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Draft Zambian Standard (draft # 3)

RAIL TANK WAGONS - Specification

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TECHNICAL COMMITTEE RESPONSIBLE

The preparation of this Zambian Standard was entrusted upon the Mechanical Division MMD/10 Technical committee - RAIL TANK WAGONS Committee, upon which the following organisations were represented:

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CONTENTS

Page

FOREWORD	iii
1.0 SCOPE	4
2.0 NORMATIVE REFERENCES	4
3.0 DEFINITIONS	5
4.0 SYMBOLS AND ABBREVIATIONS	5
5.0 REQUIREMENTS	6
5.1 GENERAL REQUIREMENTS	6
5.2 MATERIALS	6
5.3 TANK CONSTRUCTION	7
5.4 TANK FITTINGS	8
5.5 LOADING/OFF LOADING ARRANGEMENT	9
5.6 EARTHING CONNECTIONS	9
6.0 MARKINGS	10
6.1 TANKS	10
6.2 VENTS	10
7.0 INSPECTION AND METHODS OF TEST	10
ANNEX A	11
ANNEX B	12
ANNEX C	13

TABLES

Table 1. Minimum physical properties steel (other than stainless steel) 3	7
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DIAGRAMS

FOREWORD

This Zambian Standard has been prepared by the Technical Committee – Mechanical & Metallurgical Division MMD/10 Technical committee - RAIL TANK WAGONS Committee, in accordance with the procedures of the Bureau.

The absence of the official national specifications or standards with respect to Rail Tank Wagons necessitated the formation of a Technical Committee to develop a standard in this field. A Technical Committee was therefore set up under the auspices of the Zambia Bureau of Standards and facilitated by the Energy Regulation Board.

Reference has been made to the following publications in preparation of this standard:

- ZS 371: 1999 Road Tank Vehicles for Petroleum-Based Flammable Liquids
- ZS 385-1: 2003 The Petroleum Industry – Part 1: The Handling, Storage and Distribution of Petroleum Products.
- ZS 385-2: 2006 The Petroleum Industry – Part 2: Electrical Code
- ZS 402: 2006 The Classification of Hazardous Locations and the Selection of Apparatus for use in Such Locations
- ZS 604: 2006 Refinery Safety and Environment
- The Energy Regulations Act (Laws, Vol. 24, Cap 436)
- The Environmental Protection and Pollution Control Act (Cap 204 of the Laws of Zambia , No. 12 of 1990)
- The Petroleum Act (Laws, Vol, 24 Cap 435)
- The Railways Act (Laws, Vol, 25 Cap 453)
- The Tanzania-Zambia Railway Act (Laws, No. 10 of 1995)
- The Weights and Measures (Assize) Regulations, 1998 (Laws, Vol. 23, Cap 403)

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ZAMBIA BUREAU OF STANDARDS

Draft Zambian Standard

RAIL TANK WAGONS - Specification

1.0 SCOPE

This standard covers the requirements for transportation by rail, at temperatures below their boiling point, of petroleum-based flammable liquids. The tanks are specifically for the transportation of Petroleum Products.

Flammable liquids other than hydrocarbons and the rail line are excluded from this standard.

2.0 NORMATIVE REFERENCES

The following standards and Legal Provisions 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 to take steps to ensure the use of the most recent editions of the standards indicated below, which may be obtained from the Zambia Bureau of Standards.

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|----------|--|
| ZS 371 | Road Tank Vehicles for Petroleum-Based Flammable Liquids |
| ZS 385-1 | The Petroleum Industry – Part 1: The Handling, Storage and Distribution of Petroleum Products. |
| ZS 385-2 | The Petroleum Industry – Part 2: Electrical Code |
| ZS 402 | The Classification of Hazardous Locations and the Selection of Apparatus for use in Such Locations |
| ZS 604 | Refinery Safety and Environment |
- The Energy Regulations Act (Laws, Vol. 24, Cap 436)
- The Environmental Protection and Pollution Control Act (Cap 204 , No. 12 of 1990)
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- The Weights and Measures (Assize) Regulations, 1998 (Laws, Vol. 23, Cap 403)

