shall start to open at a pressure not exceeding 7 kPa and when tested in accordance with 8.5.2.1 it shall start to open at a pressure not exceeding 3 kPa.

6.5.3.2 Filling and discharging vents

Where a tank compartment is designed for filling and discharging with the hatch closure closed it shall be provided, where necessary with an artificial vent or vents that at the specified liquid load and discharging rates for the tank (see 7.1 (i) in addition to the venting provided in terms of 6.5.3.1 ensure(s) that the pressure in the tank, determined in accordance with 8.5.2.2 cannot exceed 7 kPa.

Unless effective protection against overfilling is provided the vent(s) when tested in accordance with 8.5.2.8 shall have sufficient venting capacity to ensure that in the case of accidental overfilling a tank pressure of 20 kPa is not exceeded.

6.5.3.3 Emergency vents

The following requirements shall be complied with:-

- a) Each tank or compartment of a tank (as relevant) shall be provided with one or more emergency vents of total capacity determined in accordance with 8.5.2.9 of not less than the appropriate minimum given in Table 6. The vent may be fitted as part of the manhole cover or may be fitted directly to the top of the compartment shell.
- b) Pressure-actuated emergency vents shall be of a design that in the case of a pressure increase the vent(s) will function in any overturn of the vehicle. Each such vent shall when tested in accordance with 8.5.2.3 and 8.5.2.7 open at a pressure between 23.5 kPa and 25.0 kPa and close as soon as the pressure drops below this value and shall have a flow rate determined in accordance with 8.5.3.5 and corrected to standard reference conditions of at least 170 m³ of free air per hour.
- c) Where the pressure-actuated emergency vent(s) cannot provide the total minimum venting capacity required in terms of (a) above one or more fusible emergency vents shall be fitted to increase the rate to at least the required value. The venting capacity of a fusible vent shall be determined at a pressure of 35 kPa in accordance with 8.5.2.10.

A fusible vent shall

- i. be actuated by an element that operates at a temperature not exceeding 120 °C
- ii. have an unrestricted outlet area of at least 800 mm² and
- iii. be so positioned that under normal conditions, it cannot come into contact with the flammable liquid transported in the tank.

TABLE 9 - MINIMUM EMERGENCY VENTING CAPACITY

Exposed area of tank compartment m ²	Emergency venting capacity m ³ of air/h ¹⁾ minimum	Exposed area of tank compartment m ²	Emergency venting capacity m ³ of air/h ¹⁾ minimum
2	480	30	6650
3	720	35	7260
4	960	40	7830
5	1200	45	8370
6	1440	50	8880
7	1680	55	9370
8	1920	60	9840
9	2160	65	10300
10	2400	70	10700
12	2880	75	11200
14	3360	80	11600
16	3840	85	12000
18	4320	90	12400
20	4800	95	12800
25	6000	100	13200

¹⁾ Free air measured under standard reference conditions.

6.5.3.4 Flow rate of vents

When tested in accordance with 8.5.2.4 or 8.5.2.10 as relevant, the flow rate of a vent in cubic metres per hour (m³/h) corrected to standard reference conditions shall be at least that claimed by the manufacturer (see 7.2).

6.5.4 Vapour recovery system

6.5.4.1 The tank shall be fitted with a vapour recovery system that conforms to the following:

- Collector manifolds and down pipes shall be of a cross-sectional area of at least equal to that of a pipe with inside diameter 100 mm;
- Each individual compartment vapour transfer valve shall be connected in series to the respective compartment bottom valve (the compartment vapour vent will be open before the compartment bottom valve opens);
- The vapour transfer valve shall comply with ZS EN 13082;
- The coaming vent shall be of a normally open type and shall close to the atmosphere upon coupling of the vapour recover coupler from the loading installation. It shall operate on a fail-safe principle and shall incorporate a pressure and vacuum venting function should the pressure inside the collector manifold exceed 23 kPa or the vacuum exceed 5 kPa.

- e) The maximum back pressure of the entire vapour recovery system shall not exceed 5.5 kPa
- 6.5.4.2** The vapour recovery adaptor shall be in a location suitable for loading and offloading operations.
- 6.5.4.3** The vapour recovery adaptor shall comply with ZS EN 13081
- 6.5.5 Overfill protection**
 - 6.5.5.1** Tanks shall be fitted with an effective overfill prevention system, which shall terminate loading when an overfill situation is reached
 - 6.5.5.2** The overfill prevention system shall be installed such that product spillage is prevented, taking into account the flow rates of the loading facility and the reaction time of the various system elements. In no case shall an overfill system “trigger” when the remaining ullage in the compartment being loaded is:
 - a) Less than 200 litres for a vehicle fitted with pneumatic sensors
 - b) Less than 150 litres for a vehicle fitted with electronic sensors
 - 6.5.5.3** The trigger level shall be measured between the product level and the inlet to the compartment vapour vent;
 - 6.5.5.4** Each individual compartment shall be fitted with a separate overfill sensor.
 - 6.5.5.5** The overfill system shall be configured such that when any one sensor senses an overfill condition, the complete bottom loading action for the vehicle is terminated..
 - 6.5.5.6** Where overfill sensors are of an adjustable type, means shall be provided to seal the adjustment mechanism with a seal that shall indicate tampering after initial adjustment.
- NOTE** An example of a typical seal used is a “meter” seal.
- 6.5.5.7** Overfill protection systems shall not be fitted with over-ride mechanisms (which can be used to de-activate the system whilst loading the vehicle).
- 6.5.5.8** Where overfill protection systems are fitted with a standard open (electrical contact open when air pressure is not applied) pressure switch which serves to provide the electrical signal that an overfill sensor has triggered, the pressure setting of the switch shall be such that the switching to the open position occurs at 110 % of the minimum pneumatic control system operating pressure on the vehicle.
- 6.5.5.9 Electronic Overfill systems**
 - 6.5.5.9.1** Electronic overfill prevention systems shall comply with ZS EN 13922.
 - 6.5.5.9.2** Where an electronic overfill sensor has been fitted together with a pneumatic sensor to a tank compartment, the electronic sensor shall be set to trigger at an approximate 20 mm height before the pneumatic sensor triggers.

6.5.6 Piping and fittings

The piping and fittings shall have been designed for the pressure involved and before attachment to the tank, shall have been subjected in accordance with 8.3, to a pressure of 200 kPa but in the case of valves, manifolds and fittings that are subject to bottom loading, to a pressure of 800 kPa and shall have shown no sign of leaking.

Piping and fittings shall comply with the following requirements (see also 6.2.2).

