

**QUALITY CONTROL AND MONITORING GUIDELINES FOR
THE ZAMBIAN PETROLEUM FUEL INDUSTRY**

MAY 2008

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1.0 INTRODUCTION

In a bid to uphold the quality standards of petroleum products and strengthen monitoring systems, a Committee was formed by the petroleum industry on 13th February 2008 to review the existing processes for quality monitoring and assurance. The following report outlines the findings and recommendations of the Committee.

The Committee comprised the following:

- Engen Zambia Limited (Chairman)
- INDENI Petroleum Refinery Company Limited
- TAZAMA Pipelines
- BP Zambia Plc
- Total Zambia Limited
- Energy Regulation Board (Secretary)
- Zambia Bureau of Standards
- Alfred H Knight (Zambia) Limited

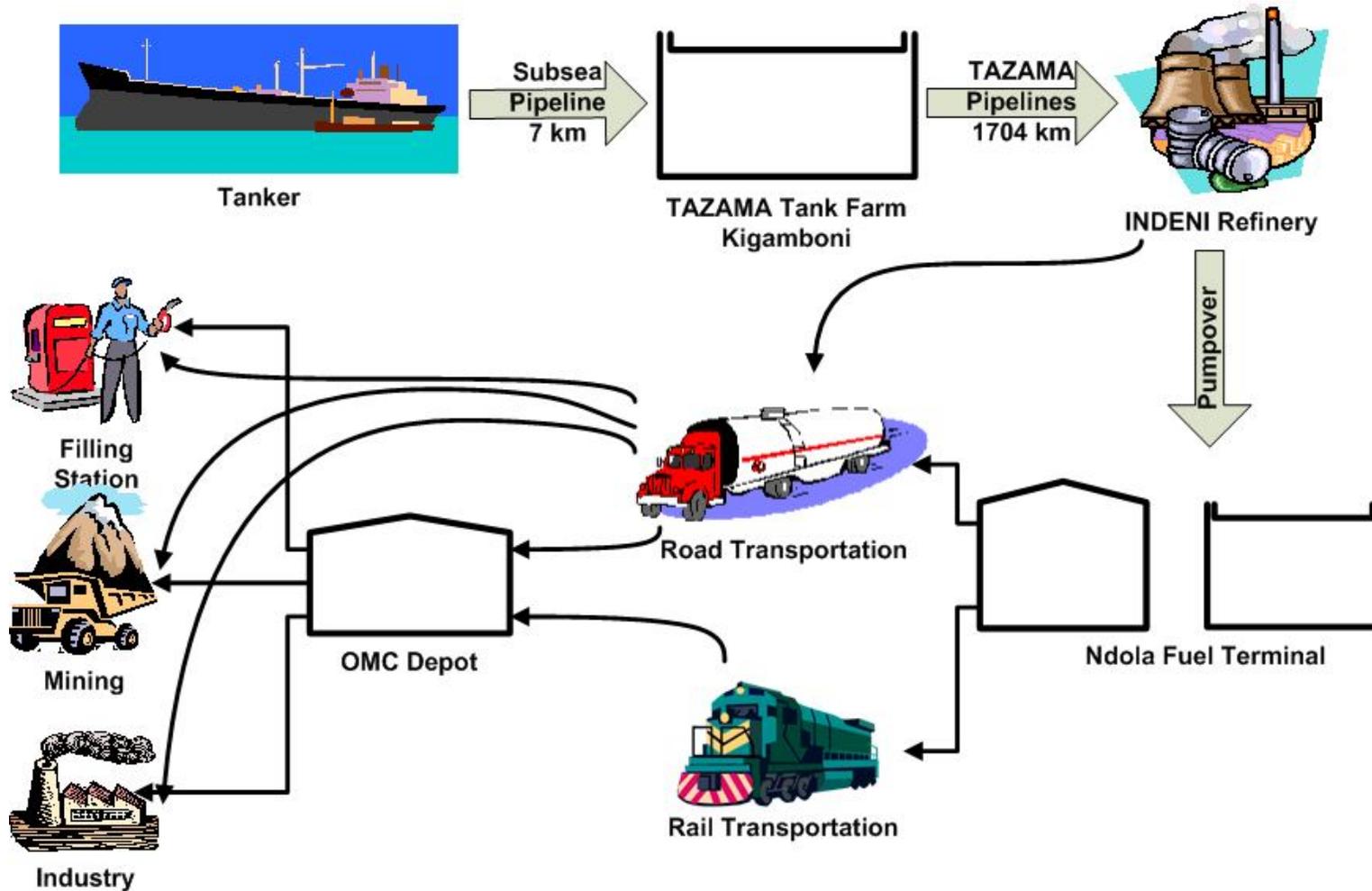
2.0 TERMS OF REFERENCE

The Terms of Reference of the Committee are as attached in Appendix A.

3.0 THE ZAMBIAN PETROLEUM CHAIN

Petroleum is imported as either feedstock or finished products. The Zambian market is served through a supply chain as illustrated below. The following stages along the chain have been identified as critical to ensure that the consumer receives a quality product that conforms to Zambian standards:

- a) Loading of petroleum feedstock components at loading port
- b) Discharge of petroleum feedstock at discharge port (Dar-es-Salaam)
- c) Pumping of feedstock from the TAZAMA Tank Farm in Dar-es-Salaam
- d) Receipt of Feedstock at INDENI Petroleum Refinery
- e) Certification of Petroleum Products at INDENI Petroleum Refinery
- f) Recertification of Petroleum Products at Ndola Fuel Terminal
- g) Recertification of Imported Petroleum Products by Oil Marketing Companies
- h) Recertification of Petroleum Products at Oil Marketing Company Depots
- i) Receipt of Petroleum Products at both consumer and retail sites
- j) Sampling of Feedstock and Petroleum Products
- k) Testing of Feedstock and Petroleum Products



The Zambian Petroleum Chain

The Committee has devised measures to ensure that quality assurance procedures are strengthened.

3.1 Loading of Petroleum Feedstock Components at Loading Port

