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DRAFT EAST AFRICAN STANDARD

Automotive biodiesel fuel – Specification

EAST AFRICAN COMMUNITY

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Copyright notice

Foreword

Development of the East African Standards has been necessitated by the need for harmonizing requirements governing quality of products and services in the East African Community. It is envisaged that through harmonized standardization, trade barriers that are encountered when goods and services are exchanged within the Community will be removed.

The Community has established an East African Standards Committee (EASC) mandated to develop and issue East African Standards (EAS). The Committee is composed of representatives of the National Standards Bodies in Partner States, together with the representatives from the public and private sector organizations in the community.

East African Standards are developed through Technical Committees that are representative of key stakeholders including government, academia, consumer groups, private sector and other interested parties. Draft East African Standards are circulated to stakeholders through the National Standards Bodies in the Partner States. The comments received are discussed and incorporated before finalization of standards, in accordance with the principles and procedures for development of East African Standards.

East African Standards are subject to review, to keep pace with technological advances. Users of the East African Standards are therefore expected to ensure that they always have the latest versions of the standards they are implementing.

The committee responsible for this document is Technical Committee EASC/TC 067, *Biofuels.*

Attention is drawn to the possibility that some of the elements of this document may be subject of patent rights. EAC shall not be held responsible for identifying any or all such patent rights.

Automotive biodiesel fuel – Specification

1 Scope

This Draft East African Standard specifies requirements, test methods and sampling for pure biodiesel intended for use as fuel in diesel engines operating at 100% concentration or as a blend component for automotive gas oil.

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.

EN 116, *Diesel and domestic heating fuels – Determination of cold filter plugging point*

EN 14103, *Fat and oil derivatives – Fatty acid methyl esters (FAME) – Determination of ester and linolenic acid methyl ester contents*

EN 14105, Fat and oil derivatives – Fatty acid methyl esters (FAME) – Determination of free and total glycerol and mono-, di-and triglyceride content (Reference method)

EN 14106, Fat and oil derivatives – Fatty acid methyl esters (FAME) – Determination of free glycerol content

EN 14106, Fat and oil derivatives – Fatty acid methyl esters (FAME) – Determination of phosphorus content by inductively coupled plasma (IPC) emission spectrometry

EN 14107, Fat and oil derivatives – Fatty acid methyl esters (FAME) – Determination of sodium content by atomic absorption spectrometry

EN 14109, Fat and oil derivatives – Fatty acid methyl esters (FAME) – Determination of potassium content by atomic absorption spectrometry

EN 14110, Fat and oil derivatives – Fatty acid methyl esters (FAME) – Determination of methanol content

EN 14111, Fat and oil derivatives – Fatty acid methyl esters (FAME) – Determination of iodine value

EN 14112, Fat and oil derivatives – Fatty acid methyl esters (FAME) – Determination of oxidation stability (accelerated oxidation test)

ISO 2160, Petroleum products – Corrosiveness to copper – Copper strip test

ISO 3104, Petroleum products – Transparent and opaque liquids – Determination of Kinematic viscosity and calculation of dynamic viscosity

ISO 3170, Petroleum products – Petroleum liquids – Manual sampling (ISO 3170)

ISO 3171, Petroleum products – Automatic pipeline sampling

ISO 3675, Crude petroleum and liquid petroleum products – Laboratory determination of density or relative density – Hydrometer method

ISO 3679, Petroleum product – Determination of flash point – Rapid equilibrium closed cup method

ISO 3987, Petroleum products – Lubricating oils and additives – Determination of sulphated ash

ISO 4259, Petroleum products – Determination and application of precision data in relation to methods of test

ISO 5165, Petroleum products – diesel fuel – Determination of the ignition quality of fuels – Cetane engine method

ISO 10370, Petroleum products – Determination of Carbon residual – Micro method

ISO 12185, Crude petroleum and petroleum products – Determination of density – Oscillating U-tube method

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 sulphur content – Wavelength- depressive X-ray fluorescence spectrometry

ISO 20846, Petroleum products – Determination of sulphur content of automotive fuels – Ultraviolet fluorescence method

ISO 20884, Petroleum products – Petroleum products – Determination of sulphur content of automotive fuels – Wavelength-dispersive X-ray fluorescence spectrometry

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

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

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

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

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

— IEC Electropedia: available at http://www.electropedia.org/

— ISO Online browsing platform: available at http://www.iso.org/obp

3.1
Additives
material added to AGO usually in small amounts, to impart or enhance desirable properties, or to suppress undesirable properties

3.2
biodiesel
fuel comprised of mono-alkyl esters of long chain fatty acids derived from plant oils, animal fats, or a combination of these feedstocks, designated as B100

3.3
biodiesel blend
pure biodiesel blended with automotive diesel

3.4
pure biodiesel, or 100 percent (as B100)
biodiesel fuel referred to as “neat” fuel

3.5
dyes
chemicals added to fuels for visual identification

3.6
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 biodiesel fuel shall contain mono-alkyl methyl esters of long-chain fatty acids derived from plant oils and/or animal fats. Suitable additives may be added to enhance various storage and performance properties of the fuel.

