SANS 342:2016
Edition 5.1

SOUTH AFRICAN NATIONAL STANDARD

Automotive fuels — Requirements and test methods for diesel

WARNING
This document references other documents normatively.

Published by SABS Standards Division
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Table of changes

<table>
<thead>
<tr>
<th>Change No.</th>
<th>Date</th>
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<tr>
<td>Amdt 1</td>
<td>2016</td>
<td>Amended to update the foreword, referenced standards and definitions</td>
</tr>
</tbody>
</table>

Foreword

This South African standard was approved by National Committee SABS/TC 028/SC 03, Petroleum products, biofuels and lubricants — Fuels, in accordance with procedures of the SABS Standards Division, in compliance with annex 3 of the WTO/TBT agreement.

This document was approved for publication in December 2016.

This document supersedes SANS 342 2014 (edition 5).

This document is referenced in the Petroleum Products Act, 1977 (Act No. 120 of 1977).

I Reference is made in Section 3 to the "relevant national legislation" in South Africa this means the Regulations of the Petroleum Products Act, 1977 (Act No 120 of 1977), as published by Government Notice No R 627 (Government Gazette No 28958) of 23 June 2006. Amdt 1

I Reference is made in the note to Section 3 to "relevant national department" in South Africa this means the Department of Energy. Amdt 1

I Reference is made in Section 3 to "relevant national legislation" in South Africa this means the Regulations of the Petroleum Products Act, 1977 (Act No 120 of 1977), as published by Government Notice No R 431 (Government Gazette No 35410) of 1 June 2012. Amdt 1

I Reference is made in the note to Section 4 to "relevant national department" in South Africa this means the Department of Energy. Amdt 1

Reference is made in Section 4 to "relevant national legislation" in South Africa, this means the Petroleum Products Act, 1977 (Act No 120 of 1977). Amdt 1

Annex A is for information only.

Compliance with this document cannot confer immunity from legal obligations.
Automotive fuels — Requirements and test methods for diesel

1 Scope

This standard specifies the grades of automotive diesel fuel containing up to a volume fraction of 5% of automotive biodiesel in accordance with SANS 1935, and suitable for use in compression-ignition engines, including high-speed engines.

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. Information on currently valid national and International standards can be obtained from the SABS Standards Division.

- ASTM D86, Standard test method for distillation of petroleum products and liquid fuels at atmospheric pressure
- ASTM D93, Standard test method for flash point by Pensky-Martens closed cup tester
- ASTM D130, Standard test method for corrosiveness to copper from petroleum products by copper strip test
- ASTM D445, Standard test method for kinematic viscosity of transparent and opaque liquids (and the calculation of dynamic viscosity)
- ASTM D482, Standard test method for ash from petroleum products
- ASTM D613a, Standard test method for cetane number of diesel fuel 011
- ASTM D976, Standard test methods for calculated cetane Index of distillate fuels
- ASTM D1298b, Standard test method for density, relative density, or API gravity of crude petroleum and liquid petroleum products by hydrometer method
- ASTM D2274, Standard test method for oxidation stability of distillate fuel 011 (accelerated method)
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ASTM D2425, Standard test method for hydrocarbon types in middle distillates by mass spectrometry

ASTM D2500, Standard test method for cloud point of petroleum products
ASTM D2622, Standard test method for sulfur in petroleum products by wavelength dispersive X-ray fluorescence spectrometry

ASTM D4052, Standard test method for density, relative density, and API gravity of liquids by digital density meter

ASTM D4057, Standard practice for manual sampling of petroleum and petroleum products

ASTM D4177, Standard practice for automatic sampling of petroleum and petroleum products

ASTM D4294, Standard test method for sulfur in petroleum and petroleum products by energy dispersive X-ray fluorescence spectrometry

ASTM D4377, Standard test method for water in crude oils by potentiometric Karl Fischer titration

ASTM D4530, Standard test method for determination of carbon residue (micro method)

ASTM D4737, Standard test method for calculated cetane index by four variable equation