Under the current arrangements, feedstock components are made up of crude oil, condensate and finished products (usually gasoil). The proportions of each component are designed to satisfy market demand. The cargo composition is formulated by INDENI Petroleum Refinery. This is availed to the importer and forwarded to the supplier. The cargo formulation is based on models of the behaviour of different components based on data collected from the processing of the respective components in the past. The Refinery is able to establish the following from their analysis:

- That the octane number of 91 will be achieved when gasoline is blended
- That the sulphur content for diesel will satisfy Zambian standards
- That the yields from the feedstock will satisfy the physical limits in terms of throughput for all refining units.

It is expected that the different components to be supplied will be in line with the standard export grade (SEG) specified in assay sheets provided by the supplier. To ensure this is the case, the standard industry practice is to have all loadings inspected by a third party surveyor (inspector). The inspector has the following responsibilities

- To determine the quantity of component that has been loaded on the ship (bill of lading)
- To determine and certify that the quality of the component that is being loaded satisfies the SEG.

The Bill of Lading and the certificates of quality are deposited in a sealed packet with the master of the vessel. Methods exist to also make this information available to the importer immediately after loading. This would require the third party inspector to send copies of these documents to the importer.

After the ship has been loaded, there are two possibilities for mixing:

- On board commingling
- Commingling at discharge

It is clear that whichever methodology of mixing is used, the objective is to ensure that a homogenous cargo is received at the Tank Farm. This will result in the expected yields being achieved and also that the expected refinery requirements are met.

3.2 Discharge of Petroleum Feedstock at Discharge Port

The Ship arrives at the discharge port and tenders Notice of Readiness. TAZAMA Pipelines, as an agent, handle the receipt and preparation for receiving feedstock on behalf of the importer. A third party inspector also inspects the vessel before discharge and then determines how much has been received in the shore tanks. The inspector will also verify that seals applied at point of loading are intact. TAZAMA collects samples of the feedstock for True Boiling Point Testing at INDENI Refinery from the vessel and also from the Tank Farm.