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

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

4.1.4 The fuel shall be clear and free of visible water, sediment, suspended matter and any other contaminant. It shall remain homogeneous during storage and not exhibit phase separation.

4.2 Specific requirements

Automotive biodiesel fuel shall comply with the requirements given in Table 1 when tested in accordance with the test methods prescribed therein.

NOTE 1 – In case of a need for identification of biodiesel, it is recommended that a method for the characterization of fatty acid methyl ester (FAME) by Liquid Chromatograph (LC)/ Gas Chromatograph (GC), in accordance with EN 14331, be used.

NOTE 2 – In case of a need to identify the source of oil of biodiesel, the iodine value of biodiesel can be calculated by the method presented in annex B.

Table 1 – Requirements for automotive biodiesel fuel

S/No.	Property	Requirements	Test methods
i.	Density, kg/m^3 • At 20 °C • At 15 °C	 860 - 900 872 - 900	ISO 3675 ISO 12185 ASTM D1298 ASTM D4052 IP 160
ii.	Ester content, % (m/m), *min*.	96.5	EN 14103
iii.	Kinematic viscosity at 40 °C[d)], mm^2/s.	3.5 – 5.0	ISO 3104 ASTM D445 IP 71
iv.	Flash point, °C, min.	120	ISO 3679 ISO 2719 ASTM D93 IP 34
v.	Sulphur content, mg/kg, *max*.	10.0	EN ISO 20846 ISO 14596 ISO 8754 ISO 20884 ISO 20847 ASTM D5453
vi.	Carbon residue (10% distillation residue), % (m/m), *max*.	0.3	ISO 10370 ASTM D93 ASTM D4530 IP 34
vii.	Cetane Number, *min*.	51.0	ISO 5165 ASTM D613
viii.	Sulphated ash, % (m/m), *max*.	0.02	ISO 3987,6245 ASTM D874
ix.	Water content, % (m/m), *max*.	0.05	ISO 12937 ASTM D95 IP 74 ISO 3733,
x.	Total contamination, mg/kg, *max*.	24	EN 12662
xi.	Copper corrosion (3 h at 50 °C), rating, *max*.	Class 1	ISO 2160 ASTM D 130
xii.	Oxidation stability, at 110 °C, h, *min*.	6	EN 14112 EN 15751 ISO 12205 ASTM D2274
xiii.	Total acid number, mg KOH/g, *max*.	0.5	EN 14104 ASTM D974
xiv.	Iodine value of Iodine g/100 g of FAME, *max*.	140	EN 14111
xv.	Linolenic acid methyl ester, % mass fraction, *max*.	12	EN 14103
xvi.	Polyunsaturated (>= 4 double bonds) methyl ester, %, mass fraction, max.	1	EN 14103
xvii.	Methanol content, % mass fraction, *max*.	0.2	EN 14110

xviii.	Monoglyceride content, % mass fraction, *max*.	0.8	EN 14105
xix.	Diglyceride content, % mass fraction, *max*.	0.2	EN 14105
xx.	Triglyceride content, % mass fraction, *max*.	0.2	EN 14105
xxi.	Free glycerol, % mass fraction, *max*.	0.02	EN 14105, EN 14106, ASTM D658
xxii.	Total glycerol, % mass fraction, *max*.	0.25	EN 14105, ASTM D6584
xxiii.	Group I metals (total of Na and K) mg/kg, *max*.	5.0	EN 14108, EN 14109
xxiv.	Group II metals (total of Ca and Mg), mg/kg, *max*.	Report	EN 145538
xxv.	Phosphorus content, mg/kg, *max*.	5.0	EN 14107 ASTM D4951
xxvi.	Cold Filter Plugging Point (CFPP), °C *max*.	+3	ASTM EN 116
xxvii.	Cloud Point, °C	Report	ASTM D2500

NOTE 1 – The precision data shall be computed as per the requirements of the respective test methods

NOTE 2 – Density may be measured by ISO 3675 over a range of temperatures from 20 °C to 60 °C. A temperature correction shall be made according to the formula given in Annex C (see 5.4.2).

NOTE 3 – If CFPP is –20 °C or lower, the viscosity measured at -20°C shall not exceed 48 mm^2/s. In this case, ISO 3104 is applicable without the precision data owing to non-Newtonian behaviour in a two-phase system.

