

KENYA STANDARD

DKS2953:2022

ICS 75.080; 75.160:

Second Edition

**Petroleum and petroleum products —
Automotive B5 Biodiesel Fuel —
Specification**

DKS 2953:2022_PUBLIC REVIEW STAGE

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REVISION OF KENYA STANDARDS

In order to keep abreast of progress in industry, Kenya Standards shall be regularly reviewed. Suggestions for improvements to published standards, addressed to the Managing Director, Kenya Bureau of Standards, are welcome.

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Petroleum and petroleum products — Automotive B5 Biodiesel Fuel — Specification

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DKS2953:2022

Foreword

This Kenya Standard was prepared by the Petroleum and Petroleum Products Technical Committee under the guidance of the Standards Projects Committee, and it is in accordance with the procedures of the Kenya Bureau of Standards.

This second edition cancels and replaces the first edition (KS 2953:2022), which has been technically revised. The main changes compared to the previous edition are as follows:

— test methods have revised to include additional methods.

Biodiesel is an ester (more generally methyl ester) usually produced from vegetable oil, or waste streams either from animal fats, used cooking oil or fish oils.

Vegetable oils are obtained classically by simple pressing of oilseeds, such as jatropha seeds, rapeseeds, sunflower, soybeans, etc. All of these oils, however, offer too much viscosity and a cetane number (the ability to auto-ignition) too low, making their direct use in traditional diesel engine difficult.

In order to obtain similar characteristics with respect to conventional fossil diesel fuel, such vegetable oils must undergo a reaction of transesterification with an alcohol (usually methanol, CH_3OH) in the presence of a catalyst, usually potassium hydroxide (KOH) or sodium (NaOH). It should be noted that the use of ethanol is also considered, but very rarely used on a commercial scale. The transesterification reaction is carried out at moderate temperature (20-80 °C) and atmospheric pressure.

The production of biodiesel is relatively simple from a technical standpoint, which also allows the construction of small decentralized production units without excessive extra costs. Such a situation represents a definite advantage, thus limiting the transport of raw materials and permitting, in a transition phase, to start with modest sized installations.

Introduction

Biofuels development in a country —Standards and regulatory framework

Implementation of biofuels in a country and choices made for the standard and regulation to encourage it, depends on the objectives pursued by the country and they include:

- Energy independence
- Support for agriculture
- Land use policy
- Tackling climate change

Each country shall define its own standard and regulation, based on its strengths and opportunities, to create conditions for biofuels market development.

All the regulations define two things:

1. **Grade** defines the maximum unit incorporation or blend allowed by the authorities and it is based on technical consideration and the knowledge of vehicles used in the country. The aim of the grade specification is to assure that incorporation of biofuel will not generate engine compatibility issues. On a worldwide basis, and according to African Refiners Association (ARA) position/specifications, the grades generally used are;
 - For gasoline: E10 (meaning 0 to 10% of ethanol can be incorporated in gasoline)
 - For diesel: B7 (meaning 0 to 7% of FAME can be incorporated in diesel)
2. **Mandate** defines the global objective of incorporation or blending the country wants to start with. It will be based on the biofuel resource the country has, and on the objectives pursued through the introduction of biofuels. The mandate defines the minimum average incorporation or blending the marketers must start with in the blending ratio. The mandate will be raised with the improvement of local production of biomolecules.

Introduction of biofuels is costly. Biomolecules are more expensive than fuels, huge investments must be made in production of biomolecules and in logistics. The introduction of a mandate compatible with local resources and of penalty system is key to assure a progressive integration of these costs in the fuel price structure. The mandate can be raised with the improvement of local production of biomolecules, and this is the incentive for investors to improve production.

A grade higher than the mandate allows the system to run smoothly. It allows the market flexibility to fulfil the mandate without uneconomical constraints. Please note the determination of the mandate including reviews from time to time will be done by Energy and Petroleum Regulatory Authority.

Petroleum and petroleum products — Automotive B5 Biodiesel Fuel — Specification

1 Scope

This Kenya Standard specifies requirements, sampling and test methods for automotive B5 biodiesel fuel.