3.3 Receipt of Feedstock at INDENI Refinery

The Feedstock is received in Ndola and measured through a meter situated at TAZAMA's Bwana Mkubwa Terminal. Receipt at the Refinery is in three feedstock storage tanks. The Refinery monitors the pipeline contents. The feedstock is sampled and tested to monitor conformance to expected cargo yields.

3.4 Refining and Certification of Products at INDENI Refinery

The feedstock is refined into refined products. These products are tested and certified on a batch by batch basis by the INDENI Laboratory as conforming to the requirements of Zambian Standards. The following products are pumped over to the Ndola Fuel Terminal:

- Unleaded Petrol
- Automotive Gas Oil
- Industrial Kerosene
- Domestic Kerosene
- Jet A-1

The following products are batched and made available from the INDENI Refinery:

- Liquefied Petroleum Gas
- Reformate
- Light Gasoline
- Short Cut Kerosene

- Lead Replacement Petrol
- Light Fuel Oil
- Heavy Fuel Oil
- Penetration Grade Bitumen
- Bitumen Cutbacks

Zambian Standards exist for all these products apart from reformate, short cut kerosene and light gasoline.

3.5 Distribution of Petroleum Products from the Ndola Fuel Terminal

Products are received at the Ndola Fuel Terminal for distribution to the market. After receipt of each batch, the tank is allowed to settle before a sample is taken and sent for testing at the INDENI Laboratory. The Test Certificate obtained for these results is made available to oil marketing companies on loading. The operation of all the Tanks is the responsibility of the Fuel Terminal operator.

Tankers that are loaded with product are sealed and despatched to either an OMC Depot or to an end-user.

3.6 Oil Marketing Company Depots

Depots operated by OMCs receive product from INDENI Refinery, the Ndola Fuel Terminal or through imports. All tankers that carry imported product will arrive with the batch test certificate from source. In most cases this imported product may mix with product already in the tank.

3.7 Receipt of Product at Consumer Sites and Filling Stations

On receipt of petroleum products, the customer is expected to ensure that all seals are unbroken. The seals are then broken and ullage marks are inspected. Ideally, the customer should also ensure that the product being received is free of water. The customer has no automatic access to a certificate of quality for the product they are receiving. In the majority of cases, no tests apart from the one that establishes the presence of water are carried out.

3.8 Sampling of Feedstock and Petroleum Products

From its deliberations, the Committee noted that no OMC was able to submit an official sampling and testing procedure. Zambian Standard ZS 396 Sampling Petroleum Products Part 1: Manual sampling of liquid hydrocarbons was promulgated in 2000 as a basis for the setting up of

sampling procedures. Whilst it was clear that the recommendations of this standard are being followed by both TAZAMA and INDENI Refinery, no OMC has established procedures based on ZS 396.

3.9 Testing of Feedstock and Petroleum Products

Currently only two laboratories are being used for the testing of petroleum fuels. These are:

- Alfred H Knight (Products)
- INDENI Petroleum Refinery (Feedstock and Products)

It has been observed that test results for the same sample from both laboratories have at times shown some unacceptable variances. Alfred H Knight is accredited to ISO 17025 while INDENI is yet to attain any certification.

