



SLOVENSKI STANDARD
SIST EN 15940:2016+A1:2018
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Goriva za motorna vozila - Parafinsko dizelsko gorivo iz sinteze ali postopka s hidrogeniranjem - Zahteve in preskusne metode

Automotive fuels - Paraffinic diesel fuel from synthesis or hydrotreatment - Requirements and test methods

Kraftstoffe für Kraftfahrzeuge - Paraffinischer Dieselkraftstoff aus Synthese oder Hydrierungsverfahren - Anforderungen und Prüfverfahren

Carburants pour automobiles - Gazoles paraffiniques de synthèse ou obtenus par hydrotraitement - Exigences et méthodes d'essais

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ICS:

75.160.20 Tekoča goriva Liquid fuels

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Automotive fuels - Paraffinic diesel fuel from synthesis or hydrotreatment - Requirements and test methods

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und Prüfverfahren

This European Standard was approved by CEN on 15 April 2016 and includes Amendment 1 approved by CEN on 3 March 2018.

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EUROPEAN COMMITTEE FOR STANDARDIZATION
COMITÉ EUROPÉEN DE NORMALISATION
EUROPÄISCHES KOMITEE FÜR NORMUNG

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European foreword

This document (EN 15940:2016+A1:2018) has been prepared by Technical Committee CEN/TC 19 “Gaseous and liquid fuels, lubricants and related products of petroleum, synthetic and biological origin”, the secretariat of which is held by NEN.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by December 2018, and conflicting national standards shall be withdrawn at the latest by December 2018.

This document includes Amendment 1 approved by CEN on 03 March 2018.

This document supersedes $\boxed{A1}$ EN 15940:2016 $\boxed{A1}$.

The start and finish of text introduced or altered by amendment is indicated in the text by tags $\boxed{A1}$ $\boxed{A1}$.

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

This document supersedes CEN/TS 15940:2012.

Significant other technical changes between this document and CEN/TS 15940:2012 are:

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- a) the limits for distillation at 250 °C and 350 °C are included in line with EN 590 and the EU Common Customs tariff for diesel fuel; [SIST EN 15940:2016+A1:2018](https://standards.iteh.ai/catalog/standards/sist/d139d5ab-7607-4ecf-9b35-a87b700b9d2c/sist-en-15940-2016a1-2018)
 - b) EN ISO 3924, also known as simulated distillation, has been incorporated in Table 1 as an additional methodology to determine distillation characteristics; <https://standards.iteh.ai/catalog/standards/sist/d139d5ab-7607-4ecf-9b35-a87b700b9d2c/sist-en-15940-2016a1-2018>
 - c) $\boxed{A1}$ EN 16906 (equivalent to DIN 51733 [22]) has been studied and allowed as an additional methodology to determine cetane number $\boxed{A1}$;
 - d) in order to allow fitness for purpose product and to align it with EN 590 product that has proven functionality in diesel engines, the arctic climate viscosity limits and the distillation recovery at 180 °C have been introduced in Table 3;
 - e) in order to present all relevant requirements within the same fuel specification, the necessary climate dependent properties from EN 590 have been introduced in 5.7; this required reference of some additional test methods in Clause 2;
 - f) further clarification on the oxidation stability requirement, as a result of recent changes in EN 15751, has been introduced;
 - g) exclusion of special sampling procedures for clean paraffinic fuel as they apply to diesel fuel in general;
 - h) to further underline the link with EN 590 that normative reference being stipulated without reference to a particular date of publication;
 - i) $\boxed{A1}$ a test procedure for aromatics content determination being developed as part of a second interlaboratory study funded by the EC on three different HPLC techniques, originally being part of this document, has been adopted in EN 12916 and as such referenced in this document $\boxed{A1}$;

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- j) introduction of an annex covering a test procedure for aromatics content determination being developed as part of a second interlaboratory study funded by the EC on three different HPLC techniques;
- k) introduction of an annex on density – temperature corrections being developed as part of a CEN/TC 19 investigation led by Mr. H. Th. Feuerhelm of DIN-FAM.