- a. They shall not project beyond the sides or the ends of the vehicle and shall be so protected as to minimise accidental damage.
- b. Piping and flexible couplings shall be designed for a maximum flow rate of 7m³/min, and to withstand the most severe combined stresses of the vapour pressure of the product at a temperature of 55 °C and either the superimposed pumping pressure or the shock loadings caused by vehicle movements.
- c. Fill pipes of diameter exceeding 50 mm shall terminate not less than 50 mm and not more than the pipe diameter from the bottom of the tank while fill pipes of diameter 50 mm and smaller shall terminate not more than 50 mm and not less than the pipe diameter from the bottom of the tank.
- d. Unless located inside the manhole cover, a fill shall
 - i. be vented to the vapour space of the tank by a vent of diameter at least 10 mm (or equivalent area), fitted with wire gauze of nominal aperture size in the range 425 mm to 600 mm and so shrouded as to redirect the liquid down to the fill pipe and
 - ii. have a closure of a type such that excess pressure is automatically relieved before the closure is opened.

6.5.7 Dip tubes

Where a dip opening is provided, it shall comply with the relevant requirements of 6.5.4.1(d) for venting and pressure relief. The tube shall be stayed and of length such that it will guide the dip stick towards a reinforcing plate of thickness at least equal to that of the tank shell but not less than 3 mm.

6.5.8 Access to manholes and fill openings

Where tank-top access is required, it shall be done by means of a secure and safe access ladder, provided with handholds at the top to allow the operator to easily and safely access the tank top. The tank top shall be skid proof.

All tankers shall be equipped with a retractable hand rail.

6.5.9 Attachment of non-liquid carrying openings

Where practicable, attachment of non-liquid carrying components shall be made to the overturn damage protection device or sub frame of the vehicle and the following requirements shall in all cases be complied with:

- a. Attachment of heavy components to the shell or head of the tank shall be made by means of mounting pads of shape and size such that excessive stress concentration on the tank is prevented. The thickness of a pad shall not exceed the thickness of the shell or head (as relevant)

or the weld joint design shall be such that, when force is applied in the region of the pad, shear failure of the weld will occur without causing the tank to rupture

- b. Skirting structures, conduit clips, brake line clips and similar light components of a suitable metal of thickness not exceeding 70% of that of the shell or head to which they will be attached, or of construction or material appreciably less strong than the shell or head, may be secured directly to the shell or head provided that each component is so designed and installed that damage will not affect the flammable-liquid retention integrity of the tank. Light components shall be secured to the tank shell by continuous welding or in such a manner as to preclude formation of pockets that could become sites for corrosion.

6.6 PUMPING SYSTEMS

6.6.1 Power source

Where a pumping system is fitted to the vehicle, it shall be driven by one of the following means:

- a) the tractive engine of the vehicle
- b) a flameproof electric motor (see ZS 402 or any other equivalent standard);
- c) an air motor or an hydraulic motor or
- d) an auxiliary compression-ignition engine of sound design and construction complying to the requirements of ZS 1069 and;
 - i. has an air intake, fitted with an efficient flame arrester or located in a position such that in the case of a backfire, flammable vapour in the atmosphere will not be ignited
 - ii. has an exhaust system free from leaks, that is mounted at least 100 mm from the tank and from all liquid-carrying components and that discharges the gases at the rear of the cab as specified in 6.8.7
 - iii. has an electrical system (if fitted) that complies with the applicable requirements of ZS 402 or any other equivalent standard and
 - iv. is located in a suitable position and so shielded that flammable vapours are not drawn towards the engine and that spillages or leaks do not come into contact with the engine or the exhaust system but that is not so enclosed that overheating or the accumulation of explosive vapours can occur.

WARNING- A spark-ignition auxiliary engine shall not be used to operate the pumping system.

6.6.2 Pumps

The pump shall be suitable for the required application and shall have a rotational speed that is so controlled that the rating of the pump cannot be exceeded. The body shall be non-porous and made of a non-flammable material. The pump shall be mounted on the vehicle in a suitable position and protected from accidental damage.

6.6.3 Working pressure

The working pressure of a pumping system shall be as required. The entire system after assembly, when hydraulically tested in accordance with 6.4 at its normal working pressure, shall not leak.

6.7 HOSES

6.7.1 Normal hoses

A normal hose for the conveyance of flammable liquids shall be compatible with the liquid to be transported and its length, normal size, maximum working pressure and type (which shall be one of the following:

- a. a hose that has electrical continuity or
- b. a hose that has an anti-static cover and no electrical bonding (1m length shall have not less than $10^4 \Omega$ and not more than $10^7 \Omega$ electrical resistance)

A hose shall withstand a pressure of twice the maximum working pressure without bursting.

Normal hoses shall comply with all the relevant requirements of or its equivalent.

6.7.2 Aircraft fuelling hoses

When an aircraft fuelling hose is specified, it shall comply with all the relevant requirements of ZS EN 13765 or equivalent.

6.8 THE ROAD TANK VEHICLE

6.8.1 Cab

- a) The cab of a road tank vehicle shall be of sound design and construction and so mounted that a distance of at least 150 mm is provided between the back of the cab and the front of the tank.
- b) Where a steel cab is fitted, it shall preferably be insulated with a material that has a fire rating of class II and in the case of a glass-reinforced polyester cab, the laminate shall be flame retarded.
- c) Where a window is provided in the back of the cab, it shall be non-opening and of safety glass that complies with the relevant requirements of ZS 1070.
- d) Provision shall be made for the fitment of a removable orange diamond plate at the front of the vehicle when the vehicle is loaded and as long as it has not been degassed.
- e) A special clearly marked document holder shall be mounted in a conspicuous position in the cab (see 6.8.13.2). If the vehicle is used for different commodities on different legs of a trip, a lockable document storage container shall be mounted in a conspicuous position in the cab (see 6.8.13.3)
- f) A fire extinguisher complying with ZS 648 shall be mounted and secured in the cab at an easily accessible position for the driver to reach whilst in the driving seat.

6.8.2 Shielding of engine

Where the engine or any component part of the engine extends beyond or is exposed at the rear of the cab, it shall be shielded from overhead spillage by a metal shield. Care shall be taken to ensure that engine cooling is not restricted.

6.8.3 Chassis and mounting of tank(s)

The chassis of a road tank vehicle and the means of attachment of tank(s) shall be designed to withstand the loading given in 6.3.6 and 6.3.7 based on the mass of the fully loaded tank(s) complete with fittings and attachments subject to a permissible stress of not more than the value given in terms of 6.3.4. The tank(s) shall form an integral part of or be attached to the chassis in a positive and safe manner and such that relative movement between a tank and the chassis is restricted and no excessive stress due to loading or vehicle movement is introduced into the shell.

In the case of a return haulier, the tank must be “attached to the chassis in a positive and safe manner such that relative movement between a tank and the chassis (trailer in our case) is restricted and no excessive stress due to loading or vehicle movement is introduced into the shell.”