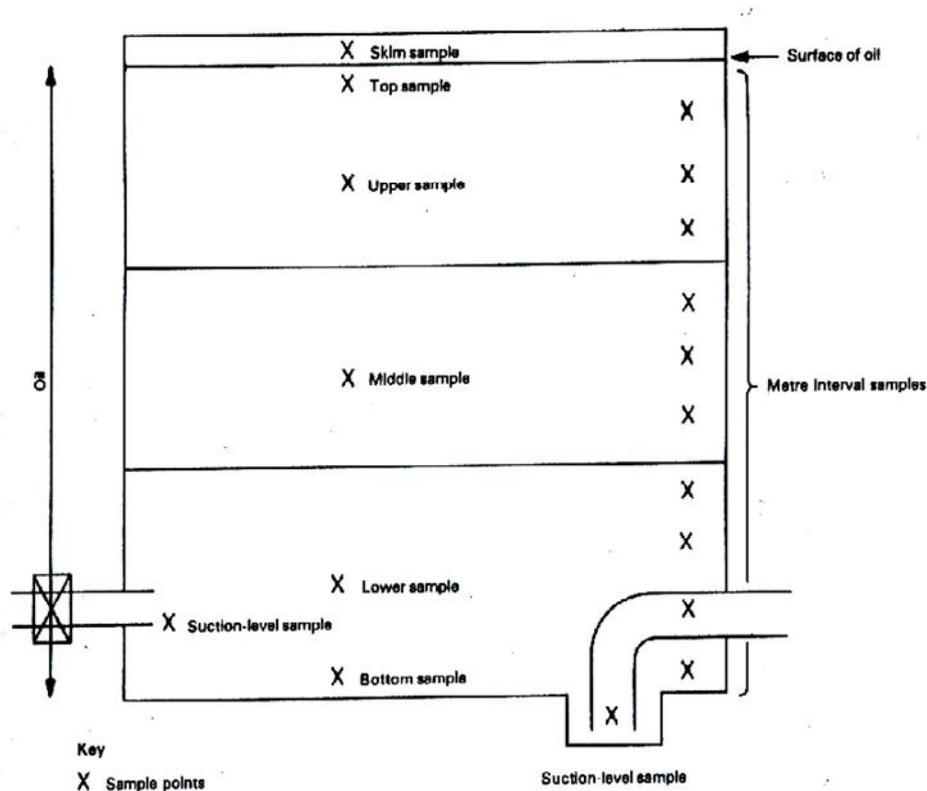


Figure 1 – Examples of sample positions

4.0 QUALITY MEASURES RECOMMENDED

4.1 Sampling

From the above petroleum chain it is clear that a lot of sampling will be required. This can only be effective if guidance is given on the methodology to be adopted for sampling. Zambian Standard ZS 396 Sampling Petroleum Products Part 1: Manual sampling of liquid hydrocarbons provides a guide for this subject. The diagram above indicates the different positions that samples can be taken from. The guidance that is now being issued by the Committee is that tank samples shall be a composite taken of the upper sample, middle sample and lower sample.

The samples should be combined into one from three equal portions. In addition all operating fuel terminal, depot and refinery tanks should be subjected to a bottom sample at least once every six months. For this to be carried out by all industry players the following sampling equipment shall be available at all sites:

- spot sampler;
- bottom sampler;

All the devices shall have a cord or cable or chain of conductive, spark proof material attached to them for the purpose of lowering or raising them in the tank. The cord should be sufficiently conductive so as not to be capable of producing static electricity. The competence of sampling personnel shall be documented and traceable.

