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DRAFT EAST AFRICAN STANDARD

Denatured ethanol for use as cooking and appliance fuel — Specification

EAST AFRICAN COMMUNITY

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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

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.

Denatured ethanol for use as cooking and appliance fuel — Specification

1 Scope

This Draft East African Standard specifies requirements, sampling and test methods for denatured ethanol for use as cooking or heating appliance fuel, or both.

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.

ISO 3165, *Sampling of chemical product for industrial use — Safety in sampling*

ISO 10101-2, *Natural gas — Determination of water by the Karl Fischer method — Part 2: Titration procedure*

ISO 10101-3, *Natural gas — Determination of water by the Karl Fischer method — Part 3: Coulometric procedure*

ISO 1388-2, *Ethanol for industrial use — Methods of test — Part 2: Detection of alkalinity or acidity to phenolphthalein*

ASTM D4815, *Test Method for Determination of MTBE, ETBE, TAME, DIPE, Tertiary-Amyl Alcohol and C1 to C4 Alcohols in Gasoline by Gas Chromatograph*

ASTM D6045 – 20, *Standard test method for colour of petroleum products by the automatic tristimulus method*

ISO 22854, *Liquid petroleum products — Determination of hydrocarbon types and oxygenates in automotive, motor gasoline and in ethanol (E85) automotive fuel — Multidimensional gas chromatography method*

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

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

ASTM D1217, *Standard Test Method for Density and Relative Density (Specific Gravity) of Liquids by Bingham Pycnometer*

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

ASTM D6423, *Standard Test Method for Determination of pH of Denatured Fuel Ethanol and Ethanol Fuel Blends*

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

ASTM D7345, *Standard Test Method for Distillation of Petroleum Products and Liquid Fuels at Atmospheric Pressure (Micro Distillation Method)*

ASTM D5501, Standard Test Method for Determination of Ethanol and Methanol Content in Fuels Containing Greater than 20 % Ethanol by Gas Chromatography

ASTM D7795, *Standard Test Method for Acidity in Ethanol and Ethanol Blends by Titration*

ISO 3170, *Hydrocarbon Liquids — Manual sampling*

ISO 3171, *Petroleum liquids — Automatic pipeline sampling*

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:

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

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

3.1
denaturant
a noxious chemical substance added to ethanol to render it unpalatable and unfit for human consumption

3.2
denatured ethanol
n - ethanol made unfit for beverage use by the addition of toxic or noxious materials

3.3
higher alcohols
n - aliphatic alcohols of general formula $C_nH_{2n+1}OH$ with *n* being 3 to 8

3.4
hydrocarbon
n - components in an ethanol-hydrocarbon blend containing only hydrogen and carbon

4 Requirements

4.1 General requirements

4.1.1 The product shall be clear and visually free of sediment and suspended matter.

4.1.2 The product shall be free of any adulterant or contaminant that can render the material unacceptable for its commonly used applications.

4.1.3 The product shall be coloured to visually indicate that it is not potable.

4.1.4 The ethanol shall be denatured as a deterrent from human consumption.

4.2 Specific requirements

Denatured ethanol shall comply with the specific requirements given in Table 1 when tested in accordance with the test methods specified therein.

Table 1 — Specific requirements for denatured ethanol for use as cooking and appliance fuel

S/N	Characteristic	Requirement	Test method
i.	Ethanol content, % volume, min.	90	ASTM D5501
ii.	Water, volume %, max.	10	ISO 10101-2 ISO 10101-3 ASTM D 95
iii.	Density kg/m^3, at 20 °C, max.	828	ASTM D1298/ ISO 3675/ ASTM D1217/ ASTM D4052
Iv.	Denatonium Benzoate, mg/Kg	10 – 20	Annex B
v.	Higher Alcohols (C3–C8), volume %, max.	2	ASTM D4815
vi.	Hydrocarbon[a], % volume, max.	1	ISO 22854
vii.	Miscibility	Miscible when mixed with distilled water	Annex C
viii.	Acidity (as acetic acid), mg/kg, max.	40	ASTM D7795
ix.	Colored dye, mg/Kg, max.	10	ASTM D6045
x.	pH	6.5-7.5	ASTM D6423
xi	Final Boiling Point, ^{0}C	225	ASTM D86 ASTM D7345
xii	Color	Purple dye	Visual inspection

[a]The hydrocarbons approved for use under this specification are as follows: gasoline, unleaded gasoline, natural gasoline, heptane, or rubber hydrocarbon solvent.

5 Sampling and sample size

Sampling shall be done in accordance with ISO 3170 or ISO 31716.

6 Packaging

6.1 The product shall be packaged in safe, dry, tight and suitable containers, without faults, made of material which does not react with ethanol and do not introduce any foreign substances or odours to the product.

6.2 Bulk quantities shall be stored in containers designed for flammable liquids and equipped with safety features such as pressure relief valves and secondary containment systems.

6.3 The containers shall be securely sealed to prevent evaporation and spillage, and stored in a well-ventilated area to avoid vapour build-up.

7 Labelling

7.1 The following information shall appear in legible and indelibly marked or on a label affixed to the container carrying the fuel: A label bearing the following information shall be affixed to the container storing or transporting the fuel:

a) manufacturer’s/ distributor's name and physical address;

b) recognized trade mark, if any;

c) country of origin;

d) name of the product as “Denatured ethanol for cooking”;

e) name of denaturant;

f) ethanol content;

g) batch/lot number;

h) manufacturing date;

i) pictorial symbols to show flammability and toxicity nature;

j) storage and instruction of use;

k) quantity; and

l) disposal of container i.e, recyclable or reusable.

