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وقود الديزل الحيوي (B100) المستخدم للخلط مع الديزل - المتطلبات  
وطرق الاختبار  
Biodiesel Fuels (B100) used for Diesel Oil blending - Requirements  
and Test Methods

Prepared By

National Technical Committee for Oil & GAS

ICS: 75. 160.20

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## **Foreword**

Emirates Authority for Standardization & Metrology (ESMA) is the national Standardization body, which is responsible for formulation and issuance of UAE national standards.

National technical committee, for Oil and Gas Standards, have reviewed the proposal to introduce B5-Biodiesel blends in Diesel Engines and prepared a standard draft for Biodiesel (B100). This has been circulated to all concerned stakeholders for their valuable comments. Feedbacks / comments received were considered prior to finalize the final draft. The same was forwarded for the approval & issuance of the standard by UAE Ministerial Cabinet Decree no. .... / year 2017 .The approved standard is no..... year 2017.

## Introduction

Biodiesel is a product of great interest given its environmentally friendly Properties/Characteristics.

It is a well-established alternative fuel compared to other alternative fuels. The physical properties of Biodiesel are similar to those of conventional diesel oil. Therefore, it can be used in diesel engines without expensive alterations to engine or fuel system.

Biodiesel fuel is renewable, biodegradable, clean-burning and significantly reduces greenhouse gas emissions and toxic air pollutants. It has much higher flashpoint compared to petroleum diesel oil and free from sulfur and aromatics making it safer to handle, store, and transport.

It can be blended with conventional diesel and can be used in different concentrations. UAE B5 Diesel blend has 5% Bio-diesel (B100-Fatty Acid Methyl Ester) and 95% conventional Diesel oil (Gas Oil).

The lubricity and cetane number of B5 biodiesel has been improved by 60% & 14% respectively. Various International governmental studies showed that toxic emissions like Carbon monoxide (CO), Hydrocarbons (HC), Particulate matter (PM) and Carbon dioxide (CO<sub>2</sub>) was reduced when using biodiesel blends. Below summarized table indicate the effect of biodiesel over conventional diesel fuel.

Property	B 100	B20	B5 *
<b>Regulated</b>			
<b>Total Unburned Hydrocarbons</b>	67% Reduction	20% Reduction	4% Reduction
<b>Carbon Monoxide</b>	48% Reduction	12% Reduction	5.3% Reduction
<b>Particulate Matter</b>	47% Reduction	12% Reduction	3.1% Reduction
<b>Non Regulated</b>			
<b>Sulphate</b>	100% Reduction	20% Reduction	5% Reduction
<b>PAH</b>	80% Reduction	13% Reduction	3.1% Reduction
<b>Ozone Potential of speciated HC</b>	50% Reduction	10% Reduction	2.5% Reduction

*\*Estimated from B20 results*

Adopting the Biodiesel alternative is the simplest and quickest way to reduce the carbon foot print without affecting the fuel consumption adversely.

The UAE B5 Diesel Blend complies with UAE.S 477/2013 standard for Ultra Low Sulfur Diesel (10 mg/kg sulfur), and offers several advantages over it.

# **Biodiesel Fuels (B100) used for Diesel blending - Requirements and Test Methods**

## **1. Scope**

This standard specifies requirements and test methods for Biodiesel Fuel Blend Stock (B100) used for Biodiesel blends. Biodiesel (B100) that is being used as a blending component with diesel fuels shall meet the requirements of standard no. UAE.S 477.

## **2. Complementary References**

The following referenced documents applicable for the usage 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.

### **2.1 Referenced documents**

- 2.1.1 UAE.S 477:2013 Diesel Fuel (Gas Oil)
- 2.1.2 UAE.S GSO ISO 3675 Crude petroleum and liquid petroleum products – Laboratory determination of density - Hydrometer method
- 2.1.3 UAE.S GSO ISO 3104 Petroleum products - Transparent and opaque liquids - Determination of kinematic viscosity and calculation of dynamic viscosity
- 2.1.4 UAE.S GSO ISO 3679 Determination of flash no-flash and flash point -- Rapid equilibrium closed cup method
- 2.1.5 UAE.S GSO ISO 3987 Petroleum products - Determination of sulfated ash in lubricating oils and additives
- 2.1.6 UAE.S GSO ISO 5165 Petroleum products - Determination of the ignition quality of diesel fuels -- Cetane engine method
- 2.1.7 UAE.S GSO ISO 12937 Petroleum products - Determination of water - Coulometric Karl Fischer titration method
- 2.1.8 UAE.S ASTM D130 Standard Test Method for Corrosiveness to Copper from Petroleum Products by Copper Strip Test
- 2.1.9 UAE.S ASTM D4951 Standard Test Method for Determination of Additive Elements in Lubricating Oils by Inductively Coupled Plasma Atomic Emission Spectrometry
- 2.1.10 UAE.S GSO ISO 3170 Petroleum Liquids - Manual Sampling
- 2.1.11 UAE.S GSO ISO 3171 Petroleum Liquids - Automatic Pipeline Sampling
- 2.1.12 ASTM D93 Test Method for Flash Point by Pensky - Martens Close Cup Tester.
- 2.1.13 ASTM D445 Standard Test Method for Kinematic Viscosity of Transparent and Opaque Liquids (and Calculation of Dynamic Viscosity)
- 2.1.14 ASTM D613 Standard Test Method for Cetane Number of Diesel Fuel Oil ASTM
- 2.1.15 ASTM D664 Standard Test Method for Acid Number of Petroleum Products by Potentiometric Titration

