DZS 867: 2023
ICS: 75.160.20
Second Edition

DRAFT ZAMBIAN STANDARD

BIODIESEL FUEL BLENDS FOR AUTOMOTIVE COMPRESSION IGNITION ENGINES – Specification

ZAMBIA BUREAU OF STANDARDS

Amendments issued since publications

Amendment No.	Date	Text affected

DATE OF PUBLICATION

This Zambian Standard has been prepared and published under the authority of the Zambia Bureau of Standards on ……..

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Copperbelt Africa Investment
CFAO Motor Zambia Limited
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FOREWORD

This National Standard has been prepared by the ……, 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.

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The preparation of this Standard has been undertaken by the …….. The absence of Standards on Biodiesel blends in Zambia necessitated the formulation of this standard.

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

- ASTM D7371: Standard Test Method for Determination of Biodiesel (Fatty Acid Methyl Esters) Content in Diesel Fuel Oil Using Mid Infrared Spectroscopy (FTIR-ATR-PLS Method)
- ZS 396: Sampling Petroleum Products – Part 1: Manual Sampling of Liquid Hydrocarbons
- ZS 702: Automotive Biodiesel (B100) - Specification
- ZS 718 Low Sulphur Gas Oil: Specification
- Developing a B20 Fuel Quality Standard, Australian Government, Department of Sustainability, Environment, Water, Population and Communities.

ACKNOWLEDGEMENT

The Zambia Bureau of Standards would like to acknowledge the invaluable material and financial support of the Energy Regulation Board and all the institutions and stakeholders that contributed in the promulgation of this standard.

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ZAMBIA BUREAU OF STANDARDS

Draft Zambian Standard

BIODIESEL FUEL BLENDS QUALITY FOR AUTOMOTIVE COMPRESSION IGNITION ENGINES – Specification

1.0 SCOPE

This specification covers blends of biodiesel fuel conforming to ZS 702 blended with petroleum diesel conforming to ZS 718 at 5, 10, and 20 volume percent (%) for use as compression ignition automotive engine fuels.

2.0 NORMATIVE REFERENCES

The following publications contains 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 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. Information on currently valid National and International standards can be obtained from Zambia Bureau of Standards.

ZS ASTM D 1298	Standard Test Method for Density, Relative Density (Specific Gravity) or API Gravity of crude petroleum and liquid petroleum products by hydrometer method
ZS ASTM D 130	Standard Test Method for Corrosiveness to Copper from Petroleum Products by Copper Strip Test.
ZS ASTM D 1613	Test Method for Acidity in Volatile Solvents and Chemical Intermediates Used in Paint, Varnish, Lacquer, and Related Products (EN 15491)
ZS ASTM D 2500	Standard Test Method for Cloud Point of Petroleum Products
ZS ASTM D 2709	Standard Test Method for Water and Sediment in Middle Distillate Fuels by Centrifuge
ZS ASTM D 3231	Standard Test Method for Density and Relative Density of Liquids by Digital Density meter
ZS ASTM D 3231	Standard Test Method for Phosphorus in Gasoline
ZS ASTM D 4052	Standard Test Method for Density, Relative Density, and API Gravity of Liquids by Digital Density Meter
ZS ASTM D 4057	Standard Test Method for Manual Sampling of Petroleum Products.
ZS ASTM D 4177	Standard Test Method for Automatic Sampling of Petroleum Products
ZS ASTM D 4294	Standard Test Method for Sulfur in Petroleum and Petroleum Products by Energy Dispersive X-ray Fluorescence Spectrometry
ZS ASTM D 445	Standard Test Method for Kinematic Viscosity of Transparent and Opaque Liquids (and Calculation of Dynamic Viscosity)
ZS ASTM D 482	Standard Test Method for Ash from Petroleum Products