This standard is applicable to automotive biodiesel at 5 % biodiesel and 95 % petroleum diesel concentration blend. For use in diesel engine vehicles designed or subsequently adapted to run on 5 % biodiesel and 95 % petroleum diesel concentration.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ASTM D86, Standard Test Method for Distillation of Petroleum Products and Liquid Fuels at Atmospheric Pressure

ASTM D93, Standard Test Methods for Flash Point by Pensky-Martens Closed Cup Tester

ASTM D445, Standard Test Method for Kinematic Viscosity of Transparent and Opaque Liquids (and Calculation of Dynamic Viscosity)

ASTM D473, Standard Test Method for Sediment in Crude Oils and Fuel Oils by the Extraction Method

ASTM D664, Standard Test Method for Acid Number of Petroleum Products by Potentiometric Titration

ASTM D974, Standard Test Method for Acid and Base Number by Color-Indicator Titration

ASTM D976, Standard Test Method for Calculated Cetane Index of Distillate Fuels

ASTM D 1298, Standard Test Method for Density, Relative Density, or API Gravity of Crude Petroleum and Liquid Petroleum Products by Hydrometer Method
ASTM D1552, Standard Test Method for Sulfur in Petroleum Products by High Temperature Combustion and Infrared (IR) Detection or Thermal Conductivity Detection (TCD)

ASTM D 1500, Standard Test Method for ASTM Colour of Petroleum Products (ASTM Colour Scale)

ASTM D 2500, Standard Test Method for Cloud Point of Petroleum Products and Liquid Fuels

ASTM D 4052, Standard Test Method for Density, Relative Density, and API Gravity of Liquids by Digital Density Meter

ASTM D4294, Standard Test Method for Sulfur in Petroleum and Petroleum Products by Energy Dispersive X-ray Fluorescence Spectrometry

ASTM D5453, Standard Test Method for Determination of Total Sulfur in Light Hydrocarbons, Spark Ignition Engine Fuel, Diesel Engine Fuel, and Engine Oil by Ultraviolet Fluorescence

ASTM D6078, Standard Test Method for Evaluating Lubricity of Diesel Fuels by the Scuffing Load Ball-on-Cylinder Lubricity Evaluator (SLBOCLE)

ASTM D6304, Standard Test Method for Determination of water in Petroleum Products, Lubricating Oils and Additives by Coulometric Karl Fischer Titration

ASTM D7042, Standard Test Method for Dynamic Viscosity and Density of Liquids by Stabinger Viscometer (and the Calculation of Kinematic Viscosity)

EN 12662:, Liquid petroleum products - Determination of contamination in middle distillates

EN 12916:, Petroleum products- Determination of aromatic hydrocarbon types in middle distillates- High performance liquid chromatography method with refractive index detection

EN 14103:, Fat and oil derivatives - Fatty Acid Methyl Esters (FAME) – Determination of ester and linolenic acid methyl ester contents

EN 14112:, Fat and oil derivatives - Fatty Acid Methyl Esters (FAME) - Determination of oxidation stability (accelerated oxidation test)

ASTM D4057, Practice for Manual Sampling of Petroleum and Petroleum products

ASTM D4157 Practice for Automatic Sampling of Petroleum and Petroleum products

1P 34, Determination of flash point — Pensky-Martens closed cup method

IP 53, Crude petroleum and fuel oils - Determination of sediment - Extraction method

IP 71, Petroleum products - Transparent and opaque liquids - Determination of kinematic viscosity and calculation of dynamic viscosity

1P 74, Petroleum products and bituminous materials - Determination of water - Distillation method

IP 123, Petroleum products — Determination of distillation characteristics at atmospheric pressure

IP 160, Crude petroleum and liquid petroleum products - Laboratory determination of density - Hydrometer method

ISO 2049, Petroleum products — Determination of colour (ASTM scale)

ISO 2160:, Petroleum products - Corrosiveness to copper - Copper strip test

ISO 2719:, Determination of flash point- Pensky-Martens closed cup method

ISO 3015, Petroleum and related products from natural or synthetic sources — Determination of cloud point

ISO 3104:, Petroleum products - Transparent and opaque liquids - Determination of kinematic viscosity and calculation of dynamic viscosity

ISO 3170:, Petroleum liquids – Manual sampling

ISO 3171, Petroleum liquids – Automatic pipeline sampling

ISO 3405, Petroleum products- Determination of oscillation characteristics at atmospheric pressure

ISO 3675, Crude petroleum and liquid petroleum products - Laboratory determination of density - Hydrometer method

ISO 3733, Petroleum products and bituminous materials — Determination of water — Distillation method

ISO 3735, Crude petroleum and fuel oils — Determination of sediment — Extraction method