3.0 DEFINITIONS

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

3.1 Acceptable: Acceptable to the appropriate approving authority as mandated by government.

3.2 Auxiliary Engine: An engine that is additional to the main propulsion engine of the Rail Wagon.

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

3.4 Combustible Liquid: Liquids which have flash points from 21°C up to and including 55 °C, handled below flash point.

3.5 Compartment: A liquid-tight division of a tank.

3.6 Demountable Tank: A tank that is designed to be lifted onto and mounted on a conventional rail wagon that is to be used as a rail tank wagon.

Note

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

3.7 Explosion Protection: 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)

3.8 Standard Reference Conditions: 20°C and 101, 325 kPa absolute.

3.9 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.

3.10 Tank Wagon: A vehicle or trailer specially constructed for the bulk transport of petroleum liquids or gases by road or rail, with a tank fixed to the chassis.

Note

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

3.11 Ullage: That portion of the total-volume capacity of a tank that is not occupied by its liquid contents.

3.12 Ullage Mark: A marking devise inside a tank that marks the level where the liquid product must reach in order for the tank to contain the volume marked on it as set by an assizing authority. The mark must posse a seal from the assizing authority.

4.0 SYMBOLS AND ABBREVIATIONS

°C	Degrees Centigrade
%	Percent
AAR	Association of American Railroads
AISI	American Iron and Steel Institute
ERB	Energy Regulation Board
ICS	International Classification of Standards
kPa	kilopascals

MPa Megapascals
 PTFE Polytetrafluorethylene
 UIC UPnP™ Implementers Corporation
 ZABS Zambia Bureau of Standards
 ZS Zambian Standard

5.0 REQUIREMENTS

5.1 GENERAL REQUIREMENTS

Rail tank wagons and their ancillary equipment shall comply with all the relevant statutory requirements and regulations for the transportation of Petroleum Products by rail.

Railways should meet licence requirements of the standard.

These rail tank wagons are meant for carrying liquid petroleum products. A payload density of 1000kg/m³ shall be provided in the wagon.

The rail tank wagon shall have an approximate tare weight and axle load as approved from time to time by the Government.

5.2 MATERIALS

5.2.1 MATERIALS FOR TANKS

Stainless steel or carbon steel may be used. Aluminium is not recommended as a material of construction of the tank because it has much less impact and fire resistance than carbon steel or stainless steel.

The interior of the tank should be coated with epoxy lining where the tank wagon is to be used for the transportation of Jet A1.

5.2.1.1 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 minimum given in table 1.

TABLE 1 – MINIMUM PHYSICAL PROPERTIES OF STEEL (OTHER THAN STAINLESS STEEL)

1	2	3
Physical 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 v.S ₀ %	20	25
Impact resistance ¹⁾ at -20 °C, J, min	20	20
1) Charp V-notch		

5.2.1.2 Stainless Steel

The minimum standard for 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

5.2.2 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.

5.2.3 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.

Note. Use of asbestos gaskets should be avoided or minimised.

5.2.4 OTHER MATERIALS

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

5.3 TANK CONSTRUCTION

5.3.1 GENERAL DESIGN FEATURES

- 5.3.1.1 Rail tank shells should be designed to take full account of additional pressure generated by liquid surge during acceleration and deceleration.
- 5.3.1.2 The bottom of rail tank shells shall be self-draining, the lowest point shall be located in the centre of the rail tank wagon.
- 5.3.1.3 All nozzles in the bottom of the tank shall be flush with the inside of the wall.
- 5.3.1.4 Pad flanges, if used for the bottom nozzles shall be machined flush with the inside radius of the tank.
- 5.3.1.5 All reinforcements as required for the design of the tank shall be located on the outside.
- 5.3.1.6 All connections at the top of rail tanks shall have facilities to collect spilled product, including a drain to the underside of the tank.
- 5.3.1.7 The manhole shall be provided with a hinged cover which can be fastened and sealed. The gasket material shall be woven PTFE or other acceptable material.
- 5.3.1.8 The design of the hinge shall prevent any distortion of the gasket facings. Dowel pins or alternative facilities shall be provided to ensure proper alignment of the cover during assembly.
- 5.3.1.9 It is recommended that the design of the tank should enable vapours to be recovered or balanced through connections at the bottom of the tank during transfer.