Structural Isolation and Attachment of the Dry Cargo Pan

Stress Isolation Mandate: The return haulier cargo pan or platform must be integrated into the vehicle frame in a manner where no localized stress, weight, or twisting force from the dry cargo is transferred into the fuel tank shell or heads.

Mounting Pad Engineering: Any load-bearing connection or heavy framework supporting the dry cargo pan that attaches near the tank structure must use dedicated structural mounting pads.

Sacrificial Weld Rule: The thickness of these mounting pads must not exceed the thickness of the tank shell or head. The weld joints must be engineered so that if an accidental shifting of dry cargo occurs, the weld will experience a shear failure cleanly **without rupturing or tearing the fuel tank shell**.

Prevention of Corrosion Pockets: Any component or framing for the cargo pan that sits adjacent to or directly on the tank body must be continuously welded. This prevents the formation of hidden gaps or pockets where moisture and debris from dry cargo could collect and trigger accelerated galvanic corrosion.

6.8.4 Stability

The height of the centroid of the tank cross-section at half the tank length shall fall within an isosceles triangle that has a base length at ground level equal to the overall width between the outside walls of the outside tyres of the major load axles and that has base angles not exceeding 62°.

6.8.5 Demountable tanks

A demountable tank shall comply with all the appropriate requirements of this standard, except that an ISO container tank designed for the conveyance of petroleum-based flammable liquids may be used, provided that such a tank is properly secured (see ZS ISO 3874) to the truck through the bottom corner fittings by means of acceptable securing devices, e.g. twist locks or pin-type securing devices.

When so required, a demountable tank shall be fitted with lifting lugs. Such lugs shall be so designed as to withstand the maximum stress values induced when a fully loaded tank is being lifted. A

demountable tank of capacity not exceeding 3,000 litres shall be exempt from the requirements given in

- a) 6.5.3.3 (emergency vents) and
- b) 6.4.4 (overturn protection) provided that each fitting is protected by (at least) a vertical metal strip a thickness at least 4.5 mm and that extends continuously around it and projects at least 25 mm above the fitting (or unless each fitting is provided with equivalent protection).

6.8.6 Mudguards

All tyres on the horse and the trailer shall be fitted with effective mudguards covering at least the full width of the tyres on the wheel position.

6.8.7 Emergency spill kits

All vehicles shall carry emergency spill kits for containment of spillages.

6.8.8 First aid Kit

All vehicles shall carry a first aid kit on the cab in accordance with the requirements of the Road Transport and Safety Agency (RTSA)

6.8.9 No bypass on overfill protector and vapour recovery system

In no case shall a bypass system be installed on an overfill protection and or vapour recovery system.

6.8.10 Reverse buzzer

A reverse buzzer shall be so fitted to provide warning when the vehicle is moving in reverse.

6.8.11 Provision of beacon

All vehicles shall be fitted with an amber beacon on the cab.

6.8.12 Drive away prevention

Drive away prevention mechanism shall be so fitted to prevent the vehicle being moved while loading or offloading.

6.8.13 Placard and document holders

6.8.13.1 Holders for identification placards

Holders for identification placards shall be fitted on each side and rear of a tank. Holders shall be of such size and shape that suitable placards can be fitted that identify the type of liquid being conveyed and describe the action to be taken in the event of an emergency. The placard holders shall be at least 710 mm by 410 mm.

6.8.13.2 Document holder in cab

A container shall be provided to store emergency information documents during transportation. The container shall be installed as a permanent fixture towards the front of the cab and near the centre of the cab so that the documents can be reached in an emergency, either from the inside of the cab or through a broken front windshield. The container shall be orange in colour and shall be marked with the word “DOCUMENTS”. The holder shall be large enough to store:

- i. Tremcards,
- ii. Dangerous goods information,
- iii. Route information.

No other items shall be stored in the document holder.

6.8.13.3 Document storage container

A separate unmarked container shall be available to hold any documents related to the current load such as signed-off delivery notes for offloaded products.

6.8.14 Electrical Equipment

6.8.14.1 Electrical System

The electrical system shall comply with the requirements given below and shall be certified through a valid electrical certificate issued by a qualified auto-electrical practitioner or institution registered with the Engineering Institution of Zambia (EIZ).

Annex E gives a typical check list of electrical inspections and tests to be performed.

6.8.14.2 Wiring

The conductors shall be large enough to avoid overheating. Conductors shall be adequately insulated. All circuits shall be protected by fuses or by automatic circuit breakers, except for the following;

- a) From the battery to the cold start and stopping systems of the engine.
- b) From the battery to the alternator
- c) From the alternator to the fuse or circuit breaker box and
- d) From the battery to the starter motor and from the battery to the power control housing of the endurance braking system if this system is electrical or electromagnetic.

The above protective systems shall be as short as possible.

The cables shall be securely fastened and positioned in such a way that the conductors are adequately protected against mechanical and thermal stresses.

6.8.14.3 Battery master switch

The vehicle shall be fitted with a master switch comprising the following requirements:

- a) A four pole isolating switch for breaking the electrical circuits shall be placed as close to the battery as is practicable. It shall be protected against inadvertent operation and shall be easily operated by someone standing next to the vehicle.
- b) The switch shall have a casing with protection degree IP 65 in accordance with ZS IEC 60529

- c) The cable connections on the switch shall be of protection degree IP 54. However this does not apply if these connections are contained in housing, such as the battery box. In this case it is sufficient to insulate the connections against short circuits, for example with rubber cap.
- d) Shall be labelled

Where jump-start sockets are fitted, these shall be connected to the switched side of the battery master switch and shall either be installed inside the battery enclosure or in a separate enclosure.

6.8.14.4 Battery

6.8.14.4.1 The battery terminals shall be electrically insulated and covered by a non-conducting battery box cover. If the batteries are not located under the engine bonnet they shall be fitted with a vented box.

6.8.14.4.2 The batteries shall be properly secured by clamping to ensure minimum movement.

6.8.14.4.3 Batteries with cell-to-cell connection exposed shall not be allowed.

6.8.14.5 Permanently Energized Circuits

Those parts of the electrical installation that include the leads that remain energized when the battery master switch is open shall be suitable for use in hazardous areas. Such equipment shall meet the general requirements.

- a) Permanently energized electrical equipment, including the leads, shall meet the requirements for zone 1 for electrical equipment in general, or shall meet the requirements for zone 2 of electrical equipment situated in the drivers cab (See ZS 402 or any other equivalent standard), and
- b) The requirements for explosion group II, temperature class T6 shall be met.