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 D5772, Standard test method for cloud point of petroleum products (linear cooling rate method)

ASTM D6304, Standard test method for determination of water in petroleum products lubricating oils, and additives by coulometric Karl Fischer titration

ASTM D6371, Standard test method for cold filter plugging point of diesel and heating fuels

ASTM D6890, Standard test method for determination of ignition delay and derived cetane number (DCN) of diesel fuel ONs by combustion in a constant volume chamber

ASTM D7042, Standard test method for dynamic viscosity and density of liquids by Stabinger viscometer (and the calculation of kinematic viscosity)

ASTM D7170a, Standard test method for determination of derived cetane number (DCN) of diesel fuel ONs — Fixed range Injection period, constant volume combustion chamber method

ASTM D7371, Standard test method for determination of biodiesel (fatty acid methyl esters) content in diesel fuel ONs Sing mid-Infrared spectroscopy (FTIR-A TR-PLS method) Amdt 1

ASTM D7668, Standard test method for determination of derived cetane number (DCN) of diesel fuel ONs — Ignition delay and combustion delay using a constant volume combustion chamber method

ASTM D7806, Standard test method for determination of the fatty acid methyl ester (FAME) content of a blend of biodiesel and petroleum-based diesel fuel ONs using mid-Infrared spectroscopy Amdt 1
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EN 1 16, Diesel and domestic heating fuels — Determination of cold filter plugging point
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 14078, Liquid petroleum products — Determination of fatty acid methyl ester (FAME) content in middle distillates — Infrared spectrometry method
EN 15195, Liquid petroleum products — Determination of Ignition delay and derived cetane number (DCN) of middle distillate fuels by combustion in a constant volume chamber
EN 15751, Automotive fuels — Fatty acid methyl ester (FAME) fuel and blends with diesel fuel — Determination of oxidation stability by accelerated oxidation method
EN 23015, Petroleum products — Determination of cloud point
IP 4, Petroleum products — Determination of ash
IP 34, Determinations of flash point — Pensky-Martens closed cup method
IP 41, Petroleum products — Determination of the Ignition quality of diesel fuels — Cetane engine method
IP 71, Petroleum products — Transparent and opaque liquids — Section 1 Determination of kinematic viscosity and calculation of dynamic viscosity
IP 74, Petroleum products and bituminous materials — Determination of water — Distillation method
IP 123, Petroleum products — Determination of distillation characteristics at atmospheric pressure
IP 154, Petroleum products — Corrosiveness to copper — Copper strip test
IP 160, Crude petroleum and liquid petroleum products — Laboratory determination of density — Hydrometer method
IP 219, Petroleum products — Determination of cloud point
IP 309, Diesel and domestic heating fuels — Determination of cold filter plugging point
IP 336, Petroleum products — Determination of sulfur content — Energy-dispersive X-ray fluorescence method
IP 356, Crude petroleum — Determination of water — Potentiometric Karl Fischer titration method

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

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

IP 391, Petroleum products — Determination of aromatic hydrocarbon types in middle distillates — High performance liquid chromatography method With refractive Index detection

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

IP 450, Diesel fuel — Assessment of lubricity using the high-frequency reciprocating ng (HFRR) — Part 1 Test method Amdt 1

IP 498, Determination of Ignition delay and dewed cetane number (DCN) of middle distillate fuels by combustion In a constant volume chamber

IP 574, Automotive fuels — Fatty acid methyl ester (FAME) fuel and blends With diesel fuel — Determination of oxidation stability by accelerated oxidation method

ISO 2160, Petroleum products — Corrosiveness to copper — Copper strip test ISO 2719, Determination of flash point — Pensky-Martens closed cup method

ISO 3015, Petroleum products — 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 3405, Petroleum products — Determination of distillation characteristics at atmospheric pressure

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

ISO 4259, Petroleum products — Determination and application of precision data In relation to methods of test

ISO 5165, Petroleum products — Determination of the Ignition quality of diesel fuels — Cetane engine method