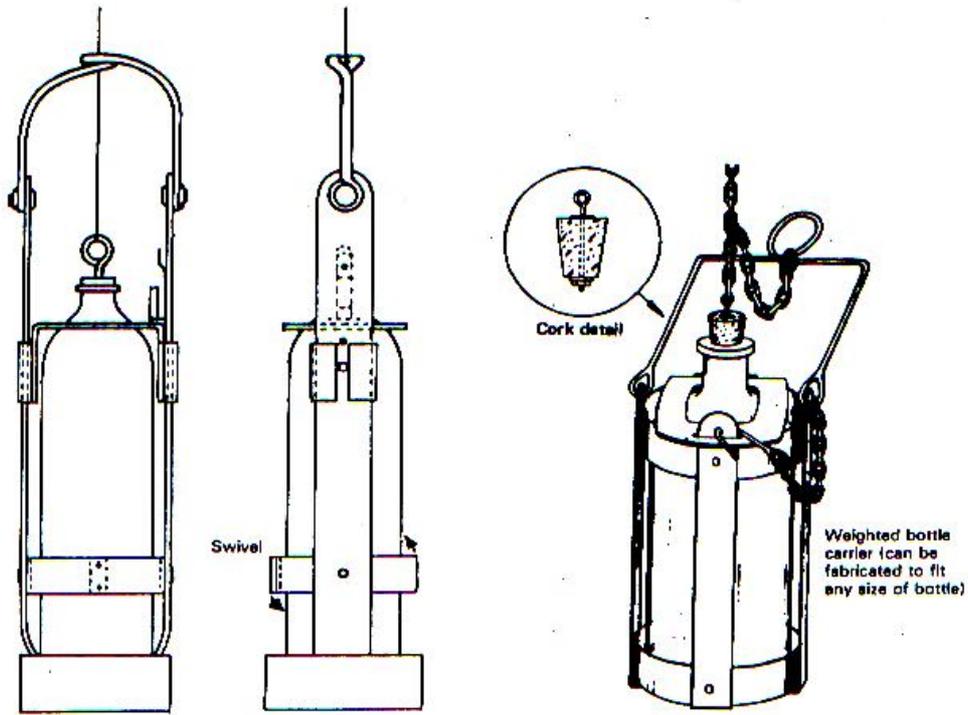


Figure 2 – Examples of sample cages

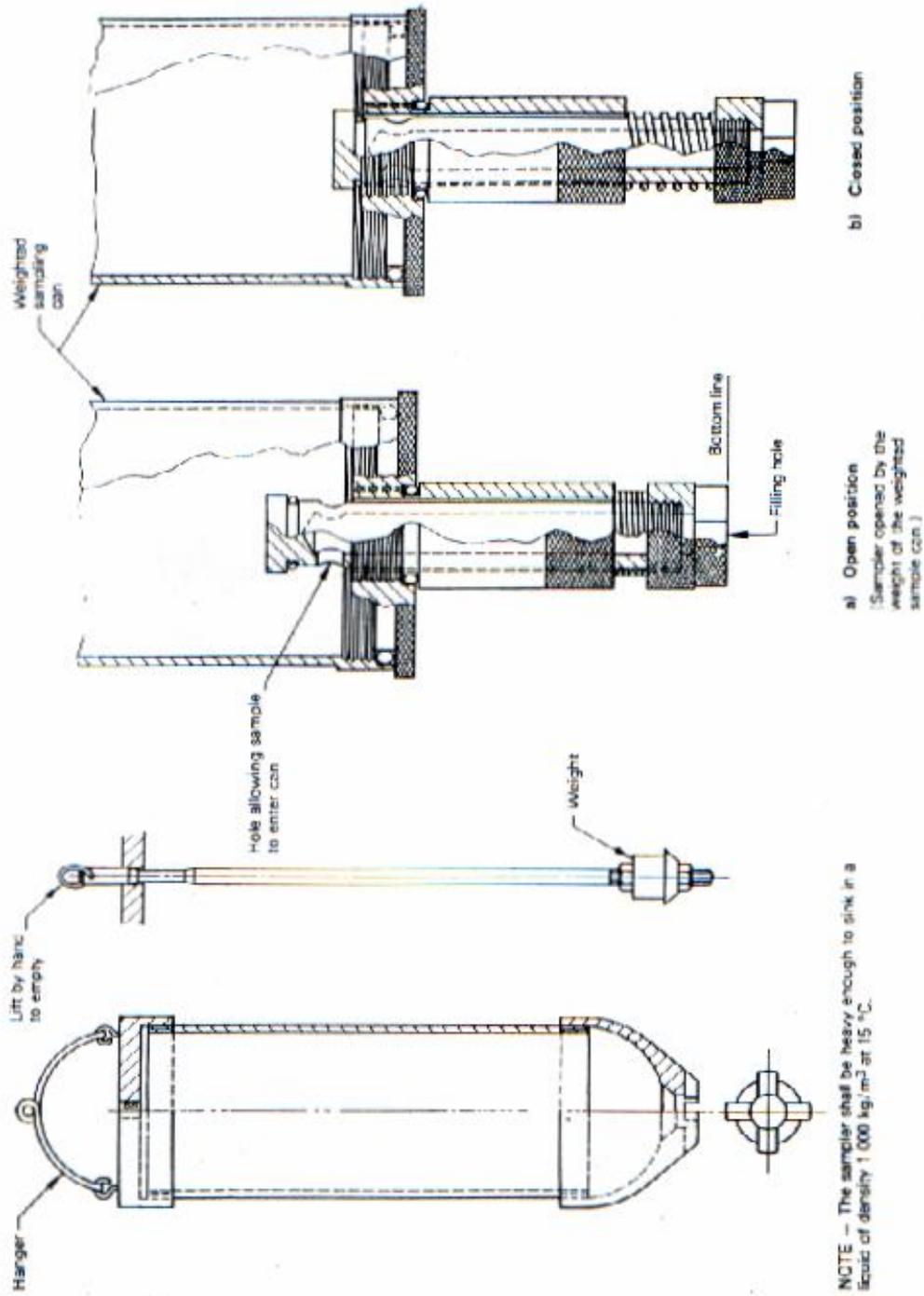


Figure 6 – Examples of bottom samplers and details of opening/closing mechanism

4.2 Responsibilities of the Importer of Petroleum Feedstock

The Committee recommends the following measures are implemented by the importer to ensure an improvement in quality monitoring and assurance:

1. The importer shall ensure that the supplier only charters vessels capable of on-board commingling
2. The importer shall file certificates of quality for all components loaded for each shipment with the Energy Regulation Board (ERB) before the ship has docked in Dar-es-Salaam.
3. The importer shall ensure that samples collected for True Boiling Point testing are a composite of upper, middle and lower level samples.
4. The importer shall file the TBP test results report with the ERB before processing of the cargo is commenced.
5. The importer shall submit the Pipeline Profile to the ERB on a weekly basis.

4.3 Responsibilities of INDENI Refinery

The Committee recommends the following measures are implemented by the Refinery to ensure an improvement in quality monitoring and assurance:

1. The Refinery shall issue Certificates of Quality for products produced. These shall be electronically filed with the ERB including the batch number.
2. The Refinery shall ensure that all product tanks are cleaned once every three years for Jet A-1 tanks and at least once every ten years for other products unless results obtained from testing bottom samples indicate that cleaning should be done more frequently

4.4 Responsibilities of the Ndola Fuel Terminal Operator

The Committee recommends the following measures are implemented by the operator of the Ndola Fuel Terminal to ensure an improvement in quality monitoring and assurance:

1. The operator shall ensure that all product tanks are cleaned once every three years for Jet A-1 tanks and at least once every ten years for other products unless results obtained from testing bottom samples indicate that cleaning should be done more frequently.