ZS ASTM D 524	Standard Test Method for Ramsbottom Carbon Residue of Petroleum Products
ZS ASTM D 5453	Test Method for Determination of Total Sulphur in Light Hydrocarbons, Spark Ignition Engine Fuel, Diesel Engine Fuel, and Engine Oil by Ultraviolet Fluorescence (EN 15485)
ZS ASTM D 6079	Standard Test Method for Evaluating Lubricity of Diesel Fuels by the High-Frequency Reciprocating Rig (HFRR)
ZS ASTM D 613	Standard Test Method for Cetane Number of Diesel Fuel Oil
ZS ASTM D 6371	Standard Test Method for Cold Filter Plugging Point of Diesel and Heating Fuels
ZS ASTM D 664	Standard Test Method for Acid Number of Petroleum Products by Potentiometric Titration
ZS ASTM D 6751	Standard Specification for Biodiesel Fuel Blend Stock (B100) for Middle Distillate Fuels
ZS ASTM D 7371	Standard Test Method for Determination of Biodiesel (Fatty Acid Methyl Esters) Content in Diesel Fuel Oil Using Mid Infrared Spectroscopy (FTIR-ATR-PLS Method)
ZS ASTM D 7467	Standard Specification for Diesel Fuel Oil, Biodiesel Blend (B6 to B20)
ZS ASTM D 86	Standard Test Method for Distillation of Petroleum Products at Atmospheric Pressure
ZS ASTM D 93	Standard Test Method for Flash Point by Pensky-Martens Closed Cup Tester.
ZS ASTM E1064	Standard Test Method for Water in Organic Liquids by Coulometric Karl Fischer Titration
ZS ASTM D 6890	Standard Test Method for Determination of Ignition Delay and Derived Cetane Number (DCN) of Diesel Fuel Oils by Combustion in a Constant Volume Chamber
ZS EN 1064	Standard Test Method for Water in Organic Liquids by Coulometric Karl Fischer Titration
ZS EN 116	Method for determination of cold filter plugging point of diesel and domestic heating fuels
ZS EN 14112	Fat and oil derivatives. Fatty acid methyl esters (FAME). Determination of oxidation stability (accelerated oxidation test)
ZS EN 15751	Oxidation Stability of FAME Fatty Acid Methyl Esters for Biodiesel
ZS EN 590	Diesel Fuel Testing
ZS ISO 12937	Petroleum products -- Determination of water - Coulometric Karl Fischer titration method
ZS ISO 3104	Petroleum Products - Transparent and opaque liquids -- Determination of kinematic viscosity and calculation of dynamic viscosity
ZS 396	Sampling Petroleum Products Part 1: Manual sampling of Liquid Hydrocarbons
ZS 702	Automotive Biodiesel – B100: Specification
ZS 718	Low Sulphur Gasoil: Specification, Specifies requirements for Low Sulphur Gas Oil
ZS 869	Blending and Handling of Biofuel Blends – Code of Practice

3.0 DEFINITIONS

For purposes of this standard the following definitions shall apply:

3.1. **Biodiesel:** A fuel comprised of mono-alkyl esters of long chain fatty acids derived from vegetable oils or animal fats, designated as B100.

3.2. **Biodiesel-Diesel blend:** a fuel consisting primarily of petroleum diesel mixed with fuel grade biodiesel.

3.3. **Impurities:** compounds other than biodiesel, such as glycerol, methanol and other undesirable substances in commercially produced biodiesel.

3.4. **FAME**: Fatty acid methyl esters. A mono alkyl ester of long-chain fatty acids from naturally occurring plant oils, animal fats, and recycled greases.

3.5. **Fatty acid**: Any of the saturated or unsaturated monocarboxylic acids that occur naturally in the form of triglycerides (or mono or diglycerides) or as free fatty acids in fats and fatty oils.

3.6. **Flash point:** The lowest temperature at which vapours from a fuel will ignite when a flame is applied under standard test conditions.

3.7. **Free fatty acids:** Any saturated or unsaturated monocarboxylic acids that occur naturally in fats, oils, or greases but are not attached to glycerol backbones.

3.8. **ASTM**: American Society for Testing and Materials.

3.9. **Lubricity**: The ability of a fuel to protect moving parts from wear.

3.10. **ZS**: Zambian Standard Published under the Standards Act of Zambia.

4.0 BLENDING PROCEDURES

The blending procedures adopted shall ensure attainment of homogeneity of the biodiesel and petroleum component.
Refer to the Blending and Handling of Biofuels - Code of Practice **ZS 869**.

5.0 BIODIESEL FUEL BLENDS PERFORMANCE REQUIREMENTS

5.1 B5 Performance Requirements

Table 1: Requirements for 5% Biodiesel Blend with 95% Petroleum Diesel (B5)

Characteristic	Requirement[1]	Test Method
Biodiesel Content, % v/v	1-5	ZS ASTM D 7371 ZS ASTM D 7467 ZS ASTM D 6751
Density, kg/m^3, at 20^{o}C • Min • Max	820 880	ZS ASTM D 1298 ZS ASTM D 4052
Kinematic Viscosity at 40^{o}C cSt	1.9 – 4.5	ZS ASTM D 445 ZS ISO 3104
Flashpoint, ^{o}C min	655	ZS ASTM D 93
Total Sulphur Content, % m/m • Blend with low sulphur gasoil	0.005 max	ZS ASTM D 4294, ZS ASTM D 5453 ZS EN 590
Copper strip corrosion number (3h at 50^{o}C) max	1	ZS ASTM D 130
Carbon Atom Residue (10% distillation) max	0.35	ZS ASTM D524
Derived Cetane number, min	47	ZS ASTM D 6890 ZS ASTM D 613
Ash content % m/m	0.01	ZS ASTM D 482
Phosphorus Content % mass, max	0.001	ZS ASTM D 3231
Water Content (% Vol), max	0.05	ZS ASTM D 6371 ZS ASTM E 1064 ZS ISO 12937
Cloud Point ^{o}C	Report	ZS ASTM D 2500
Cold filter Plugging Point ^{o}C	Report	ZS ASTM D 6371 ZS ASTM E116
Oxidation Stability, hours, min	6	ZS EN 590 ZS EN 14112 ZS EN 15751
Total Acid Number (mgKOH/g), max	0.3	ZS ASTM D 664
Water and sediment (% Vol), max	0.05	ZS ASTM D2709
Lubricity, HFRR at 60^{o}C µg, max	520	ZS ASTM D 6079
Full Distillation Profile	T90 @ 343^{o}C T95 @ 360^{o}C	ZS ASTM D86

