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FINAL DRAFT

BELIZE STANDARD

SPECIFICATION FOR DIESEL FUEL (HIGH SULPHUR, LOW SULPHUR AND ULTRA-LOW SULPHUR)

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This is a draft and should not be regarded or used as Belize Standard.

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FINAL DRAFT BELIZE NATIONAL STANDARD SPECIFICATION FOR DIESEL FUEL (HIGH SULPHUR, LOW SULPHUR AND ULTRA-LOW SULPHUR)

Committee Representation

The preparation of this standard for the Standards Advisory Council established under the Standards Act 1992 was carried out under the supervision of the Bureau's Technical Committee for Fuels and Lubricants, which at the time comprised the following members:

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BELIZE STANDARD SPECIFICATION FOR DIESEL FUEL (HIGH SULPHUR, LOW SULPHUR AND ULTRA-LOW SULPHUR)

0 FOREWORD

0.1 The Belize Bureau of Standards has recommended that this standard be declared a compulsory standard to protect the consumer or user against danger to health or safety, to protect the environment, and to ensure a minimum acceptable quality of diesel fuel sold or used in Belize.

0.2 It is intended that the limits for sulphur content, cetane number, cetane index, and total aromatic hydrocarbon content be revised when the manufacturer or supplier is able to meet more stringent requirements.

0.3 This national standard has been developed in recognition of the consumer concerns as it relates to quality of the product with respect to performance, environmental and health concerns present in a growing nation which is increasing the use of vehicles that use diesel fuel. This standard represents one aspect of efforts to minimize air pollution with a view to reducing harmful effects to the public and the environment. It includes requirements for three key properties, namely, cetane value (number and index), sulphur content and aromatic hydrocarbon content.

0.4 This standard is intended for compliance by manufacturers, suppliers and distributors of diesel fuel.

0.5 In the preparation of this national standard considerable assistance was derived from the following documents.

ASTM D975-11b	Standard Specification for Diesel Fuel Oil;
COPANIT 71-381-2008	Specification for Automotive Diesel Fuel Grade 2D, Panama;
TTS 569: 2007	Automotive Diesel Fuel Specification, Trinidad and Tobago;
NOM-086-2005	Fossil fuels specification for environmental protection, Mexico;
RTCA 75.02.17:06	Diesel Products – Specification for Diesel Fuel Oils, Central American Technical Regulation;
NOM-086-2005	Fossil fuels specification for environmental protection, Mexico

Jamaica Technical Regulations for Automotive Diesel oil, August 31, 2009.

1 SCOPE

This standard specifies the physical-chemical characteristics for Grade 2D Diesel (High Sulphur, Low Sulphur and Ultra-Low Sulphur) for use in Belize.

2 NORMATIVE REFERENCES

The following referenced documents are indispensable for the application 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 International

a) ASTM D86 - *Standard Test Method for Distillation of Petroleum Products at Atmospheric Pressure;*

b) ASTM D93 - *Standard Test Methods for Flash Point by Pensky-Martens Closed Cup Tester;*

c) ASTM D97 - *Standard Test Method for Pout Point of Petroleum Oils;*

d) ASTM D129 - *Standard Test Method for Sulfur in Petroleum Products*;

e) ASTM D130 - *Standard Test Method for Corrosiveness to Copper from Petroleum Products by Copper Strip Test;*

f) ASTM D189 - *Standards Test Method for Conradson Carbon Residue of Petroleum Products;*

g) ASTM D287 - *Standard Test Method for Density and Relative Density of Liquids by Digital Density Meter;*

h) ASTM D445 - *Standard Test Method for Kinematic Viscosity of Transparent and Opaque Liquids (and Calculation of Dynamic Viscosity);*

i) ASTM D482 - *Standard Test Method for Ash from Petroleum Products;*

j) ASTM D524 - *Standard Test Method for Ramsbottom Carbon Residue of Petroleum Products;*

k) ASTM D613 - *Standard Test Method for Cetane Number of Diesel Fuel Oil;*

l) ASTM D1298 - *Standard Practice for Density, Relative Density (Specific Gravity) or API Gravity of Crude Petroleum and Liquid Petroleum Products by Hydrometer Method;*

m) ASTM D1319 - *Standard Test Method for Hydrocarbon Types in Liquid Petroleum Products by Fluorescent Indicator Absorption*;

n) ASTM D1500 - *Standards Test Method for ASTM in Petroleum Products (ASTM Color Scale);*

o) ASTM D2709 - *Standards Test Method for Water and Sediment in Distillate Fuels by Centrifuge;*

p) ASTM D2500 - *Standard Test Method for Cloud Point of Petroleum Products;*

q) ASTM D4176 - *Standards Test Method for Free Water and Particulate Contamination in Distillate Fuels; and*

r) ASTM D4737 - *Standard Test Method for Calculated Cetane Index by Four Variable Equation;*