ISO 6245, Petroleum products — Determination of ash

ISO 10370, Petroleum products — Determination of carbon residue — Micro method

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

ISO 12205, Petroleum products — Determination of the oxidation stability of middle-distillate fuels

ISO 12937, Petroleum products — Determination of water — Coulometric Karl Fischer titration method

ISO 12156-1, Diesel fuel — Assessment of lubricity using the high-frequency reciprocating ng (HFRR) — Part 1 Test method

ISO 13759, Petroleum products — Determination of alkyl nitrate In diesel fuels — Spectrometric method

SANS 833, Biodiesel production — Quality management system — Producer requirements

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SANS 1518, Transport of dangerous goods — Design, construction, testing, approval and maintenance of road vehicles and portable tanks

SANS 1935, Automotive biodiesel — Fatty Acid Methyl Esters (FAME) for diesel engines Requirements and test methods

SANS 10131, Above-ground storage tanks for petroleum products

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3 Definitions
For the purposes of this document, the following definitions apply

3.1 additive substance Intentionally added to a petroleum product in trace or small quantities in order to improve one or more of the petroleum product’s performance or storage stability, its
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Performance in an engine, or a reduction of the emissions from an engine powered by that petroleum product.

3.2 Biodiesel renewable fuel or fuel components comprised of methyl esters of long chain fatty acids that comply with SANS 1935, and that are produced in accordance with SANS 833.

3.3

CFI cleaner fuels
1 Standard grade diesel with a maximum sulfur content of 500 mg/kg, and low sulfur grade with a maximum sulfur content of 50 mg/kg, where both grades may contain a biodiesel content of not more than 5% (volume fraction), and which are as referenced in the relevant national legislation (see foreword).

NOTE: The validity of the relevant national legislation (see foreword) is to be determined at a future date by the relevant national department (see foreword).

Amendment 1

3.4 CF2 cleaner fuels
2 Low sulfur grade diesel with a maximum sulfur content of 10 mg/kg, which may contain a biodiesel content of not more than 5% (volume fraction), and which is referenced in the relevant national legislation (see foreword).

NOTE: The validity of the relevant national legislation (see foreword) is to be determined at a future date by the relevant national department (see foreword).

Amendment 1

3.5 Lot quantity of diesel fuel in containers bearing the same brand name or trade mark, grade designation and batch identification, from one manufacturer or a supplier, and submitted at any one time for inspection and testing.

4 Requirements

4.1 General

4.1.1 The diesel fuel shall be one of the following:

a) CFI standard diesel 500 mg/kg, or
b) CFI low sulfur diesel 50 mg/kg, or
c) CF2 low sulfur grade diesel 10 mg/kg

4.1.2 The fuel shall comply with the relevant requirements given in Table 1, and shall be clear and free from visible water, sediment, suspended matter and any other contaminant that can cause malfunctioning of equipment designed to use this type of fuel.
4.2 Automotive diesel fuel

The requirements for all automotive diesel fuel are given in table 1

NOTE For further Information on the quality verification of automotive diesel fuel see annex A

4.3 Additives

In order to Improve the performance quality, the use of additives IS allowed. Suitable fuel additives without known harmful side-effects are recommended in the appropriate amount, to help avoid deterioration of driveability and emission control durability. Other technical means with equivalent effect may also be used.

4.4 Biodiesel blending

Where the fuel IS blended With automotive biodiesel, the biodiesel component shall not be more than 5 % (volume fraction) of the total blend (see table 1). The biodiesel component used in such blends shall comply With SANS 1935.

For higher biodiesel blends refer to the relevant national legislation (see foreword).