2. The operator shall provide certificates of quality (COQs) preferably from an ISO certified laboratory for all products sold to all OMCs and file the COQs with the ERB.

4.5 Responsibilities of importers of petroleum products

The Committee recommends the following measures are implemented by importers of petroleum products to ensure an improvement in quality monitoring and assurance:

1. All imports shall be accompanied by a quality certificate preferably issued by an ISO certified laboratory.
2. All imported products must meet or exceed the national standards
3. The quality certificate preferably from an ISO certified laboratory shall be submitted to ZABS and ERB at the point of entry into the country
4. All depots that have received imports should have batch quality certificates preferably from an ISO certified laboratory. These must be filed with the ERB

4.6 Responsibilities of Dealers and Commercial consumers

The Committee recommends the following measures are implemented by Dealers and Commercial consumers to ensure an improvement in quality monitoring and assurance:

1. A record of all deliveries for the previous three months must be maintained at the site. A sample of the record has been included overleaf to clarify how the chain of custody of fuel will be transparent.

Quality Control and Monitoring Guidelines for the Zambian Petroleum Fuel Industry

OIL MARKETING COMPANY

L No. _____

PRODUCTS STOCK TRANSFER
BULK PRODUCT BY ROAD

1 Issuing Depot _____	Date of Issue _____
Ex. _____ Depot	
Product _____	Temp. C _____
Batch Number _____	Density _____
Delivering Tank Number _____	Water Test _____
Observed Volume Despatched on Vehicle (Litres) _____	Seal Numbers 1
	2
Colour _____	3
Transporter _____	4
Vehicle Registration Number _____	5
	6
Volume of Product despatched on vehicle checked and agreed by: _____	7
_____	_____
Despatched Depot Operator's Signature	Driver's Name and Signature