3 TERMS AND DEFINITIONS

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

3.1 **API Gravity** means a special function of the relative density (specific gravity) 15.56 ^{0}C/15.56 ^{0}C (60^{0}F/60^{0}F), defined as the relationship of the mass of an equal volume of pure water at the same temperature. API Gravity is calculated by:

API Gravity (^{0}API) = (141.5/d $_{15.56\ ^0C/15.56\ ^0C}$) – 131.5

where:

d $_{15.56\ ^0C/15.56\ ^0C:}$ Relative Density 15.56 ^{0}C/15.56 ^{0}C

3.2 **Cetane Number** means a measure of the ignition quality of the fuel on the combustion process which influences the start of the engine in the control of emissions and the anti-knock.

3.3 **Cetane Index** means an estimation of the cetane number (ignition quality) for distillate fuels or API gravity and from distillation temperature to obtain 50% of evaporation, by means of the formula.

3.4 C**ompression ignition engine** means an engine in which the fuel is ignited by the heat of highly compressed air

NOTE In compression ignition engines, ignition occurs spontaneously when the diesel fuel is sprayed into the hot air. In some cases, ignition is also induced by the presence of a glow plug.

3.5 **Flash point** means the lowest test temperature at which a fuel sample produces a vapour-air mixture that ignites on exposure to an open test flame.

3.6 **High Sulphur Diesel Fuel (S5000)** - means a homogenous fuel derived from fractionation or from the primary distillation of crude oil or any other fossil fuel, suitable for use in internal combustion engines of compression ignition (Diesel), whose maximum sulfur content is 0.5% by weight (5000 ppm wt).

3.7 **Low Sulphur Diesel Fuel (S500)** - means a homogenous fuel derived from fractionation or from the primary distillation of crude oil or any other fossil fuel, suitable for use in internal combustion engines of compression ignition (Diesel), whose maximum sulfur content is 0.05% by weight (500 ppm wt).

3.8 **Ultra-Low Sulfur Diesel Fuel (ULSD) (S15)** - means a homogenous fuel derived from fractionation or from the primary distillation of crude oil or any other fossil fuel, suitable for use in internal combustion engines of compression ignition (Diesel), whose maximum sulfur content is 0.0015% by weight (15 ppm wt).

4 REQUIREMENTS

4.1 General composition

Diesel fuel shall:

a) consist of hydrocarbons; and

NOTE: Diesel fuel may contain additives.

b) be visually free of water, sediment and suspended matter.

4.2 Properties

Diesel fuel shall conform to the requirements specified in Table 1.

5 SAMPLING

5.1 Samples from dispensing pumps

Representative samples of diesel fuel from dispensing pumps shall be collected in accordance with Annex A.

5.2 Samples from other sources

Sampling from sources other than dispensing pumps shall be carried out in accordance with ASTM D4057 or ASTM D4177.

6 TEST METHODS

Tests to determine compliance with the requirements given in clause 4.2 shall be carried out in accordance with the ASTM method(s) specified for each property presented in Table 1 or any other approved methods by the Belize Bureau of Standards.

Table 1 - Specification for Grade 2D - Diesel Fuel

Property Description	ASTM Test Method	UNITS	High Sulphur (S5000)		Low Sulphur (S500)		Ultra-Low Sulphur (S15)	
			min	max	min	max	min	max
Appearance	D4176	-	clear and bright					
Additives	-	-	Report					
API Gravity @ 60 ^{0}F	D1298		Report					
Color ASTM	D1500	-	-	2.5	-	2.5	-	2.5
Flash point	D93	^{0}C (F)	60 (140)	-	60 (140)	-	60 (140)	-
Cetane Index, calculated	D976	-	45	-	45	-	45	-
Cetane Number	D613	-	45	-	45	-	45	-
Copper Strip Corrosion rating, max (3h at 50^{0}C)	D130	-	-	2	-	2	-	2
Ash content	D482	% mass (% wt)	-	0.01	-	0.01	-	0.01
Water and sediment	D2709	% vol	-	0.05	-	0.05	-	0.05
Distillation 10% recovered	D86	^{0}C	Report					
Distillation 50% recovered	D86	^{0}C	Report					
Distillation 90% recovered	D86	^{0}C	282	360	282	360	282	360
Final boiling point	D86	^{0}C	Report					
Distillation residue	D86	^{0}C	Report					
Kinematic Viscosity at 40^{0}C	D445	mm^2/S	1.9	4.1	1.9	4.1	1.9	4.1
Sulfur content	D129	% wt	-	0.5	-	0.05	-	0.0015
Carbon residue Conradson on 10 % distillation residue or	D189	% wt	-	0.1	-	0.1	-	0.1