In this document, all relevant characteristics, requirements and test methods are specified. These specifications are relevant for the driveability of the vehicles and are currently known to prevent harm to the vehicles and their powertrains. Climate dependent requirements of this document may vary according to national adoptions of EN 590 and EN 14214, A_1 and A_1 should be indicated by a specific National Annex.

Several assessments of test methods for paraffinic diesel fuel have been executed and the results thereof [1] led to conclusions regarding the applicability of each of the test methods as required in Clause 5. The conclusion of these assessments, partially funded by the European Commission, led to the possibility to upgrade the original Technical Specification into a full European Standard. Although it is its main actual use, the product is now no longer limited to captive fleet usage, but the scope defines the need to check the use of the product with the vehicle manufacturer. There are no EU legislative needs to limit the product to captive fleets. Such restriction is not for the specification but for the market to decide upon. Therefore, and in the light of the defined need to check the use of the product with the vehicle manufacturer, all restrictions towards captive fleet from the CEN/TS text have been deleted

A_1 This document is based on current knowledge at the time of publishing, but will require review based on further experiences with the use of paraffinic diesel fuel or when the specification for either regular automotive diesel fuel, EN 590, or FAME, EN 14214, has been determined (revised) by CEN/TC 19 or based on further experiences with the use of paraffinic diesel fuel according to this document. A_1 Further background can be found in CEN/TR 16389 [2].

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, Former Yugoslav Republic of Macedonia, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and the United Kingdom.

Introduction

A1 This document has been laid down to define a quality specification for diesel fuel on the basis of synthesis gas or of hydrotreated bio-oils or -fats. Its main use is as diesel fuel in dedicated diesel vehicle fleets and engines. Paraffinic diesel fuel does not meet the automotive diesel fuel standard, EN 590 [22]. Its density can be outside the limits for automotive diesel fuel, and the described class A type fuel has a higher cetane number. Paraffinic diesel fuel is not validated for all vehicles, consult vehicle manufacturer before use.

As some production processes result in a fuel containing cyclo-paraffins, as well as n-paraffins and iso-paraffins, they show different cetane number compared to other paraffinic diesel fuels. Hence, in this document, two classes have been defined, one class showing improved ignition quality compared to automotive diesel fuel meeting EN 590.

Blending of paraffinic diesel fuel with fatty acid methyl ester (FAME) is covered in this document. Against the background of the EU Renewable Energy Directive (RED, 2009/28/EC [3]) and also the latest developments regarding the European automotive diesel fuel standard, there is now a pressing requirement to allow for FAME blend variations of those paraffinic fuels, which are not already classified as being from renewable resources.

Paraffinic diesel fuel is also used as a blending component in automotive diesel fuel. In that case it does not have to meet EN 15940 requirements since composition and properties of diesel fuel blends are defined in the respective automotive diesel fuel standards, e.g. EN 590 and EN 16734 (see EN 590:2013+A1:2017, 5.4 and EN 16734:2016+A1:2017, 5.4).

The document will be usable on a voluntary basis for engine clearance, fuel acceptance and fuelling station allowance, supporting both local regulations and international trade. **A1**

[SIST EN 15940:2016+A1:2018](https://standards.iteh.ai/catalog/standards/sist/d139d5ab-7607-4ecf-9b35-a87b700b9d2e/sist-en-15940-2016a1-2018)

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1 Scope

A1 This European Standard describes requirements and test methods for paraffinic diesel fuel marketed and delivered as such, and containing a level of up to 7,0 % (V/V) fatty acid methyl ester (FAME) **A1**. It is applicable to fuel for use in diesel engines and vehicles compatible with paraffinic diesel fuel. It defines two classes of paraffinic diesel fuel: high cetane and normal cetane.

Paraffinic diesel fuel originates from synthesis or hydrotreatment processes.

A1 NOTE 1 For general diesel engine warranty, paraffinic automotive diesel fuel may need a validation step to confirm the compatibility of the fuel with the vehicle, which for some existing engines may still need to be done (see also the Introduction to this document). The vehicle manufacturer needs to be consulted before use **A1**.