6.8.14.6 Electrical Installation at the rear of the drivers cab.

6.8.14.6.1 General

Electrical installations to the rear of the cab shall comply with the following requirements:

- a) electrical junction boxes and other equipment shall not be installed in positions where there is a risk of product spillage onto such equipment from leaking valves, pipelines and product handling activities, such as loading and discharge,
- b) all connections shall be made in secure junction boxes using fixed terminals or in moulded conduit branches,
- c) cable entry into the junction boxes shall be by means of suitable glands,
- d) electrical connections shall not make use of open contacts, connections by means of piercing contacts and push-in connections, unless the latter are fitted with a durable mechanical latch,
- e) electrical equipment installed adjacent to equipment and areas that might vent to the atmosphere, including the bottom loading and vapour recovery adaptors, shall comply with the requirements in Table 10 This does not include permanently energized

equipment.

TABLE 10 — DISTANCES FROM SOURCE OF VAPOUR/LIQUID RELEASE TO ELECTRICAL EQUIPMENT

1	2
Distance from source of vapour/liquid release	Equipment requirement
Less than 500 mm	Suitable for Zone 2 operation (refer to ZS 402)
From 500 mm to 1000 mm	Totally protected against dust ingress and Protected against low pressure water jets from any direction. Limited ingress permitted.
Greater than 1000 mm	No restriction

6.8.14.6.2 Wiring

The wiring located to the rear of the drivers cab shall be protected against impact, abrasion and chafing during normal vehicle operation. Examples are shown in Figures 1-4 below. The sensor cables of anti-lock braking devices do not need additional protection.

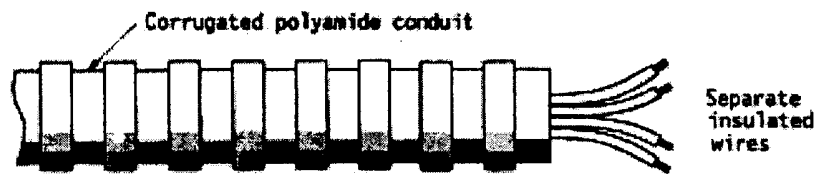


Figure 1 — Corrugated polyamide conduit

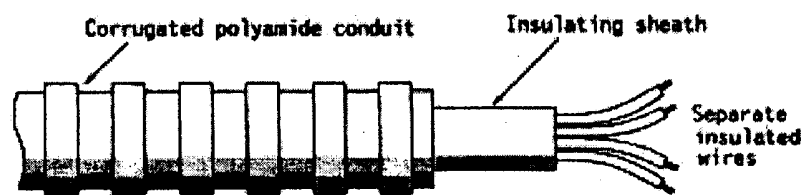


Figure 2 — Corrugated polyamide conduit with insulating sheath

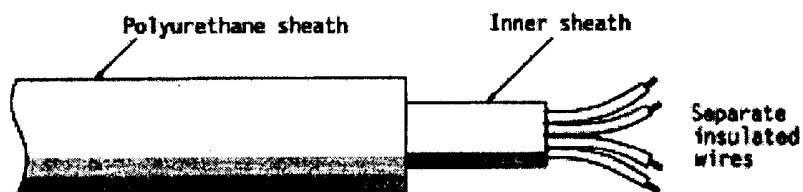


Figure 3 — Polyurethane sheath with inner sheath

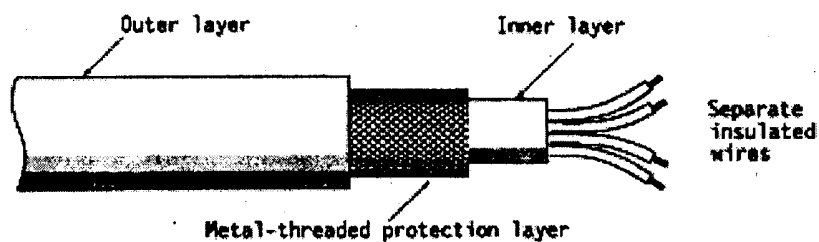


Figure 4 – Metal-threaded protection layer

6.8.14.6.3 Lighting

Lamp bulbs with screw caps shall not be used.

6.8.14.6.4 Electrical Connections

Electrical connections between motor vehicles and trailers shall be of protection degree IP 54 in accordance with ZS IEC 60529 and shall be designed to prevent accidental disconnection. Examples of appropriate connections are given in ZS ISO 7638-1 and ZS ISO 7638-2.

6.8.14.6.5 Electrical bonding

The chassis, tank, piping and associated equipment, including all covers shall be so bonded together as to ensure electrical continuity. This bonding shall be connected to two clearly marked earthing points one on each side of the vehicle, each of which shall be connected to the earth bond wire when the tank is being filled or discharged. The final discharge electrical hose connection shall be bonded to the road tank vehicle or shall be completely insulated from the road tank vehicle by means of an insulating block or a non-conductive hose. (See also ZS 385-2).

No earth point shall be insulated or painted.

6.9 BRAKING EQUIPMENT

6.9.1 General requirements

Motor vehicles shall comply with the requirement of 6.9.2 and 6.9.3 in accordance with Table 1.

6.9.2 Anti-lock braking system

Motor vehicles of GVM exceeding 16 000 kg, and motor vehicles authorized to tow trailers of GVM exceeding 10 000 kg, shall be equipped with anti-lock braking systems of category 1 in accordance with ZS 1071.

Trailers of GVM exceeding 10 000 kg shall be equipped with anti-lock braking systems of category A in accordance with ZS 1071.

6.9.3 Endurance Braking system

Motor vehicles of GVM exceeding 16 000 kg, and motor vehicles authorized to tow trailers of GVM exceeding 10 000 kg, shall be fitted with endurance braking system. The system may be a single device or a combination of several devices and each device may have its own control.

The effectiveness of the endurance braking system shall be so controlled by the anti-lock braking system that the axle(s) braked by the endurance system cannot be locked by the endurance braking system at speeds above 15 km/h. This requirement shall not apply to that part of braking system constituted by natural engine braking.

6.10 PREVENTION OF FIRE RISKS

6.10.1 Vehicle Cab

Any windows in the rear of the cab or in the shield shall be hermetically closed and shall be made of fire-resistant safety glass with fire resistant frames that prevent the glass from falling out in the event of a fire. Furthermore, there shall be a clear space of at least 150mm between the tank and the cab or the tank and the shield.

6.10.2 Fuel Tanks

In the event of any leakage from the fuel tank(s) supply of the vehicle, the fuel shall drain to the ground without coming into contact with hot parts of the vehicle or the load.

6.10.3 Exhaust System

The exhaust shall discharge sideward on the right hand side of the vehicle at the point not closer than 1000 mm from any tank outlet or liquid discharge point. Parts of the exhaust situated directly below the fuel tanks shall either have a clearance of at least 1000 mm or be protected by a thermal shield. A vertical shield may be used provided that there is effective shielding and an effective method of preventing ingress of flammable liquid is used.