1 Unless otherwise state, all values are stated in SI units

5.1 B10 Performance Requirement

Table 2: Requirements for 10% Biodiesel Blend with Petroleum Diesel (B10)

Characteristic	**Requirement[2]**	**Test Method**
Biodiesel Content, % v/v	6-10	ZS ASTM D 7371 ZS ASTM D 7467 ZS ASTM D 6751
Density, kg/m^3, at 20^{o}C • Min • Max	 820 880	 ZS ASTM D 1298 ZS ASTM D 4052
Kinematic Viscosity at 40^{o}C cSt	1.9 – 4.5	ZS ASTM D 445 ZS ISO 3104
Flashpoint, ^{o}C min	655	ZS ASTM D 93
Total Sulphur Content, % m/m • Blend with low sulphur gasoil	 0.005 max	ZS ASTM D 4294, ZS ASTM D 5453
Copper strip corrosion number (3h 50^{o}C) max	1	ZS ASTM D 130
Carbon Atom Residue (10% distillation) max	0.35	ZS ASTM D524
Derived Cetane number, min	47	ZS ASTM D 6890 ZS ASTM D 613
Ash content % m/m	0.01	ZS ASTM D 482
Phosphorus Content % mass, max	0.001	ZS ASTM D 3231
Water Content (% Vol), max	0.05	ZS ISO 12937 ZS ASTM E 1064 ZS ASTM D 6371
Cloud Point ^{o}C	Report	ZS ASTM D 2500
Cold filter Plugging Point ^{o}C	Report	ZS EN 116
Oxidation Stability, hours, min	6	ZS EN 590 ZS EN 14112 ZS EN 15751
Total Acid Number (mgKOH/g), max	0.3	ZS ASTM D 664
Water and sediment (% Vol), max	0.05	ZS ASTM D2709
Lubricity, HFRR at 60^{o}C µg, max	520	ZS ASTM D 6079
Full Distillation Profile	T90 @ 343^{o}C T95 @ 360^{o}C	ZS ASTM D86

2 Unless otherwise state, all values are stated in SI units

5.1 B20 Performance Requirements

Table 3: Requirements for 20% Biodiesel Blend with Petroleum Diesel (B20)

Characteristic	Requirement[3]	Test Method
Biodiesel Content, % v/v	11-20	ZS ASTM D 7371 ZS ASTM D 7467 ZS ASTM D 6751
Density, kg/m^3, at 20^{o}C • Min • Max	 820 880	 ZS ASTM D 1298 ZS ASTM D 4052
Kinematic Viscosity at 40^{o}C cSt	1.9 – 4.5	ZS ASTM D 445 ZS ISO 3104
Flashpoint, ^{o}C min	655	ZS ASTM D 93
Total Sulphur Content, % m/m • Blend with low sulphur gasoil	0.005 max	ZS ASTM D 4294, ZS ASTM D 5453
Copper strip corrosion number (3h –at 50^{o}C) max	1	ZS ASTM D 130
Carbon Atom Residue (10% distillation) max	0.35	ZS ASTM D524
Derived Cetane number, min	47	ZS ASTM D 6890 ZS ASTM D 613
Ash content % m/m	0.01	ZS ASTM D 482
Phosphorus Content % mass, max	0.001	ZS ASTM D 3231
Water Content (% Vol), max	0.05	ZS ASTM D 6371 ZS ASTM E 1064 ZS ISO 12937
Cloud Point ^{o}C	Report	ZS ASTM D 2500
Cold filter Plugging Point ^{o}C	Report	EN 116
Oxidation Stability, hours, min	6	EN 590 EN 14112 EN 15751
Total Acid Number (mgKOH/g), max	0.3	ZS ASTM D 664
Water and sediment (% Vol), max	0.05	ZS ASTM D2709
Lubricity, HFRR at 60^{o}C µg, max	520	ZS ASTM D 6079
Full Distillation Profile	T90 @ 343^{o}C TT95 @ 360^{o}C	ZS ASTM D86

3 Unless otherwise state, all values are stated in SI units

6.0 SAMPLING, CONTAINERS AND SAMPLE HANDLING

For the purpose of this Zambian Standard all sampling shall be carried out in accordance with the relevant procedures of ZS 396 Part 1: and ZS869.

All intended test methods should be reviewed prior to sampling to better understand the importance and effects of sampling technique, proper containers, and special handling required for each test method.

A minimum sample size of 1L is recommended.

7.0 TEST METHODS

For all characteristics, use the applicable methods listed in Tables 1-3