- 2.1.16 ASTM D874 Standard Test Method for Sulfated Ash from Lubricating Oils and Additives
- 2.1.17 ASTM D974 Standard Test Method for Acid and Base Number by Color-Indicator Titration
- 2.1.18 D2500 Standard Test Method for Cloud Point of Petroleum Products and Liquid Fuels
- 2.1.19 ASTM D1160 Standard Test Method for Distillation of Petroleum Products at Reduced Pressure
- 2.1.20 ASTM D2622 Standard Test Method for Sulfur in Petroleum Products by Wavelength Dispersive X-ray Fluorescence Spectrometry
- 2.1.21 ASTM D2709 Standard Test Method for Water and Sediment in Middle Distillate Fuels by Centrifuge
- 2.1.22 ASTM D4052 Standard Test Method for Density, Relative Density, and API Gravity of Liquids by Digital Density Meter
- 2.1.23 ASTM D4530 Standard Test Method for Determination of Carbon Residue (Micro Method)
- 2.1.24 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
- 2.1.25 ASTM D6584 Standard Test Method for Determination of Total Monoglycerides, Total Diglycerides, Total Triglycerides, and Free and Total Glycerin in B-100 Biodiesel Methyl Esters by Gas Chromatography
- 2.1.26 ASTM D3231 Standard Test Method for Phosphorus in Gasoline
  
- 2.1.27 ASTM D6751 Standard Specification for Biodiesel Fuel Blend Stock (B100) for Middle Distillate Fuels
- 2.1.28 EN 14108 Fat and oil derivatives - Fatty Acid Methyl Esters (FAME) - Determination of sodium content by atomic absorption spectrometry
- 2.1.29 EN 14109 Fat and oil derivatives - Fatty Acid Methyl Esters (FAME) - Determination of potassium content by atomic absorption spectrometry
- 2.1.30 EN 14110 Fat and oil derivatives - Fatty Acid Methyl Esters (FAME) - Determination of methanol content
- 2.1.31 EN 14112 Fat and oil derivatives - Fatty Acid Methyl Esters (FAME) - Determination of oxidation stability (accelerated oxidation test)
- 2.1.32 EN 14538 Fat and oil derivatives - Fatty acid methyl ester (FAME) - Determination of Ca, K, Mg and Na content by optical emission spectral analysis with inductively coupled plasma (ICP OES)
- 2.1.33 EN 15751 Automotive fuels - Fatty acid methyl ester (FAME) fuel and blends with diesel fuel - Determination of oxidation stability by accelerated oxidation method.

## 2.2 UAE Regulation

**2.2.1** Ministerial Cabinet Decree no (21) / 2015 UAE Regulation for Petroleum Products control.

### **3. Terminology**

#### **3.1 Definitions:**

- 3.1.1 Biodiesel is a fuel comprised of mono-alkyl esters of long chain fatty acids derived from vegetable oils or animal fats, designated as B100.
- 3.1.2 Discussion—Biodiesel is typically produced by a reaction of a pure or used vegetable oil or animal fat with an alcohol such as methanol or ethanol in the presence of a catalyst to yield mono-alkyl esters and glycerin. The finished biodiesel derives approximately 10 % of its mass from the reacted alcohol. The alcohol used in the reaction may or may not come from renewable resources.
- 3.1.3 Biodiesel blend (BXX) is a blend of biodiesel fuel with conventional diesel fuel oils, in the abbreviation BXX, the XX represents the volume percentage of biodiesel fuel in the blend.
- 3.1.4 Monoglyceride is a partially reacted fat or oil molecule with one long chain alkyl ester group on a glycerin.
- 3.1.5 Total glycerin, the sum of the free glycerin and the glycerin portion of any unreacted or partially reacted oil or fat.
- 3.1.6 FAME is fatty acid methyl esters and it is the main compound contributing to more than 95 % in biodiesel (B100).

#### **4. Characteristics and Requirements**

- 4.1 The biodiesel specified shall be mono-alkyl esters of long chain fatty acids derived from vegetable oils and animal fats.
- 4.2 The biodiesel specified shall conform to the detailed specifications shown in below given tabulation.

***NOTE 1:*** *The user should consult the equipment manufacturer or refer to owner's manual regarding the suitability of using biodiesel or biodiesel blends in a particular engine or application.*

#### **5. Sampling**

Samples for analysis shall be taken in accordance with ASTM D4057 or D4177 procedures.