6.10.4 Endurance Braking

Vehicles equipped with endurance braking systems that raise the temperature and that are placed behind the rear wall of the driver's cab, shall be equipped with thermal shield, securely fixed and located between the system and the tank or load so as to avoid any heating, even local, of the tank wall or the load.

In addition, the thermal shield shall protect the braking system against any outflow or leakage, even accidental, of the load. Protection that includes a twin-shell shield is considered satisfactory.

6.10.5 Combustion heaters for heavy fuel oil and bitumen road tank vehicles

6.10.5.1 Combustion heaters and their exhaust gas routing shall be so designed, located and protected or covered as to prevent any unacceptable risk of heating or ignition of the load. This requirement shall be considered to have been complied with if the fuel tank and the exhaust system of the appliance comply with the requirements equivalent to those prescribed for fuel tanks and exhaust system in 6.10.2 and 6.10.3 respectively.

6.10.5.2 Combustion heaters shall have an air intake with a flame arrestor.

6.10.5.3 Combustion heaters shall be capable of being put out of operation by at least the following methods:

- a) intentional manual switching from the driver's cab;
- b) stopping of the vehicle engine, in which case the heating device may be restarted manually by the driver; and\
- c) start-up of a feed pump on the vehicle for the dangerous goods carried.

6.10.5.4 The combustion heater shall be switched on manually. Programming devices shall not be used.

6.11 FIRE EXTINGUISHERS

One portable (1 kg to 4.5 kg maximum) dry chemical powder Fire Extinguisher (or any acceptable type) shall be carried in the cabin. Two portable fire extinguishers shall be carried on the outside of each road tank vehicle, one on each side. An extinguisher shall be of the multipurpose dry powder type (suitable for fires of classes A, B, and C) and shall comply with the relevant requirements of ZS 373-3 and be of capacity at least 9.0 Kg. The suitable mounting position provided for the extinguishers must allow for easy access to the equipment.

The fire extinguisher shall be fully charged, serviced by a competent service provider, have a service sticker indicating the service date and the next service date that is weather proof with indelible marking.

Multiple combination vehicles shall carry one fire extinguisher per unit in the combination; rigid vehicles shall have two fire extinguishers and on a truck tractor as in the case of ISO containers (see 6.8.5) there shall be two fire extinguishers.

6.12 REAR BUMPER AND UNDER RUN PROTECTION

Stout steel guards on the frame of the vehicle shall be used to protect the lower part of the rear of the tank and piping in the event of a collision and to minimize the possibility that the tank will be struck by any part of a colliding vehicle. The tank must not go beyond the chassis. The rear bumper shall be placed at least 300 mm beyond the rear end of the tank

Road tank vehicles of GVM exceeding 3500 kg shall be fitted with rear and side under run protection devices at a maximum height of 500mm from the ground.

6.13 MANHOLE COVERS

Manhole cover, including fill openings shall comply with the requirements of one of the following tests:

- a) a drop test (see 8.6.1) after which there shall be no leakage or
- b) a pressure test (see 8.6.2). The unit shall be structurally capable of withstanding, without leakage or permanent deformation that would affect its structural integrity, the greater of a static internal fluid pressure of 25 KPa or the tank test pressure (see 8.2).

6.14 TYRES

All tyres shall be in good condition as provided for in ZS 437-2. A combination of steel belted and nylon tyres on the same side of an axial shall be prohibited. No re-treaded combination on any axial either horse or trailer. Tyre mismatch by tread depth and tread pattern shall not be accepted. The acceptable allowable tread depth mismatch shall be 4mm.

The vehicle shall have a minimum of one spare tyre within the manufactures shelf life.

6.15 ELECTRICAL CONTINUITY

6.15.1 Metal-to-metal connections shall have a continuity of less than 10 ohms.

6.15.2 Non-metallic conductive components shall be installed such that electrical continuity with the adjacent component is less than 10^6 ohms.

6.15.3 Tanks shall be mounted such that the electrical conductivity between the tank and the wheels does not exceed 10 ohms and between the tank and the road surface does not exceed 10^6 ohms.

6.16 SPEED LIMITING DEVICE

Road Tank Vehicles may be fitted with speed limiters complying with provisions of the Road traffic Act No. 11 of 2002.

6.17 TRACKING SYSTEM

Road Tank Vehicles shall be fitted with a real time (satellite) monitoring device

7. MARKING

7.1 Tanks

The tank serial number shall be stamped on a suitable part of the tank. Each tank shall in addition bear the following information legibly and durably marked on a flameproof data and inspection plate that is adequately secured to the tank or attached structure and that is preferably located on the left side (facing forward) of the tank near the front and in a place readily accessible for inspection:

- a) the manufacturer's name trade name or trade mark
- b) the serial number of the tank
- c) the date of manufacture
- d) the date of test
- e) the design pressure
- f) the tank capacity in litres per compartment (front to rear)
- g) the maximum liquid load in kilograms
- h) the maximum design liquid density in kilograms per cubic metre
- i) the maximum fill rate in litres per minute and pressure, in kilopascals
- j) the maximum discharge rate in litres per minute

7.2 Vents

Each vent shall be legibly and durably marked with its flow capacity and the pressure at which this was determined or with a reference number. Where a vent is marked with a reference number the supplier shall provide, in a pamphlet or booklet details of the flow capacity and pressure for that reference number.

7.3 Warning signs (HAZCHEM, Reflectors, No smoking, No naked flame and Switch off Cell phone)

- 6.3.2** For the purpose of fire handling alert, each tanker must carry HAZCHEM signs and adjacent No smoking and No Naked Flame signs at the rear and at the front side of the cargo tank (See Annex D).
- 6.3.3** The tank trailer must have high density orange reflectors along its sides for the safety of other road users. The reflectors shall be continuous along the sides of the tractor, tanks or trailer. These reflectors shall comply with ZS 676.
- 6.3.4** The rear of the trailer shall have a chevron and adequate red reflectors
- 6.3.5** The tractor and the trailer(s) shall have certified number plates for easy identification

8. INSPECTION AND METHODS OF TEST (start)

8.1 Inspection

Visually examine and using any means that will provide the required accuracy, then measure the tank and components of the road tank vehicle for compliance with all the relevant requirements of clauses 6 and 7 which tests are not given in 8.2 to 8.6.2 inclusive. Ongoing inspection of road tank vehicles for flammable liquid shall include the evaluation of the operator's quality system. In this connection it should be noted that ZS ISO 9001 covers the provisions of quality management system.

Internal and External Inspection of the road tank vehicle shall be undertaken by an authorized inspections body at least once every year. In addition to this requirement the internal and external inspections shall be carried out after any major repairs are undertaken (e.g. road accident repairs, structural repairs).

A certificate shall be issued to show the test results of the inspection carried out as shown in 8.2 to 8.6.