7.2 For bulk transportation, the information specified in 7.1 shall be in the documentation accompanying the product.

Annex A
(informative)

Relationship between density in air and ethanol content

Table 2 gives the relation between density in air and ethanol content, expressed in either percentage by volume, or as a percentage by mass, at a 20 ˚C.

Table 2 — Relationship between density in air and alcoholic strength

Density in air (g/mL)	Ethanol content at 20 ˚C	
20 °C	% (m/m)	% (v/v)
0.8281	85.7	90.0
0.8264	86.3	90.5
0.8248	87.0	91.0
0.8231	87.6	91.5
0.8213	88.3	92.0
0.8196	89.0	92.5
0.8178	89.6	93.0
0.8160	90.3	93.5
0.8141	91.0	94.0
0.8122	91.7	94.5
0.8103	92.4	95.0
0.8083	93.1	95.5
0.8063	93.8	96.0
0.8043	94.6	96.5
0.8022	95.3	97.0
0.8000	96.1	97.5
0.7978	96.8	98.0
0.7955	97.6	98.5
0.7932	98.4	99.0
0.7907	99.2	99.5
0.7882	100.0	100.0

Annex B
(informative)

Determination of Denatonium Benzoate in alcoholic products by HPLC-UV

B.1 Principles

This method describes the determination of Denatonium Benzoate (DB) in CDA (Completely Denatured Alcohol) formulations using HPLC with UV detection at 210 nm. The samples are directly injected into the HPLC system after membrane filtration. The working range for quantitative determination of DB is 0.5 to 20.0 mg / L.

B.2 Instrumentation and materials

B.2.1 HPLC system equipped with.

- Pumping system suitable for isocratic elution.
- Solvent degassing system (on-line/off-line).
- Injection system with 20 µl loop.
- Analytical column, for example: LiChrospher 100 CN (5 µm) in LiChroCART 250-4 guard column
- Thermostated column compartment (oven).
- Diode array detector (DAD) or UV detector.
- Integrator or computer with data acquisition software and printer.

B.2.2 Analytical balance with a precision of 0.1 mg.

B.2.3 0.5, 2, 5, 10 and 20 ml pipettes.

B.2.4 100 and 1000 ml volumetric flasks.

B.2.5 Weighing bottle.

B.2.6 Syringes.

B.2.7 0.45 µm cellulose membrane filters.

B.2.8 250 ml beaker.

B.2.9 1000 ml graduated cylinder.

B.3 Reagents and solutions.

B.3.1 Denatonium benzoate, purity ≥ 99 %. Handle it with gloves.

B.3.2 Ethanol 96 % vol.

B.3.3 Sodium chloride, extrapure.

B.3.4 Acetonitrile, HPLC grade.

B.3.5 Water, HPLC grade.

B.3.6 0.2 % sodium chloride solution.

Weigh 0.4 g of sodium chloride in a weighing bottle and dissolve it in a beaker with 200 ml of water HPLC grade.

B.3.7 Mobile phase

Add in a 1000 ml volumetric flask, 200 ml of 0.2 % sodium chloride solution and 800 ml of acetonitrile HPLC grade.

B.4 Standard solutions

B.4.1 Preparation of the stock solution (100 mg DB / L).

Weigh, recording the exact weight, 0.1 g of denatonium benzoate in a weighing bottle and dissolve it in a 1000 ml volumetric flask with ethanol 96 % vol. Mix gently.

Measure the mass of this solution with a top loading balance and the density at 20ºC with an electronic densimeter.

B.4.2 Preparation of the working calibration solutions.

Add, in 100 ml volumetric flasks, 20 ml of ethanol 96 % vol. (to minimize weighing errors), then 0.5, 2, 5, 10 or 20 ml (weighing) of the stock solution and top up to the filling mark with ethanol 96 % vol. Mix gently.

B.5 Chromatographic and calibration parameters.

When using LiChrospher 100 CN (5 µm) column, chromatographic and calibration parameters recommended are:

- Column flow: 1.2 ml / min.
- Stoptime: 14 min.
- Detector: signal 210 nm (bandwidth 8 nm), reference 360 nm (bandwidth 100 nm).
- Mobile phase: acetonitrile 80:20 0.2 % sodium chloride solution.
- Injection volume: 20 µl.
- Column oven temperature: 27 °C.
- Calibration: external standard.

- Signal: peak area.
- Curve type: linear.
- Origin: included.
- Weight: equal.

B.6 Calibration

Working solutions containing the following concentrations of denatonium benzoate 0.5, 2, 5, 10 and 20 mg / l are analysed by injecting one replicate of each working solution. Peak areas corresponding to denatonium benzoate are plotted according to the respective concentrations in order to obtain a linear regression line expressed by the formula $y = ax + b$. The correlation coefficient must be > 0.99.

Otherwise, the system must be checked to improve the linear regression if possible, or the working solutions must be discarded and a new set of calibration solutions should be prepared.

B.7 Analysis of samples

No specific sample preparation is required. The samples are directly injected into the HPLC system after 0.45 µm cellulose membrane filtration.

B.8 Instrument results

The instrument denatonium benzoate results are calculated by comparing the sample denatonium peak area response to the calibration curve for the denatonium benzoate. This calibration curve is part of the instrument method.

Annex C
(normative)

Test for miscibility with water

C.1 To 5 ml of the denatured technical alcohol contained in a 100-ml Nessler cylinder, add 95 ml of distilled water, mix thoroughly.

C.2 Examine vertically for opalescence against a black background with side illumination, using as a standard, a similar cylinder containing 100 ml of distilled water.

Bibliography

[1] KS 2838, *Denatured technical alcohol for use as cooking and appliance fuel — Specification*

[2] TZS 3119, *Denatured ethanol for use as cooking and appliance fuel — Specification*