## 6. Test Methods

The requirements enumerated in this specification shall be determined in accordance with the following methods:

- 6.1 Flash Point—Test Methods: ASTM D93, shall be the referee method.
- 6.2 Water and Sediment—Test Method ASTM D2709, shall be the referee method.
- 6.3 Viscosity—Test Methods: UAE.S GSO ISO 3104 or D445.
- 6.4 Monoglycerides—Test Method D6584, shall be the referee test method.
- 6.5 Sulfated Ash—Test Methods: UAE.S GSO ISO 3987 or D874.
- 6.6 Oxidation Stability—Test Method EN 15751. Test Method EN 14112 (accelerated oxidation test) may also be used. Test Method EN 15751 shall be the referee test method.
- 6.7 Sulfur—Test Method D5453. Test Method D7039 may also be used. Other test methods may also be suitable for determining up to 0.05 % (500 ppm) sulfur in biodiesel fuels such as Test Methods D1266, D2622, and D3120. Test Method D5453 shall be the referee test method.
- 6.8 Corrosion—Test Method UAE.S ASTM D130, 3 h test at 50°C.
- 6.9 Cetane Number—Test Methods: UAE.S GSO ISO 5165 or ASTM D613. Test Method UAE.S GSO ISO 5165 shall be the referee method.

***NOTE 2:** Precision from Test Method D7668 were obtained from results produced by laboratories using externally obtained pre-blended calibration reference material.*

- 6.10 Cloud Point—Test Method D2500, shall be the referee test method.
- 6.11 Acid Number—Test Methods: UAE.S GSO ISO 6618 or ASTM D664.
- 6.12 Carbon Residue—Test Method ASTM D4530. A 100% sample shall replace the 10 % residual, with percent residue in the original sample reported using the 10 % residual calculation (see X1.9.1). Test Method D4530 shall be the referee method.

## 7. Terms of Technical Applications

Biodiesel (B100) product is deemed in accordance with this standard if it is registered with ESMA according to “Ministerial Cabinet Decree no (21) / 2015 UAE Regulation for Petroleum Products control”.

**Main References:**

- ASTM D6751-15
- EN 14214: 2012 + A1: 2014

**Table**  
**Specifications and Requirements for Biodiesel (B100)**

<b>S. no.</b>	<b>Property</b>	<b>Units</b>	<b>Specification</b>	<b>Method of Test<sup>A</sup></b>
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1.	Ester content	% mass	Report	EN 14103
2.	Density at 15 °C	kg/m <sup>3</sup>	Report	UAE.S GSO ISO 3675 ASTM D4052
3.	Kinematic Viscosity <sup>B</sup> at 40°C	mm <sup>2</sup> /s	1.9-6.0	UAE.S GSO ISO 3104, ASTM D445
4.	Flashpoint	°C	93 min.	UAE.S GSO ISO 3679, ASTM D93
5.	Sulfur content	% mass	0.0010 max.	ASTM D5453/D2622
6.	Distillation (AET) 90 % recovered	°C	360 max.	ASTM D1160
7.	Carbon residue <sup>c</sup> (100%) or Carbon residue (10%)	% mass	0.05 max. -	ASTM D4530
8.	Cetane number		47 min.	UAE.S GSO ISO 5165, ASTM D613
9.	Sulfated ash	% mass	0.02 max.	UAE.S GSO ISO 3987, ASTM D874
10.	Water and sediment	% volume	0.05 max.	UAE.S GSO ISO 12937, ASTM D2709
11.	Cloud point <sup>D</sup>	°C	Report	ASTM D2500
12.	Copper corrosion		No.3	UAE.S ASTM D130
13.	Acid number	mgKOH/g	0.50 max.	EN 4104, ASTM D664
14.	Oxidation stability	hrs.	3 min.	EN 14112 , EN 15751
15.	Methanol content	% mass	0.2 max.	EN 14110
16.	Monoglyceride content	% mass	0.40	ASTM D6584 EN 14105
17.	Free glycerol content	% mass	0.020 max.	ASTM D6584 EN 14105
18.	Total glycerol content	% mass	0.240 max.	ASTM D6584 EN 14105
19.	Na+K	mg/kg	5 max.	EN 14108 EN 14109, EN 14538
20.	Ca+Mg	mg/kg	5 max.	EN 14538
21.	Phosphorous content	mg/kg	10 max.	UAE.S ASTM D4951, ASTM D3231

A- The test methods indicated are the approved referee methods.

B- For some engines it may be advantageous to specify a minimum viscosity because of power loss due to injection pump and injector leakage.  
The 6.0 mm<sup>2</sup>/s upper viscosity limit is higher than petroleum based diesel fuel and should be taken into consideration when blending.

C- Carbon residue shall be run on the 100 % sample. A 100% sample shall replace the 10 % residual, with percent residue in the original sample reported using the 10 % residual calculation.

D- The cloud point of biodiesel is generally higher than petroleum based diesel fuel and should be taken into consideration when blending.