8.2 Resistance of the tank to Hydrostatic or Pneumatic Pressure

With the manhole cover removed the manhole opening covered with a plate and all relief valves clamped, plugged or otherwise rendered inoperative, subject the tank to an internal hydrostatic or pneumatic test pressure equal to the higher of the marked design pressure (see 7.1 (e)) or 35 kPa.

Maintain the pressure for a period of 30 minutes at 1.25 MAWP (Maximum Available Working Pressure) to verify that the tank does not burst or leak (see 6.4.1 and 6.4.5). If it is a compartmentalised tank, test each compartment separately, ensuring that the adjacent compartments are empty and at atmospheric pressure.

8.3 Hydrostatic or Pneumatic Testing of Pipes, Valves, Manifold and Fittings

Prior to attachment, subject each pipe, valve, manifold and fitting used for conveying liquid to a hydrostatic or a pneumatic test at the relevant pressure given in 6.5.4. Maintain the pressure long enough to detect any leaks.

8.4 Resistance of the Pumping System to Hydraulic Pressure

After final assembly subject the entire pumping system (if fitted) of the road tank vehicle to a hydraulic pressure test at normal working pressure (see 6.6.3). Continue pumping long enough to detect any leaks.

This shall be carried out to determine the residual thickness of the shell plate in comparison to the minimum allowable retirement thickness.

8.5 Welding Tests

These shall be carried out after any welding repairs on the tank as set out in ZS ISO 15614-1 or its equivalent)

8.5.1 Apparatus. Shall consist of the following:

8.5.1.1 Steel test tank of depth 0.3m and of length and width 1 m each, suitably constructed to withstand a pressure of at least 50 kPa, with provision for mounting a manhole cover, adapters for fitting additional vents where required, and an 80 mm screwed inlet at the bottom.

8.5.1.2 Pressure gauge, capable of reading from - 10 kPa to + 100 kPa.

8.5.1.3 Air flow meter.

8.5.1.4 Water flow meter

8.5.1.5 Exhauster

8.5.1.6 Compressed air supply

8.5.1.7 Water supply

8.5.2 Procedure

- 8.5.2.1** Fit in the normal operating positions the manhole cover, the hatch and where relevant any additional vent(s) of the prototype used on the test tank. Test the appropriate vent(s) as given in 8.5.2.2 to 8.5.2.10 with, when relevant all other vents sealed or otherwise rendered inoperative.
- 8.5.2.2** Connect the exhauster, air flow meter and pressure gauge to the tank. Operate the exhauster, record the vacuum at which the vent starts to open and check normal vents for compliance with 6.5.3.1.
- 8.5.2.3** Where relevant, slowly increase the rate of exhaustion to a value corresponding to the maximum liquid discharging rate (see 7.1 (j)).
- 8.5.2.4** Check that filling and discharging vents do not allow the vacuum to exceed 7 kPa (see 6.5.3.2).
- 8.5.2.5** Disconnect the exhauster and replace it with the compressed air supply. Slowly introduce dry air and check the pressure at which the vent starts to open for compliance with 6.5.3.1 in the case of normal vents and with 6.5.3.3 (b) in the case of pressure actuated emergency vents.
- 8.5.2.6** Adjust the air flow until steady operating conditions are obtained at a pressure corresponding to the pressure claimed by the manufacturer (see 7.2) Except in the case of fusible vent (which is tested as in 8.5.2.10) record the flow rate and check for compliance with 6.5.3.4).
- 8.5.2.7** When relevant adjust the air flow until a steady pressure of 35 kPa is obtained and check the flow rate of pressure actuated emergency vents for compliance with 6.5.3.3(b).
- 8.5.2.8** When relevant adjust the rate of air flow to the maximum liquid filling rate for the tank (see 7.1(1)) and check filling and discharging vents for compliance with 6.5.3.2.
- 8.5.2.9** Adjust the air flow to obtain a pressure in excess of 25 kPa, slowly decrease the air flow and check the pressure at which the emergency pressure vent closes for compliance with 6.5.3.3(b).
- 8.5.2.10** When relevant, connect the tank to the flow meter, pressure gauge and water supply. Adjust the flow rate to the maximum liquid filling rate for the tank (see 7.1 (i) and check the filling vent for compliance with the relevant requirement of 7.5.3.2.
- 8.5.2.11** Dry the tank manhole cover and vents. Where a fusible vent is fitted remove the plug. Connect the air supply, flow meter and pressure gauge to the tank and by introducing dry air at a steady pressure of 35 kPa, verify that the total venting capacity of the emergency vents complies with 6.5.3.3(a).
- 8.5.2.12** Where a fusible vent is fitted by repeating 8.5.2.4 with the plug removed and with all other vents sealed verify the accuracy of the flow rate claimed by the manufacturer (see 7.2 and 6.5.3.3(c)).

8.6 Testing of Manhole Covers (and Hatch Closures, when fitted)

8.6.1 Drop test

Conduct the test as follows:

- 8.6.1.1** attach the base plate of the manhole cover, including the fill opening of the end of a steel tube of such thickness that it will not distort during the test and that it has a length of 1.5 to 1.6 m and a shape such that the sealing ring of the base plate forms a liquid tight joint with the tube and with a suitable stop at the end of the tube;
- 8.6.1.2** place the assembly in a suitable apparatus with the manhole cover at the bottom. Fill the tube with water to a depth of 0.9 m to 1.0 m;
- 8.6.1.3** raise the assembly vertically to height of 1.45m to 1.55m (measured from its lowest point); and
- 8.6.1.4** allow the tube and fitted manhole cover to fall freely through a distance of 1.20m - 1.21m and arrest the fall abruptly by means of the stop at the open end of the tube.

Consider the manhole cover (and hatch closure, if fitted) to have passed the test if the assembly remains liquid-tight throughout, except that slight leakage is permissible on impact, provided that the leakage stops immediately thereafter.