5.3.2 UNDERFRAME

- 5.3.2.1 The under frame shall be either all steel welded construction or alternatively stub steel type and shall be designed to suit relevant AAR standards or equivalent. Provision shall be made to accommodate the centre buffer coupler and draft gear.
- 5.3.2.2 The under frame shall be designed for all stresses set up in service including those due to its own weight and weight of the tank and its contents, braking, draw and buffing and jacking forces.

5.3.3 TYPE OF BOGIE

The Operator shall provide information on the type of bogie being used. It shall use roller bearings only.

5.3.4 TANK BODY

5.3.4.1 The tank body shall be of all welded construction having a cylindrical cross section and dished ends. The design of the body shall be in accordance with relevant AAR/UIC standards.

5.3.4.2 The plate thickness of the body shall not be less than 10mm of carbon steel.

5.3.4.3 Provision shall be made for adequate baffle plates to minimise surging effects of contents.

5.3.5 TANK CAPACITY

5.3.5.1 The tank body shall have adequate volumetric capacity to permit the desired level of loading of petroleum products after providing a minimum ullage of 2.5%.

5.3.5.2 The tank shall be suitably calibrated for quick reading of the volume of contents. The calibration chart shall be provided.

5.3.6 STRESS RELIEVING

5.3.6.1 Each tank including its attachments shall be stress relieved after final assembly. The stress relieving shall be done in one operation and not in stages. Screw threads, if any shall be properly protected during this operation.

5.4 TANK FITTINGS

The body shall be fitted with adequate safety devices and arrangements for the inspection of the interior.

The operator and/or his contractor must have his own operating procedures and regulations for access to the tank wagon.

5.4.1 MANHOLE FOR INSPECTION

5.4.1.1 At the top of the middle of the tank, a manhole with an opening large enough (not less than 410mm diameter) to permit inspection of the inside of the tank shall be provided.

5.4.1.2 The manhole shall be provided with a dome shaped removable cover made of ductile malleable cast iron. Suitable locking arrangement shall be provided to lock the cover in closed position.

5.4.1.3 Provision shall be made on the manhole for fitment of a suitable and non-slippery ladder of adequate size to facilitate inspection and maintenance of the interior.

5.4.1.4 Every tank shall be designed and constructed such that it has sufficient heat resistance and pressure management capability so that when full with Petroleum Products it will withstand heat radiation of 15 kW/m² for at least 10 minutes so that

- a) the internal pressure does not exceed the maximum obtainable pressure
- b) the tank does not rupture releasing contents.

5.4.2 MANWAY PLATFORM

- 5.4.2.1 A level steel platform, open type, approximately 2x2 m square shall be provided around the manhole to permit staff to move around the dome for convenient operation and maintenance of the dome.
- 5.4.2.2 Necessary safety and hand rails shall be provided around the platform to enable convenient movement on the platform.
- 5.4.2.3 Two steel ladders of suitable size shall be provided, one on each side of tank, to permit access to the platform from ground.

5.5 LOADING/OFF LOADING ARRANGEMENT

5.5.1 LOADING ARRANGEMENT

- 5.5.1.1 Where loading is from the top of the tank it shall be fitted with a dome cover. The dome cover shall be suitable for quick operation and shall be fitted with a leak proof seal.
- 5.5.1.2 Where facilities exist, the tank wagon can also be loaded from the bottom.