2 Receiving Site _____	Date of Receipt _____
Observed Volume Received (Litres) _____	Temp. C _____
Colour _____	Density _____
Seals Intact? _____	Water Test? _____
Volume of Product received checked and agreed by: _____	Ullage Marks? _____
_____	_____
Receiving Official's Name and Signature	Driver's Name and Signature

3 To be filled in by Receiving Site

Volume despatched (Litres)	_____
Volume received (Litres)	_____
Therefore Loss / Gain (Litres)	_____
Loss / Gain (%)	_____

4 Comments

4.7 Responsibilities of the Energy Regulation Board

The Committee recommends the following measures are implemented by the Energy Regulation Board to ensure an improvement in quality monitoring and assurance:

1. The random sampling and testing of products collected from the following:
 - a) INDENI Petroleum Refinery (at least twice a quarter)
 - b) Ndola Fuel Terminal (at least twice a quarter)
 - c) Oil marketing company depots (at least once a quarter)
 - d) Consumer sites and retail sites (at random)

Samples taken shall be 1 litre for service stations and 2 litres for other samples.

2. The auditing of quality assurance systems within all the industry players at least once a year.
3. Maintain a database of all quality related information received from all industry players.
4. All information obtained shall be public information.

4.8 Responsibility of Laboratories

The Committee recommends the following measures are implemented by the Laboratories to ensure an improvement in quality monitoring and assurance:

1. That all laboratories that are used for testing of petroleum products shall ensure that they attain full accreditation under ISO 17025 within three years.
2. That the Secretariat for the Inter-Laboratory Cross Check shall strengthen systems in testing of petroleum products and file reports regarding cross-checks with the ERB.

4.9

	Name	Organisation	Signature
1.	Mr Stephen Mwenya (Chairman)	Engen Zambia Limited	
2.	Mr Damaso Matukutuku	Alfred H Knight	
3.	Mr Davison Thawethe	TAZAMA Pipelines Limited	
4.	Mr Joseph Nkaka	INDENI Petroleum Refinery	
5.	Mr Stanley Chipeta	BP Zambia Plc	
6.	Mr Mclean Sakala	Zambia Bureau of Standards	
7.	Mr Patrick Kalumba	Total Zambia Limited	
8.	Mr Chasuzga Mtawale (Secretary)	Energy Regulation Board	

APPENDIX A

TERMS OF REFERENCE FOR THE PETROLEUM PRODUCT QUALITY COMMITTEE

1.0 Purpose of the committee

The purpose of the committee is to come up with a system and procedure that will ensure that the quality of petroleum products is monitored and assured at different stages of the supply chain.

2.0 Composition

The committee shall comprise the following:

- i) INDENI Petroleum Refinery
- ii) TAZAMA Pipeline
- iii) BP (Z) Plc
- iv) Total (Z)
- v) Engen Petroleum Zambia
- vi) Energy Regulation Board

3.0 Reporting

The Committee, to which the ERB shall be the Secretariat, shall elect a Chairperson who will preside over the meetings. Further, the committee shall elect one Oil Marketing Company (OMC) amongst those represented to be responsible for coordinating consensus building meetings within the industry.

5.0 Specific tasks

The committee shall perform the following tasks:

- i) Conduct a thorough examination of the petroleum products supply chain for Zambia with a view to identify all possible points and types of contamination,
- ii) Examine the existing system (framework and procedures) that is currently in place, aimed at ensuring that the quality of the petroleum products on the market are within the relevant product quality standards in order to identify areas of weaknesses,

- iii) Propose a clearly defined system (framework and procedures) that will ensure that the quality of the petroleum products on the market are within the relevant product quality standards,
- iv) Make recommendations on how the proposed system in (iii) will be sustained

6.0 Expected outputs

The expected output from the committee shall be a report outlining the following:

- i) Identification of types and points of contamination of petroleum products within the supply chain,
- ii) Identification of gaps and areas of weakness pertaining to the current system in place and propose remedial measures,
- iii) Revised system,
- iv) Implementation, monitoring and evaluation of the revised system.