- ISO 4259, Petroleum products - Determination and application of precision data in relation to methods of test
- ISO 4264, Petroleum products- Calculation of Cetane index of middle-distillate fuels by the four- variable equation
- ISO 5165, Petroleum products — Determination of the ignition quality of diesel fuels — Cetane engine method
- ISO 6245, Petroleum products- Determination of ash
- ISO 6619, Petroleum products and lubricants — Neutralization number — Potentiometric titration method
- ISO 7537, Petroleum products — Determination of acid number — Semi-micro colour-indicator titration method
- ISO 8754, Petroleum products — Determination of sulfur content — Energy-dispersive X-ray fluorescence spectrometry
- ISO 10370, Petroleum products - Determination of carbon residue (micro method)
- ISO 12156-1, Diesel fuel — Assessment of lubricity using the high-frequency reciprocating rig (HFRR) — Part 1: Test method
- ISO 12185, Crude petroleum and petroleum products- Determination of density- Oscillating U-Tube method (
- ISO 12205, Petroleum products- Determination of oxidation stability of middle – distillate fuels
- ISO 12937, Petroleum products - Determination of water - Coulometric Karl Fisher titration method
- ISO 13759, Petroleum products – Determination of alkyl nitrate in diesel fuels –Spectrometric method.
- ISO 14596, Petroleum products — Determination of sulfur content — Wavelength-dispersive X-ray fluorescence spectrometry
- ISO 20884, Petroleum products – Determination of sulfur content of automotive fuels Wavelength- dispersive X-ray fluorescence spectrometry
- ISO 20847, Petroleum products – Determination of sulfur content of automotive fuels –Energy- dispersive X – ray fluorescence spectrometry
- ISO 20846, Petroleum products — Determination of sulfur content of automotive fuels — Ultraviolet fluorescence method
- ASTM D 664, Standard Test Method for Acid Number of Petroleum Products by Potentiometric Titration
- ASTM D1500, Standard Test Method for ASTM Color of Petroleum Products (ASTM Color Scale)
- ASTM D482, Standard Test Method for Ash from Petroleum Products
- IP 309, Diesel and domestic heating fuels - Determination of cold filter plugging point copy
- ISO 12205, Petroleum products — Determination of the oxidation stability of middle-distillate fuels
- ISO 2160, Petroleum products — Corrosiveness to copper — Copper strip test
- EN 12662, Liquid petroleum products - Determination of total contamination in middle distillates, diesel fuels and fatty acid methyl esters

IP 74, Petroleum products and bituminous materials - Determination of water - Distillation method

ISO 4264, Petroleum products — Calculation of cetane index of middle-distillate fuels by the four variable equation

ISO 5165:2017, Petroleum products — Determination of the ignition quality of diesel fuels — Cetane engine method

IP 34, Determination of Flash Point - Pensky-Martens closed cup method

ASTM D4052, Standard Test Method for Density, Relative Density, and API Gravity of Liquids by Digital Density Meter

ASTM D1298, Standard Test Method for Density, Relative Density, or API Gravity of Crude Petroleum and Liquid Petroleum Products by Hydrometer Method

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)

ASTM D7861, Standard Test Method for Determination of Fatty Acid Methyl Esters (FAME) in Diesel Fuel by Linear Variable Filter (LVF) Array Based Mid-Infrared Spectroscopy

IP 365, Crude petroleum and petroleum products - Determination of density - Oscillating U-tube method

ASTM D1552, Standard Test Method for Sulfur in Petroleum Products by High Temperature Combustion and Infrared (IR) Detection or Thermal Conductivity Detection (TCD)

ASTM D4294, Standard Test Method for Sulfur in Petroleum and Petroleum Products by Energy-Dispersive X-Ray Fluorescence Spectrometry

ASTM D5453, Standard Test Method for Determination of Total Sulfur in Light Hydrocarbons, Spark Ignition Engine Fuel, Diesel Engine Fuel, and Engine Oil by Ultraviolet Fluorescence

ASTM D4530, Standard Test Method for Determination of Carbon Residue (Micro Method)

ASTM D189, Standard Test Method for Conradson Carbon Residue of Petroleum Products

IP 13, Petroleum products - Determination of carbon residue - Conradson method

IP 398, Petroleum products - Determination of carbon residue - Micro method

ASTM D613, Standard Test Method for Cetane Number of Diesel Fuel Oil

ASTM D4737, Standard Test Method for Calculated Cetane Index by Four Variable Equation

IP 380, Petroleum products - Calculation of cetane index of middle distillate fuels by the four-variable equation

ISO 6296, Petroleum Products - Determination of Water - Potentiometric Karl Fischer Titration Method

ASTM D95, Standard Test Method for Water in Petroleum Products and Bituminous Materials by Distillation