5.5.2 OFFLOADING ARRANGEMENT

- 5.5.2.1 The bottom of the rail tank wagon shall be well drained to a centrally located outlet of 100mm diameter to permit complete emptying through suitable outlets.
- 5.5.2.2 The offloading arrangement shall consist of two closing devices fitted in series. The operation of these devices shall be independent of each other.
- 5.5.2.3 The first closing device shall consist of 100mm ball stop valve provided on the main discharge pipe directly below the tank.
- 5.5.2.4 The stop valve shall be operated by a lever/wheel that shall have a foolproof mechanism to retain it in the closed position.
- 5.5.2.5 The second closing device shall consist of a discharge valve offloading through a TEE configuration to permit offloading from either side of the tank. Suitable closing caps, with provision for seals, shall be fitted on each end of the TEE configuration.
- 5.5.2.6 Adequate safety arrangements shall be provided against rupture of tank bottom discharge arrangement and the pipe-line in the event of derailments. All external fittings below valve shall be designed to 'break away' in such cases.

5.6 EARTHING CONNECTIONS

When loading/off-loading Petroleum Products into/from Tank Wagons, it is absolutely necessary to ground wagons in a safe way to divert the electrostatic charges and to prevent a possible generation of sparks by an unintentional discharge which may cause an explosion.

Earth connections shall be provided at both sides of each bottom outlet nozzle, or in the centre of the chassis at both sides.

Bonding is to be carried out according to procedures in ZS 385-2.

6.0 MARKINGS

6.1 TANKS

The 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 plate that is adequately secured to the tank or attached structure and that is preferably located on both sides of the tank and in place readily accessible for inspection:

- a) The manufacturers 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
- g) The maximum design liquid flow density to be carried in the tank, in kilopascals
- h) The permitted maximum discharge rate in litres per minute and pressure in kilopascals.
- i) The owner and operator names.

6.2 VENTS

Each vent shall be legibly and durably marked with its flow capacity and the pressure at which this was determined.

7.0 INSPECTION AND METHODS OF TEST

The operator shall keep inspection and maintenance records on each rail tank wagons.

The records shall be made available for inspection.

ANNEX A

GENERAL ASSEMBLY DIAGRAM

Descriptive schematic diagrams of what a (general) rail tank wagon looks like will be provide. In addition some special features that require visual illustrations will be provided.

Suggestions of diagrams are invited.

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ANNEX B

INFORMATION TO BE SUPPLIED BY THE OPERATOR

Proposals are welcome of what information an operator should supply when introducing a new wagon to the fleet.

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ANNEX C

EXAMINATION AND HANDLING OF RAILWAY TANK WAGONS

- B.1** Loading and unloading with regard to fire safety shall be carried out according to procedures in ZS 385-2.
- B.2** Smoking is prohibited where these rail tank wagons are being loaded or offloaded.
- B.3** Tank Wagons shall coupled at least two wagons away from a running locomotive when inflammable liquids are being conveyed.
- B.4** If there is bush fire ahead of such a train, the train has to be stopped until the fire has been put off.
- B.5** Such wagons are never to be subjected to throw off or loose shunting.
- B.6** Such vehicles are never to be detached from a train until it has been brought to a stand still.
- B.7** Before such rail tank wagons are placed in position for loading purposes, the brakes and other running gears, the filling mechanism and outlet valves are examined and defects rectified.
- B.8** The warning boards are cleaned, and it is ensured that ladders, brackets and steps are in good order, and then stationed for loading or offloading.
- B.9** Before loading or offloading, the date of next workshop maintenance on the periodic repair chart is checked and ensured that the fixed period is not exceeded.
- B.10** Leak detection of the rail tank wagon must be done before loading.
- B.11** When a product of different type is to be loaded, the rail tank wagon must be cleaned or flashed according to the grade change procedures.
- B.12** Loaded rail tank wagon must be secured by seals with appropriate privately owned locks.
- B.13** Bearings and brake gear are carefully examined for any abnormalities, like over heating and binding respectively.
- B.14** Caps are tightened by sparking-proof spanner and not by hammer and chisels.
- B.15** When a defect develops on such a rail tank wagon, it should be detached from the train and handed over to the relevant officer for repairs.