5 Transportation and storage

Due to the hygroscopic and oxidative nature of biodiesel, appropriate precautions shall be taken to keep the transportation, storage and handling systems as dry as possible to prevent fuel degradation.

6 Packaging

The condition of the containers, rail tankers and road tank vehicles shall not be detrimental to the quality of the fuel during transportation and storage.

The containers shall be acceptably sealed or leakproof, clean, and free from materials soluble in biodiesel.

7 Labelling

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 or and physical address the brand name of the product or both;
b) a description of the product, i.e. PURE BIODIESEL FUEL, (B100)
c) batch identification; and
d) the quantity of the contents.
e) the warning, "DANGER"
f) date of manufacture;
g) country of origin

8 Methods of test

8.1 General

8.1.2 For all tests, use samples taken in accordance with Annex D.

8.1.3 For all properties, use the applicable test method or, when relevant, one of the applicable test methods listed in column 3 of Table 1.

8.1.4 The limiting value for the carbon residue given in Table 1 is based on the product prior to the addition of ignition improver, if used. If a value exceeding the limit is obtained on finished fuel in the market, use ISO 13759 to determine the presence of a nitrate-containing compound. If an ignition improver is thus proved present, the limit value for carbon residue of the product under test cannot be applied. The use of additives does not exempt the manufacturer from meeting the requirement of a maximum 0.30% mass fraction of carbon residue prior to the addition of additives.

8.2 Precision and dispute

8.2.1 All test methods referred to in this East African Standard include a precision statement according to ISO 4259. In case of dispute, use the procedure described in ISO 4259 for resolving the dispute, and the interpretation of the results based on the test method precision shall be used. However, the methods currently available for total contamination, ester content, tri- glyceride content, free glycerol and alkaline metals (total amount of Na and K) do not meet the 2R requirement of ISO 4259 at the limit in Table 1.

8.2.2 Test methods for petroleum products may contain precision data specific to these products. When the same methods are used to test biodiesel fuel, the precision data might differ; such data are given in Annex A.

8.2.3 In case of dispute concerning density, use ISO 3675 with the determination carried out at 15 °C.

NOTE – Available conversion Tables are not applicable to biodiesel.

8.2.4 In case of dispute concerning free glycerol, the reference method is EN 14105.

8.2.5 For the determination of Cetane Number, alternative methods may also be used in cases of dispute, 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 an alternative method is used, shall also have a demonstrable relationship to the result obtained when using the reference method.

9 Placarding

Where biodiesel is transported in road tanks or vehicles carrying portable tanks that exceed 3,500 kg, placarding may apply.

10 Sampling

Sampling shall be done in accordance with ASTM D4057, ASTM D4177, ISO 3170 or ISO 3171.

Annex A
(Informative)

Table A.1 – Table of precision data

S/N	Property	Test Method	Data for pure FAME [a, b, c]
1	Kinematic viscosity at 40 °C, mm^2/s	ISO 3104	r =0.0011X R =0.018X
2	Sulphur content, mg/kg	ISO 20846	r =0.0285X +2 R =0.1088X +2 r =0.0226X +1.356 R =0.0567X + 1.616
3	Distillation °C	ASTMD 1160	r = 2.0 R = 3.0 (90% v/v distilled)
4	Cetane Number	ISO 5165	r = 2.4 R = 5.5
5	Sulphated ash content, % mass fraction	ISO 3987	r =0.06 $X^{0.85}$ r =0.142 $X^{0.85}$
6	Total contamination, mg/kg	EN 12662[d]	r = 2.24 R = 13.6
7	Total of Na and K, mg/kg	EN 14108, 14109	r = 0.017X + 0.512 R = 0.305X + 1.980

[a] r is the repeatability in accordance with ISO 4259
[b] R is the reproducibility accordance with ISO 4259
[c] X is the mean of two results being compared
[d] The precision of EN 12662 is for biodiesel

Annex B
(Informative)

B.1 Scope

This method describes a procedure for calculating the iodine value of 100% concentration biodiesel or biodiesel extracted from blends with diesel fuel. In case of dispute on the iodine value this method shall be used as a substitute of EN 14111.

NOTE – This method is adapted for biodiesel from AOCS recommended practice Cd-85 for the determination of iodine value of vegetable oil from its fatty acid composition.

B.2 Definition

This method is used to calculate the Iodine value expressed in g I_2/100g sample from the percentage by mass of methyl esters as determined by either EN 14103 (neat biodiesel) or EN 14331 (biodiesel extracted from blends with diesel fuel).