It IS strongly recommended to add oxidation stability enhancing additives in the biodiesel product at the production stage and before storage, providing an action similar to that obtained With 1 000 mg/kg of 3,5-dl-tert-butyl-4-hydroxy-toluol (butylated hydroxyl-toluene, BHT)
Table 1 — Requirements for all automotive diesel fuel

<table>
<thead>
<tr>
<th>Property</th>
<th>Units</th>
<th>Requirement</th>
<th>Test method</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>CF1</td>
<td>CF2</td>
</tr>
<tr>
<td>Sulfur content for</td>
<td>mg/kg</td>
<td>500</td>
<td>ASTM 02622,</td>
</tr>
<tr>
<td>a) Standard diesel 500 ppm, max</td>
<td>mg/kg</td>
<td>50</td>
<td>ASTM D5453, IP 336 or</td>
</tr>
<tr>
<td>b) Low sulfur diesel 50 ppm, max</td>
<td>mg/kg</td>
<td>10</td>
<td>ASTM D4294</td>
</tr>
<tr>
<td>c) Low sulfur diesel 10 ppm, max</td>
<td>mg/kg</td>
<td></td>
<td>ASTM D5453 or</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>ASTM D2622</td>
</tr>
<tr>
<td>Biodiesel content (FAME), max</td>
<td>% (volume fraction)</td>
<td>8</td>
<td>ASTM D7371, ASTM D7806 or</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>EN 14078 (see 4.4)</td>
</tr>
<tr>
<td>Polyaromatic hydrocarbons, max</td>
<td>% (mass fraction)</td>
<td>45</td>
<td>ASTM D613a, IP 41</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>ISO 5165, EN 15195,</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>ASTM 06890, IP 498,</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>ASTM D7668, or</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>ASTM D7170a</td>
</tr>
<tr>
<td>Cetane number, min</td>
<td>45</td>
<td>51</td>
<td>IP 391, ASTM D2425 or</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>EN 12916</td>
</tr>
<tr>
<td>Density</td>
<td>kg/m³</td>
<td>362</td>
<td>IP 123, or</td>
</tr>
<tr>
<td>(at 20 °C)</td>
<td></td>
<td></td>
<td>ASTM D86</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>ISO 3405</td>
</tr>
<tr>
<td>T90, max</td>
<td>% (volume fraction)</td>
<td>360</td>
<td>ASTM D130, IP 154</td>
</tr>
<tr>
<td>T95, max</td>
<td>% (volume fraction)</td>
<td>65</td>
<td>or ISO 2160</td>
</tr>
<tr>
<td>Recovered at 250 °C (E250), max</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Recovered at 350 °C (E350), mn</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Flash point, min</td>
<td>55</td>
<td></td>
<td>IP 34 or</td>
</tr>
<tr>
<td>Copper strip corrosion</td>
<td>Rating</td>
<td>Class 1</td>
<td></td>
</tr>
<tr>
<td>(3 h at 100 °C), classification, max</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
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### Cold filter plugging point (CFPP)

<table>
<thead>
<tr>
<th></th>
<th>CFI</th>
<th>CF2</th>
</tr>
</thead>
<tbody>
<tr>
<td>1) Summer, max</td>
<td>+3</td>
<td></td>
</tr>
<tr>
<td>2) Winter, max</td>
<td>-4</td>
<td></td>
</tr>
<tr>
<td>Test method</td>
<td>ASTM D6371, IP or EN 116</td>
<td></td>
</tr>
</tbody>
</table>

### Cloud Point

<table>
<thead>
<tr>
<th></th>
<th>CFI</th>
<th>CF2</th>
</tr>
</thead>
<tbody>
<tr>
<td>1) Summer, max</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2) Winter, max</td>
<td>+6</td>
<td></td>
</tr>
<tr>
<td>Test method</td>
<td>EN 23015, ASTM D5772, ASTM D2500, IP 219 or ISO 3015</td>
<td></td>
</tr>
</tbody>
</table>