ASTM D6217, Standard Test Method for Particulate Contamination in Middle Distillate Fuels by Laboratory Filtration

ASTM-D7321, Standard Test Method for Particulate Contamination of Biodiesel B100 Blend Stock Biodiesel Esters and Biodiesel Blends by Laboratory Filtration

IP 440, Liquid petroleum products - Determination of contamination in middle distillates

IP 154, Petroleum products - Corrosiveness to copper - Copper strip test

ASTM D130, Standard Test Method for Corrosiveness to Copper from Petroleum Products by Copper Strip Test

IP 393, Determination of volatility of automotive lubricating oils - Thermogravimetric method

ASTM D2274, Standard Test Method for Oxidation Stability of Distillate Fuel Oil (Accelerated Method)

IP 388, Petroleum products - Determination of the oxidation stability of middle-distillate fuels

EN 116:2015, Diesel and domestic heating fuels - Determination of cold filter plugging point - Stepwise cooling bath method

ASTM D6371, Standard Test Method for Cold Filter Plugging Point of Diesel and Heating Fuels

IP 4, Petroleum products - Determination of ash

ASTM D6079, Standard Test Method for Evaluating Lubricity of Diesel Fuels by the High-Frequency Reciprocating Rig (HFRR)

ASTM D5771, Standard Test Method for Cloud Point of Petroleum Products and Liquid Fuels (Optical Detection Stepped Cooling Method)

ASTM D5773, Standard Test Method for Cloud Point of Petroleum Products and Liquid Fuels (Constant Cooling Rate Method)

IP 219, Petroleum products - Determination of cloud point

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)

ASTM D7861, Standard Test Method for Determination of Fatty Acid Methyl Esters (FAME) in Diesel Fuel by Linear Variable Filter (LVF) Array Based Mid-Infrared Spectroscopy

KS EAS 177 Automotive Gas Oil (Automotive Diesel) – Specification

KS 2227 Automotive Biodiesel Fuel – Specification

3 Terms and definitions

For the purposes of this document, the following term and definition apply.

3.1 additive
compound added to the biodiesel fuel to improve either the performance of the biodiesel or its storage stability or both

3.2 biodiesel
fuel comprised of methyl esters of long chain fatty acids derived from vegetable oils, or waste streams either from animal fats, used cooking oil or fish oils.

3.3 grade
maximum unit incorporation allowed by the authorities. Based on technical consideration and the knowledge of vehicles used in the country, the aim of the grade specification is to assure that incorporation of biofuel will not generate engine compatibility issues

3.4 dyes
chemicals added to fuels for visual identification

3.5 markers
substances added to fuels for traceability to protect them against theft or adulteration and also to distinguish between different fuels.

4 Requirements

4.1 General requirements

4.1.1 The automotive biodiesel fuel shall contain, principally, mono-alkyl methyl esters of long chain fatty acids derived from vegetable oil, waste streams either from animal fats, used cooking oil or fish oils

4.1.2 Suitable fuel additives without known side effects may be used to help avoid deterioration of driveability and emissions control durability. Other technical means that exhibit an effect equivalent to that of additives can also be used.

4.1.3 The fuel may contain small quantities of dye which are documented as harmless to give it a distinctive colour.

4.1.4 The fuel may contain small quantities of Markers which are documented as harmless.

4.1.5 The fuel shall be clear and free of visible water, sediment, suspended matter and any other contaminant that is documented as likely to cause malfunctioning of equipment designed to use this type of fuel, as a blended form.

4.2 Physical and chemical properties

The fuel shall comply with all the requirements given in Table 1 when tested in accordance with the test methods specified therein.

NOTE: In case of a need for identification of biodiesel, it is recommended that a method based on the characterization of fatty acid methyl esters by LG/GC, in accordance with EN 14331, be used.

Table 1 — Requirements for Automotive B5 Biodiesel Fuel

| 1 | 2 | 3 |
|--|--------------|--|
| Property | Requirements | Test method |
| FAME content, % volume fraction , max. | 5 | EN 14078 ASTM D7371 ASTM D7861 |
| Density at 15 °C, kg/m ³ | 820-870 | ISO 3675, |
| Density at 20 °C, kg/m ³ | 820 - 850 | ISO 12185 ASTM D1298 ASTM D4052 IP 160 IP 365 ASTM D7042 |
| Kinematic viscosity at 40 °C, mm ² /s | 2.0– 5.0 | ISO 3104 ASTM D445 IP 71 |
| Flash point, °C, min. | 60 | ISO 2719 ASTM D93 IP 34 |
| Sulfur content, mass, max. | 50.0 | ISO 14596 ISO 8754 ISO 20846 ISO 20884 ISO 20847 ASTM D1552 ASTM D4294 ASTM D5453 |
| Carbon residue (on 10 % distillation residue), %, mass fraction, max | 0.3 | ISO 10370 ASTM D4530 ASTM D189 IP 13 IP 398 |
| Cetane Number, min. | 51.0 | ISO 5165 ASTM D613 |
| Cetane Index, min. | 46 | ISO 4264 ASTM D976 |