B.3 Procedure

B.3.1 Check the methyl ester composition of the sample by using the appropriate method as described in B.2.

NOTE – The total methyl ester thus revealed should be equal to 100 after the deduction of the methyl ester C17 used for internal standard in EN 14103.

B.3.2 Use the percentage by mass obtained in B.3.1 to calculate the sample's iodine value, being the sum of the individual contributions of each methyl ester, obtained by multiplying the methyl ester percentage by its respective factor (see table B.2). The factor for each constituent of biodiesel is given in table B.1.

Table B.1 – Methyl ester factors (Informative)

S/N	Methyl ester	Factor
1	Methyl ester of saturated fatty acids	0
2	Methyl hexadecenoate (Methyl palmitoleate) C16:1	0.950
3	Methyl octadecenoate (methyl oleate) C18.1	0.860
4	Methyl octadecadienoate (methyl lineoleate) C18.2	1.732
5	Methyl octadectrienoate (methyl linolenate) C18.3	2.616
6	Methyl eicosenoate (methyl gadoleate) C20: 1	0.785
7	Methyl decasenoate (methyl erucate) C22: 7	0.723

B.4 Expression of the result

Iodine value (calculated from the methyl ester composition) = g iodine/100g of FAME. The result should be reported to the first decimal place.

NOTE 1 – In 1994 the AOCS Uniform Methods Committee reviewed the coefficients used and concluded that no changes were necessary at that time. The present procedure uses the coefficients selected in the past for use in calculating the iodine in triglyceride blends. The reasoning behind that choice is that triple the molecular weight of methyl ester is almost identical to the molecular weight of the corresponding triglyceride.

NOTE 2 – For samples with unsaponifiable content greater than a mass fraction of 0.5% or those containing a significant additive content, the calculated value tends to be higher than true value.

NOTE 3 – The calculated result tends to be lower than the true value in samples with a lower iodine value.

Table B.2 – Calculation example (Informative), e.g. sunflower

S/N	Methyl ester of the following acids	Percentage mass fraction	Factor	Contribution
1	Myristic C14:0	0.3	0	0
2	Pamitic C 16:0	4.0	0	0
3	Palmitoleic C16:1	1.1	0.950	1.0
4	Stearic C18:0	2.0	0	0
5	Oleic C 18.1	60.5	0.860	52.0
6	Linoleic C18.2	19.8	1.732	34.3
7	Linolenic 18:3	9.4	2.616	24.6
8	Eicosanoic (euricic) C20:0	0.4	0	0
9	Docosanoic (gadoleic) C22:0	0.7	0	0
10	Docosenoic (arachidic) C22:1	1.1	0.723	0.8
			Calculated Iodine value	113.3

Annex C
(Informative)

Correction factor for calculation of density of biodiesel

The following equation shall be used for the calculation of density of biodiesel at 15 °C.

$P(15) = P(T) + 0.723(T – 15)$

where,

P(15) is density of biodiesel at 15 °C.
P(T) is density at any other temperature in the range of 20 °C to 60 °C. T is any temperature in the range of 20 °C to 60 °C.

Annex D

(Informative)

Potential health effects

D.1 Inhalation

Negligible unless heated to produce vapours. Vapours or finely misted materials may irritate the mucous membranes and cause irritation, dizziness, and nausea. Remove to fresh air.

D.2 Eye contact

May cause irritation. Irrigate the eye with water for at least 15 to 20 minutes. Seek medical attention if symptoms persist.

Annex E
(Informative)

First aid measures

E.1 Eyes

Irrigate eyes with a heavy stream of water for at least 15 to 20 minutes.

E.2 Skin

Wash exposed areas of the body with soap and water.

E.3 Inhalation

Remove from area of exposure; seek medical attention if symptoms persist.

E.4 Ingestion

Give one or two glasses of water to drink. If gastro-intestinal symptoms develop, consult medical personnel. (Never give anything by mouth to an unconscious person.)

Annex F

(Informative)

Handling and storage

Store in closed containers between 50° F (10° C) and 120° F(48.88° C). Keep away from oxidizing agents, excessive heat, and ignition sources. Store and use in well-ventilated areas. Do not store or use near heat, spark, or flame; store out of sun. Do not puncture, drag, or slide the container. Drum is not a pressure vessel; never use pressure to empty.

Annex G

(Informative)

Disposal considerations

Waste may be disposed of by following the available regulation and laws. Contaminated absorbent material may be disposed of in an approved landfill. Follow national regulations.

Bibliography

1. KS 2227: 2023 *Petroleum and petroleum products— Automotive biodiesel fuel — Specification*
2. TZS 1099: 2012 *Automotive biodiesel fuel – Specification*