Carbon residue Ramsbottom on 10% distillation residue	D524	% wt	-	0.13	-	0.13	-	0.13
Pour Point	D97	^{0}C	Report					
Cloud Point	D2500	^{0}C	10 max					
Aromatic contents	D1319	% vol	Report					
Lubricity	D6079	microns	-	520	-	520	-	520

7 SAFETY AND HANDLING

Diesel Grade 2D shall be distributed in such a manner that ensures the safety of the people, product and the environment during transportation, storage and distribution in accordance with established standards for this area.

8 TRANSPORTATION

The transportation of fuels and flammable materials shall comply with the regulations of the transport department and fire department and in accordance with established standards for this area.

Annex A (normative)
Sampling of diesel fuel from dispensing pumps

A.1 General

This annex sets out procedures for obtaining a representative sample of diesel fuel for analysis from a dispensing pump.

A.2 Apparatus

The apparatus for obtaining a representative sample from a dispensing pump shall include the following items:

a) a stock of cans to be used for the sole purpose of obtaining samples of diesel fuel. The cans shall be of 1 L and 5 L capacity and shall comply with the requirements of ASTM D4057. Each can shall have a fuel-resistant sealing washer positioned in its cap; and

NOTE: Other suitable sample containers may be used. These containers must also meet the requirements specified in ASTM D4057.

b) a clean dry metal funnel washed with proper bonding/grounding cable.

NOTE: Plastic funnels shall not be used.

A.3 Procedure

Where practical, it shall be ensured that the sampling procedure is not carried out in direct sunlight. The following procedure shall be observed.

a) Remove all possible sources of ignition.

b) Before use, all cans shall be checked to ensure that each is sound and does not allow leakage. Also, each can shall be thoroughly rinsed with a small quantity of diesel fuel from the stock to be sampled and checked to ensure that it is at ambient temperature. The disposal of diesel fuel used to rinse the can shall be done in accordance with the Department of the Environment (DOE) requirements.

c) Using the clean, dry, metal funnel, carefully draw 5 L of diesel fuel into cans from the dispensing pump. Where it is desirable to have more than a 5 L sample, the operation shall be subsequently repeated before the pump is used again for any other purpose.

d) Immediately after drawing the diesel fuel from the pump, using the funnel, decant the 5 L of sample or samples into the requisite number of 1 L cans, ensuring that the cans are filled to approximately 25 mm from the brim. Tighten the screw caps fully and check to ensure that there are no leaks.

NOTE: Although two 1 L cans of sample are sufficient for the determination of cetane number and certain other tests, it is advisable to collect and retain extra stock of the diesel fuel being sampled to cater for repeated testing.

e) All samples shall be labeled. The labels shall contain the following information but not limited to the product, reference number, pump number, date, time and person taking the sample.

A.4 Sample storage

Except when being transferred, samples shall be maintained in a closed container in order to prevent loss of light components. Samples shall be protected during storage to prevent degradation from light, heat or other detrimental condition.

Annex B
(informative)
Explanatory notes on the properties of diesel fuel

B.1 General

This annex provides a general explanation of the significance of the properties of diesel fuel.

B.2 Aromatics

Aromatic hydrocarbons in comparison to other types of hydrocarbons are denser, have poorer self- ignition qualities and produce more soot on combustion. A typically straight run diesel fuel may contain 20 % - 40 % aromatics by volume in comparison to a diesel fuel blended from catalytically cracked stocks which may contain between 40% and 60% aromatics. The latter in comparison has significantly lower cetane number values, and results in more difficulty in cold-starting, increased combustion noise, and emissions of hydrocarbons and nitrogen oxides. Efforts to reduce diesel emissions have resulted in the regulation of aromatic hydrocarbon content.

B.3 Ash

Ash-forming materials in diesel fuel may be present in two forms:

a) suspended solids; and

b) soluble metallic soaps.

The suspended solids contribute to wear of various engine components and also to engine deposits. The metallic soaps have little effect on engine wear but may contribute to engine deposits.

B.4 Carbon residue

Carbon residue is a measure of the carbon/coke-forming tendencies of a diesel fuel when heated under prescribed conditions. It cannot be directly related to the formation of deposits in engine components; it is considered to be an indication of this tendency.