| | | |
|--|----------------|--|
| | | ASTM D4737 IP 380 |
| Distillation temperature (% vol recovered) | | |
| <ul style="list-style-type: none"> Initial Boiling Point | To be reported | ISO 3405 ASTM D86 IP 123 |
| <ul style="list-style-type: none"> % (V/V) recovered at 250 °C, max | 65 | |
| <ul style="list-style-type: none"> % (V/V) recovered at 350 °C, min | 85 | |
| <ul style="list-style-type: none"> 95 % (V/V) recovered at °C, max | 360 | |
| <ul style="list-style-type: none"> Final boiling point °C, max. | 400 | |
| Water content, mg/kg, max. | 200 | ISO 12937 IP 74 ISO 3733 ASTM D6304 ASTM D95 ISO 6296 |
| Total contamination, mg/kg, max. | 24 | EN 12662 ASTM D6217 IP 440 ASTM D7321 |
| Copper strip corrosion (3 h at 50 °C), rating, max. | Class A | ISO 2160 ASTM D 130 IP 154 |
| Polycyclic aromatic hydrocarbons, % (v/v), max. | 11 | EN 12916 IP 393 |
| Oxidation stability, g/m ³ , max | 25 | ISO 12205 ASTM D2274 IP 388 |
| Cold Filter Plugging Point (CFPP), max. | 12 | IP 309 ASTM D6371 EN 116 |
| Ash Content, %, (m/m), max | 0.01 | ISO 6245 ASTM D482 IP 4 |
| ASTM colour, max | 3.5 | ISO 2049 ASTM D1500 |
| Lubricity, corrected wear scar diameter (wsd 1.4) at 60 °C, µm, max | 450 | ISO 12156-1 ASTM D6078 ASTM D6079 IP 450 |
| Cloud Point, °C | To be reported | ISO 3015 ASTM D2500 ASTM D5771 ASTM D5773 IP 219 |

| | | |
|--|------------|---|
| Sediment, % m/m, Max | 0.01 | ISO 3735 ASTM D473 IP 53 |
| Neutralization value: Strong acid No., KOH, mg/g Total Acid No., KOH, mg/g | Nil 0.5 | ISO 6619 ASTM D974 ISO 7537 ASTM D 664 |

4.3 Dyes and markers

The use of dyes and markers is allowed.

4.4 Precision and dispute

4.4.1 All test methods referred to in this Kenya standard include a precision statement. In cases of dispute, the procedures for resolving the dispute and interpretation of the results based on test method precision, described in ISO 4259, shall be used.

4.4.2 In cases of dispute concerning density, ISO 3675 shall be used

4.4.3 In cases of dispute concerning cetane number, ISO 5165 shall be used. For the determination of cetane number alternative methods to those indicated in table1, provided that these methods originate from a recognized method series, and have a valid precision statement, derived in accordance with ISO 4259, which demonstrates precision at least equal to that of the referenced method. The test result, when using an alternative method, shall also have a demonstrable relationship to the result obtained when using the referenced method

5 Packing

Except when transported in bulk, the biodiesel shall be packed in sound, clean, dry drums not deleteriously affected by the biodiesel. The drums shall be so closed that leakage and contamination of the biodiesel is prevented during normal handling and transport.

6 Marking

The following information shall appear in prominent, legible and indelible marking on each drum or, in the case of biodiesel filled in bulk storage tanks or bulk carriers, in the storage and consignment documents of each bulk carrier:

- a) the manufacturer's (or the supplier's) name;
- b) the brand name of the product;
- c) a description of the product, i.e. "Automotive B5 Biodiesel Fuel";
- d) batch identification; and
- e) the quantity of the contents.

7 Sampling

Samples shall be taken as described in KS ISO 3170 or KS ISO 3171.

In view of the sensitivity of some of the test methods referred to in this Kenya Standard, particular attention shall be paid to compliance with any guidance on sampling containers, which is included in the test method standard.

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