8.6.2 Pressure test

Conduct the test as follows:

- 8.6.2.1** fit each manhole cover including the fill opening with a safety device that prevents the cover from opening fully when internal pressure is present;
- 8.6.2.2** secure each cover with fastening that will prevent opening of the covers as a result of vibration under normal conditions of transportation or of shock impact due to a rollover accident on the roadway or shoulder, provided that the area is not struck by a substantial obstacle.
- 8.6.2.3** mark each cover permanently by stamping or other means with
 - a) the manufacturers name
 - b) the test pressure in kPa; and
 - c) a statement certifying that the manhole cover meets the pressure test requirements

ANNEX A

(Normative)

NOTES TO PURCHASERS

The following requirements shall be specified in tender invitations and in each order or contract:

- a) the type and grade of metal required for the tank(s) see 6.2.1;
- b) the type of road tank vehicle;
- c) the total volume capacity of the tank in litres (see 6.3.2);
- d) when relevant, the orientation of oval manholes (see 6.4.5);
- e) the normal working pressure of the pumping system (see 6.6.3);
- f) the length, normal size, maximum working pressure and type of hoses (see 6.7);
- g) whether lifting lugs are to be fitted to demountable tanks (see 6.8.5);
- h) whether identification placard holders are to be fitted (see 6.8.6); and
- i) when relevant, the volume capacity of the individual compartments. (see 6.3.2)

ANNEX B

(Normative)

INFORMATION TO BE SUPPLIED BY THE MANUFACTURER

The manufacturer shall supply the purchaser with the following information in the form of a data book with each road tank vehicle produced:

- a) details of the markings required for tanks and vents in terms of clause 7;
- b) design calculations that prove compliance with the relevant requirements of 6.3;
- c) where applicable certificates covering the chemical analysis and tensile properties of all metal(s) used for the construction of the tank(s) piping and fitting (see 6.2.1 and 6.2.2);
- d) where applicable, certificates covering the Charpy V-notch impact values for the metal(s) and weld deposit(s) used in the construction of the tank(s) (to prove compliance with the requirements of 6.2.1 and 6.4.2.2);
- e) weld procedure test results that prove compliance with 6.4.2;
- f) proof of compliance of the prototype and of road tank vehicles of the same model designation with the requirements for manhole covers (see 6.4.5) vents (see 6.6.3) and hoses (see 6.7); and
- g) the results of pressure tests carried out in accordance with 8.2 to 8.6

ANNEX C

(Normative)

INSPECTION RECORD

Inspection of a road tank vehicle during and after its fabrication should include but not restricted to the following items and should be supported by a full detailed inspection report:

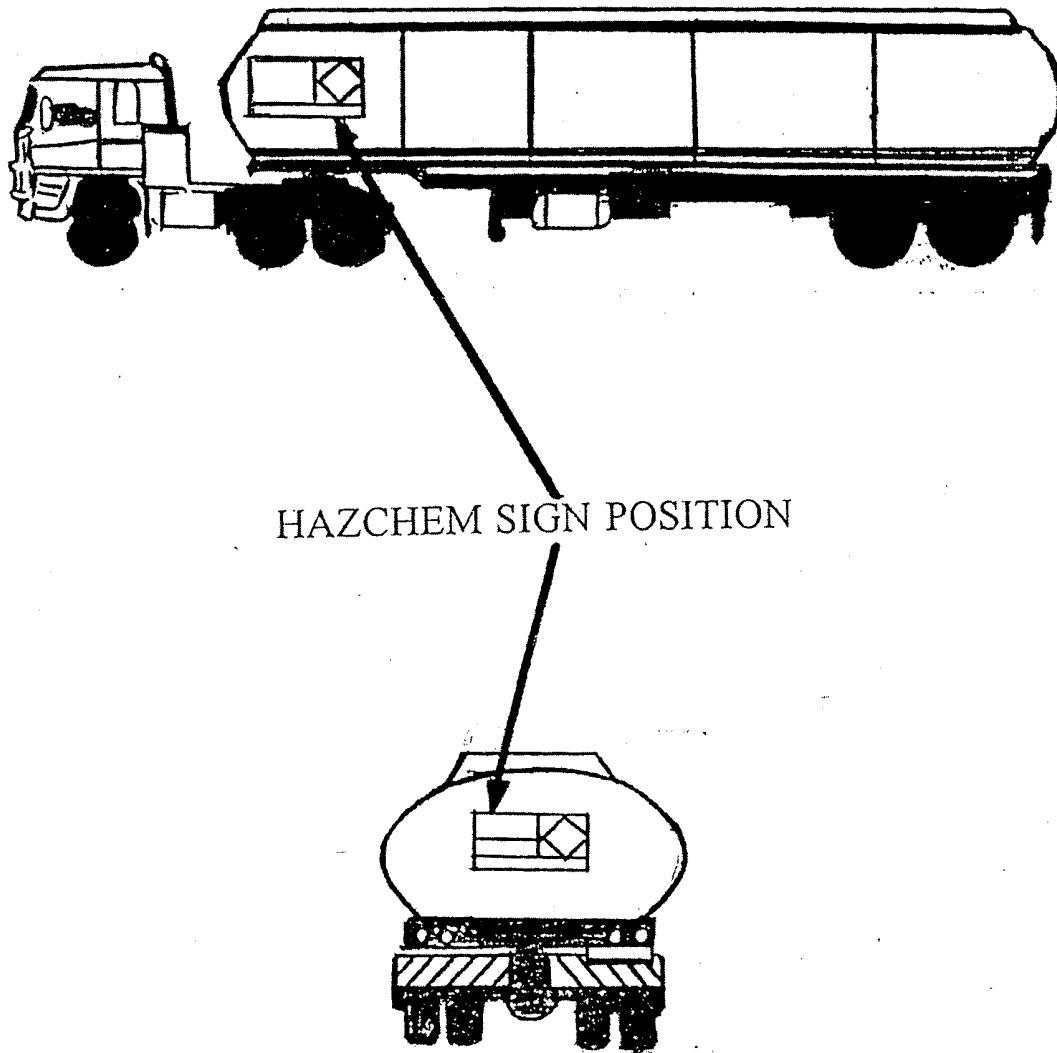
Sub clause	Item inspected
6.2.1	Metal(s) for tank(s)
6.2.2	Materials for pipes, fittings and other ancillary equipment
6.2.3	Gasket joint rings and other components
6.2.4	Other materials if any
6.3.2	Capacity of each tank
6.3.9	Thickness of the shell, heads, bulk-heads and baffles
6.3.10	Stiffening of heads, bulk-heads and baffles
6.3.11	Circumferential reinforcement
6.4.2.1	Welding: general
6.4.2.2	Welds in steel and stainless steel
6.4.2.3	Welds in aluminium alloys
6.4.3	Baffle and ring stiffener joints
6.4.4	Overturn protection
6.4.5	Manholes and fill openings
6.5.2.1	Valves: design and mounting
6.5.2.2	Valve controls
6.5.3.1	Normal vents
6.5.3.2	Filling and discharging vents
6.5.3.3	Emergency vents
6.5.4	Piping and fittings
6.5.5	Dip tubes
6.5.6	Access to manholes and fill openings (ladder, catwalk, hand rail etc)
6.5.7	Attachment of non-liquid carrying components
6.6.1	Power source for pumping
6.6.2	Pump(s)
6.6.3	Working pressure
6.7.1	Normal hoses
6.7.2	Aircraft fuelling hoses
6.8.1	Cab
6.8.2	Shielding of engines
6.8.3	Chassis and mounting of tank(s)
6.8.5	Demountable tanks
6.8.6	Placard and document holders
6.8.6.1	Holders for identification placards (if applicable)
6.8.6.2	Document holder in cab
6.8.6.3	Document storage container
6.8.7	Electrical Equipment
6.8.7.1	Electrical system
6.8.7.2	Wiring
6.8.7.3	Battery Master switch
6.8.7.4	Battery