B.5 Cetane index

The cetane index is an estimation of cetane number of a fuel which is often used for routine monitoring. The index value is computed from correlations of the diesel fuel's physical properties. It may be used for estimating cetane number when:

a) a cetane test engine is not available;

b) the quantity of sample is insufficient for a test engine determination; or

c) a quick check on the quality of fuel during production is needed.

NOTE: For this purpose it has limited application

Cetane index may also be specified as a limitation on the amount of high aromatic components in some fuel types.

B.6 Cetane number

Cetane number is a measure of ignition quality of a fuel. Ignition quality describes the readiness of the fuel to ignite spontaneously under certain conditions of temperature and pressure in the engine's combustion chamber.

Increasing cetane number typically requires lowering the aromatic content of the fuel, unless it is increased by the use of additives. It also increases engine efficiency up to a certain level and reduces the emission of polyaromatic hydrocarbons, carbon monoxide, nitrogen oxides, and particulates in some cases.

B.7 Copper strip corrosion

This test is a measure of possible corrosiveness of the diesel fuel to copper, brass or bronze parts of the engine fuel system and of the fuel distribution and storage network.

B.8 Distillation

Distillation tests reflect the volatility of the fuel. Volatility requirements vary with engine design, size, speed, load variations, starting and atmospheric conditions. Generally, there must be some trade off made between the better performance of high volatility fuels with respect to rapidly fluctuating loads and speeds, particularly in relation to emissions, and the better fuel economy of the heavier types of fuel.

B.9 Flash point

Flash point is the temperature at which the fuel produces a vapour-air mixture that ignites on exposure to a test flame. This measurement is specified as a safety precaution against hazards under normal use, storage and handling. It is an indication of the flammability of the diesel fuel.

B.10 Kinematic viscosity

The actual injection timing of an engine depends on fuel viscosity (among other properties). Optimization of vehicle manufacturer's pump setting will therefore depend upon the specified range for fuel viscosity. Values outside this range will affect fuel delivery and other operations under running conditions.

Low viscosity fuel may cause excessive wear in some injection pumps and power loss due to pump injector leakage. Combustion may also be impaired and power economy decreased.

High viscosity fuel may cause filter damage or pump drive-line wear because of increased pump resistance. It can also cause poor atomization and hence poor combustion. This may be accompanied by loss of power and economy, and the washing away of the lubricating oil film on cylinder walls which may in turn cause dilution of the crankcase oil and excessive wear. In addition, there

is also a risk of rotary fuel injection pump seizure at start up under cold conditions.

B.11 Oxidation stability

The ability of the fuel to retain its pertinent properties between manufacture and use is an important quality requirement. Oxidation stability is one of the measures of diesel fuel stability.

Air and water in contact with diesel fuel may cause oxidation, particularly if the fuel contains hydrotreated cracked products which are relatively unstable. High temperatures may also accelerate the oxidation process. Accordingly, prolonged storage of fuel in such environments can result in oxidation which is accompanied by the formation of gums and sediment. These may cause filter plugging, combustion chamber deposit formation, and gumming or lacquering of injection system components with resultant sticking and wear.

B.12 Polyaromatic hydrocarbon (PAH)

PAHs are chemical compounds that consist of fused aromatic rings. They are formed by the incomplete combustion of carbon- containing fuels such as wood, coal, diesel, fat or tobacco. The simplest PAHs as defined by the International Union on Pure and Applied Chemistry (IUPAC) are phenanthrene and anthracene isomers of three fused rings (C4 H10). Smaller molecules such as benzene and naphthalene are not formally PAHs, although they are chemically related.

B.13 Sediment content

Generally sediment in fuel consists of carbonaceous material, metal or other inorganic material. It may consist of rust and metal particles from fuel tanks and lines or dirt entering from the atmosphere or poor house-keeping practices. Instability and resultant degradation of fuel in contact with air contribute to the formation of organic sediment, particularly during storage and handling at elevated temperatures. Sediment can cause premature blocking of filters, deposits, and wear in both the injection system and the engine itself.

B.14 Sulphur content

Sulphur content of fuels affects vehicular emissions and engine wear. It also contributes to engine deposits. Engine wear is a result of both the corrosive nature of the combustion by-products of sulphur containing compounds present in the fuel, and the ‘active’ sulphur which tends to attack and corrode injection system components. A reduction in the sulphur content of diesel fuel, results both in a decrease of sulphur oxides and particulates in exhaust emissions and engine wear. However if the sulphur content is reduced below a certain level and lubricating additives are not added to the fuel, engine wear may increase since the inherent lubricating properties of some of the naturally occurring sulphur compounds are lost.

B.15 Water content

Water in fuel may cause corrosion of the injection system components and may promote fungal and bacterial growth which can cause filter blocking. Water generally impairs the desirable bright and clear appearance of the fuel.