### Carbon residue on 10 % (volume fraction) distillation residue, max

<table>
<thead>
<tr>
<th>Property</th>
<th>Requirement</th>
<th>Test method</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ash content, max</td>
<td>% (mass fraction)</td>
<td>0,01</td>
</tr>
<tr>
<td>Water content, max</td>
<td>mg/kg</td>
<td>350</td>
</tr>
<tr>
<td>Total contamination, max</td>
<td>mg/kg</td>
<td>24</td>
</tr>
<tr>
<td>Lubricity, corrected wear scar diameter (wsd 1,4) at 60 °C, max</td>
<td>pm</td>
<td>460</td>
</tr>
<tr>
<td>Viscosity at 40 °C</td>
<td>mm²/s</td>
<td>2,00 to 4,50</td>
</tr>
<tr>
<td>Oxidation stability</td>
<td>mg/100 ml-</td>
<td>2,0 max</td>
</tr>
<tr>
<td></td>
<td>g/m³</td>
<td>25 max</td>
</tr>
<tr>
<td></td>
<td>hours</td>
<td>20 min g</td>
</tr>
</tbody>
</table>

NOTE In the case of a product sold in colder areas (as defined by historic meteorological data), additional CFPP Improver should be included with the intention to achieve —7 °C, or better.

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<table>
<thead>
<tr>
<th>5.1 Sampling and methods of test</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>5.1 Sampling</strong></td>
</tr>
<tr>
<td>Use the relevant sampling procedure described in ASTM D4057 (referee method), or ASTM D4177 or ISO 3170, as appropriate, to obtain the samples for testing, and deem the samples so taken to represent the lot for the respective properties.</td>
</tr>
<tr>
<td>In view of the sensitivity of some of these test methods referred to in this document, particular attention shall be paid to compliance with any guidance on sample containers required by the specific test method. Specify the sample size, sample container and method in accordance with the test method requirements (see Table 1).</td>
</tr>
</tbody>
</table>

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The test methods listed in table 1 have been shown to be applicable in an Inter-laboratory test program. Data from the program are incorporated in the relevant test method (see table 1).

5.2.2 In the case of dispute regarding the determination of a specific property, use the referee test method as given in table 1.

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

6 Logistic requirements

6.1 Packing and transport

The condition of the drums, intermediate bulk containers, rail and road tank vehicles and shipping cargo tanks shall be of sound construction, clean, dry and of suitable material such as not to be detrimental to the quality of the diesel during normal transportation and storage.

For the packing and transport of diesel SANS 1518, SANS 10187-1, SANS 10187-6, SANS 10187-8, SANS 10229-1, SANS 10229-2, SANS 10231, SANS 10232-1, SANS 10232-3, SANS 10232-4, and SANS 10233 shall apply.

6.2 Classification and labelling

6.2.1 The following information shall appear in prominent, legible and indelible marking on each drum or, in the case of diesel 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 the brand name of the product or both,
b) a description of the product,
c) batch identification, and
d) the quantity of the contents.

The information on each drum, bulk storage tank or bulk carrier shall be in accordance with SANS 10229-1, SANS 10229-2, SANS 10232-1, SANS 10233, SANS 10234, and SANS 10228.
6.2.2 For the labelling, placarding and preparation of shipping documents for fuel that complies With the requirements of this standard, the following shall apply:

a) the hazard-class diamond, as for class 3 dangerous goods,

b) the proper shipping name 'DIESEL FUEL',

c) the substance Identification number UN 1202, and

d) other Information including the supplier's brand name or trade mark, the name of the fuel grade (standard or low sulfur), the description 'DIESEL FUEL', and the quantity.

6.3 Storage equipment for diesel

For storage equipment for diesel SANS 10089-1, SANS 10089-2, SANS 10089-3, SANS 10263-0, and SANS 10131, shall apply.
Annex A (Informative) Quality verification of automotive diesel fuel

When a purchaser requires ongoing verification of the quality of diesel fuel, it is suggested that, instead of concentrating solely on evaluation of the final product, he also direct his attention to the supplier's quality system. In this connection, it should be noted that SANS 9001 covers the provision of an integrated quality system.

Bibliography

CEN/TR 15367-1, Petroleum products - Guide for good housekeeping — Part 1 Automotive diesel fuels

CEN/TR 15367-3, Petroleum products - Guide for good housekeeping — Part 3 Prevention of cross contamination

SANS 9001/ISO 9001, Quality management systems — Requirements