Sub clause	Item inspected
6.8.7.5	Permanently Energised circuits
6.8.7.6	Electrical installation at the rear of the driver's cab
6.9	Braking System
6.10	Prevention of Fire risks
6.10.1	Vehicle cab
6.10.2	Fuel tanks
6.10.3	Exhaust system
6.10.4	Endurance braking
6.10.5	Combustion heaters for heavy fuel oil and bitumen road tank vehicles
6.11	Fire extinguishers
6.12	Rear bumper and under run
6.13	Manhole covers and openings
6.14	Tyres
6.15	Speed limiters
6.16	Vapour recovery system
6.17	Overfill protection sensors
6.18	Flame arrestors
7.	Marking
7.1	Marking of tanks
7.2	Marking vents
8.	Inspection and Methods of test
8.2	Resistance of the tank to hydrostatic or pneumatic pressure
8.3	Hydraulic or pneumatic testing of pipes, valves, manifolds and fittings
8.4	Resistance of the pumping system to hydraulic pressure
8.5	Pressure, vacuum and flow testing of vents
8.6	Testing of manhole covers (and hatch closures, when fitted)

ANNEX D

(Normative)

REFLECTOR AND HAZCHEM SIGN POSITIONS



ANNEX E

(Normative)

ELECTRICAL INSPECTION AND TESTING CHECK LIST

Under listed are mandatory electrical checks for a road worthy vehicle. These checks shall be considered to the minimum requirements.

Vehicle registration number:

Check serviceability of: CONDITION

1. **Battery Master Switch**
2. **Battery Electrolyte and Terminals**
3. **Battery Bracket and Cover**
4. **Indicator and Lenses**
5. **Parking Lights and Lenses**
6. **Brake Lights and Lenses**
7. **Headlights and Lenses**
8. **Wipers**
9. **Horn**
10. **Starter Motor Cables and Connections**
11. **Charging System**
12. **Ignition System**
13. **General Cable Insulation and Wiring**
14. **Tachograph**
15. **Bonding Cable**
16. **Earth Pins**

VALIDITY PERIOD: Three (3) months

DATE OF ISSUE:

EXPIRY DATE:

CHECKED BY: Company name:

Address:

Name of Inspector:

Qualification:

SIGNATURE:

ANNEX F

(Normative)

SAMPLE PICTURES OF A RETURN HAULIER VEHICLE

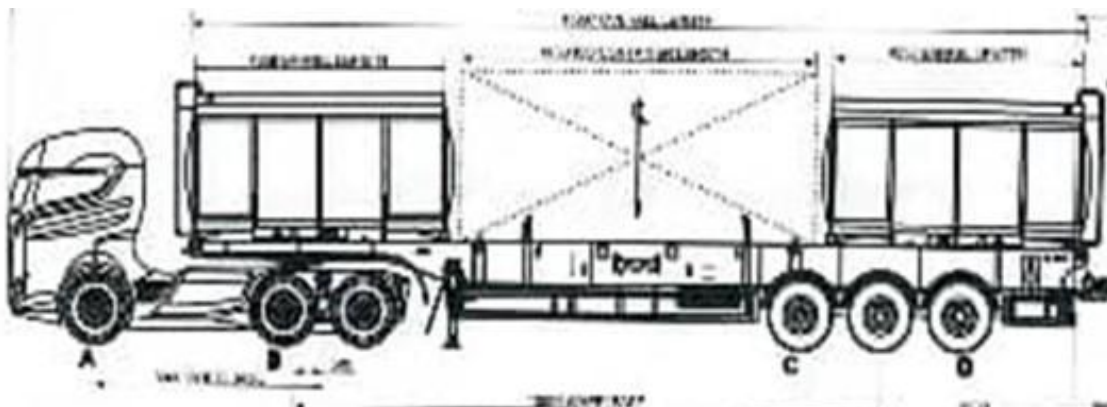
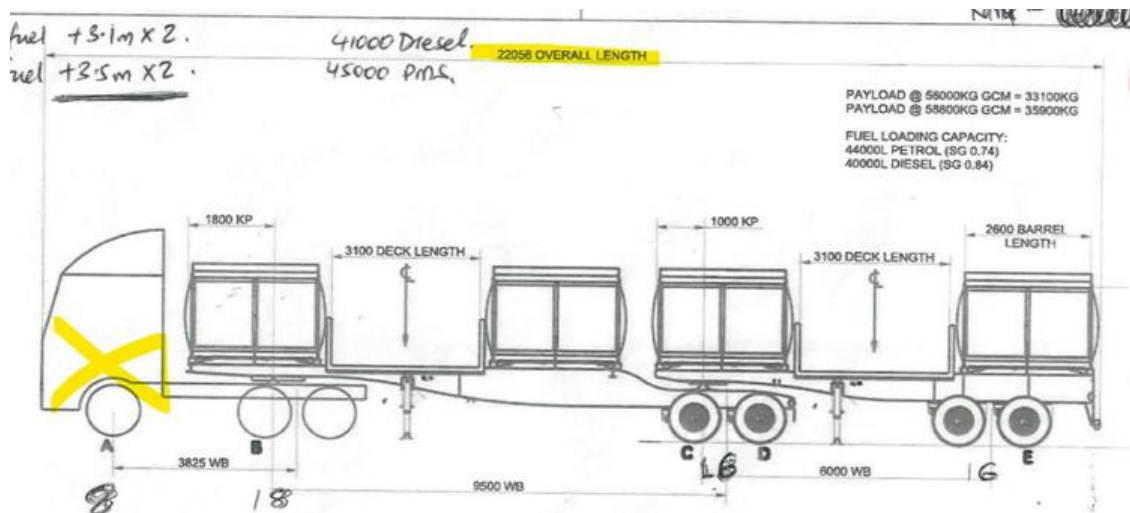
F.1 Loaded with petroleum products



F.2 Ready to load dry cargo(offloaded petroleum product)



F.3 Loaded with dry cargo



ANNEX G

(Informative)

BIBLIOGRAPHY

1	BS 5500	Specification for unfired fusion welded pressure vessels
2	ZS 385-1	The Petroleum Industry - Part 1: Storage and distribution of petroleum products in above ground bulk installations – Code of Practice
3	ZS 670-1	Transportation of dangerous goods by road, rail, water and air. Part 1 : identification and classification of dangerous goods for transport
4	ZS 670-2	Transportation of dangerous goods by road, rail, water and air. Part: 2 Marking, labeling, testing and packaging of dangerous goods guidelines for transport in Zambia
5	ZS 708:	Globally Harmonized System of Classification and Labelling of Chemicals