NOTE 2 For the purposes of this document, the terms “% (m/m)” and “% (V/V)” are used to represent respectively the mass fraction and the volume fraction.

A1 NOTE 3 In this European Standard, A-deviations apply (see Annex D). **A1**

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

EN 116:2015, *Diesel and domestic heating fuels - Determination of cold filter plugging point - Stepwise cooling bath method*

EN 12662:2014, *Liquid petroleum products - Determination of total contamination in middle distillates, diesel fuels and fatty acid methyl esters*

A1 EN 12916:–,¹ *Petroleum products — Determination of aromatic hydrocarbon types in middle distillates — High performance liquid chromatography method with refractive index detection* **A1**

EN 14078:2014, *Liquid petroleum products - Determination of fatty acid methyl ester (FAME) content in middle distillates - Infrared spectrometry method*

EN 14214:2012+A1:2014, *Liquid petroleum products - Fatty acid methyl esters (FAME) for use in diesel engines and heating applications - Requirements and test methods*

EN 15195:2014, *Liquid petroleum products - Determination of ignition delay and derived cetane number (DCN) of middle distillate fuels by combustion in a constant volume chamber*

EN 15751:2014, *Automotive fuels - Fatty acid methyl ester (FAME) fuel and blends with diesel fuel - Determination of oxidation stability by accelerated oxidation method*

A1 Deleted text **A1**

A1 EN 16576:2014, *Automotive fuels - Determination of manganese and iron content in diesel - Inductively coupled plasma optical emission spectrometry (ICP OES) method* **A1**

EN 16329:2013, *Diesel and domestic heating fuels - Determination of cold filter plugging point - Linear cooling bath method*

¹ **A1** Under preparation. Stage at time of publication: prEN 12916:2018. **A1**

prEN 16906, *Liquid petroleum products — Determination of the ignition quality of diesel fuels — BASF engine method*

EN 23015:1994, *Petroleum products - Determination of cloud point (ISO 3015:1992)*

A1 Deleted text **A1**

EN ISO 2160:1998, *Petroleum products - Corrosiveness to copper - Copper strip test (ISO 2160:1998)*

A1 EN ISO 2719:2016, *Determination of flash point - Pensky-Martens closed cup method (ISO 2719:2016)*

EN ISO 3104:1996, *Petroleum products - Transparent and opaque liquids - Determination of kinematic viscosity and calculation of dynamic viscosity (ISO 3104:1994)*

EN ISO 3170:2004, *Petroleum liquids - Manual sampling (ISO 3170:2004)*

EN ISO 3171:1999, *Petroleum liquids - Automatic pipeline sampling (ISO 3171:1988)*

EN ISO 3405:2011, *Petroleum products - Determination of distillation characteristics at atmospheric pressure (ISO 3405:2011)* ²⁾

EN ISO 3675:1998, *Crude petroleum and liquid petroleum products - Laboratory determination of density - Hydrometer method (ISO 3675:1998)*

A1 EN ISO 3924:2016, *Petroleum products - Determination of boiling range distribution - Gas chromatography method (ISO 3924:2016)* **A1**

EN ISO 4259:2006, *Petroleum products — Determination and application of precision data in relation to methods of test (ISO 4259:2006)* ²⁾

EN ISO 5165:1998, *Petroleum products — Determination of the ignition quality of diesel fuels — Cetane engine method (ISO 5165:1998)* ²⁾

EN ISO 6245:2002, *Petroleum products - Determination of ash (ISO 6245:2001)*

EN ISO 10370:2014, *Petroleum products - Determination of carbon residue - Micro method (ISO 10370:2014)*

A1 EN ISO 12156-1, *Diesel fuel - Assessment of lubricity using the high-frequency reciprocating rig (HFRR) - Part 1: Test method (ISO 12156-1:2016)* **A1**

EN ISO 12185:1996, *Crude petroleum and petroleum products - Determination of density - Oscillating U-tube method (ISO 12185:1996)* ²⁾

EN ISO 12205:1996, *Petroleum products - Determination of the oxidation stability of middle-distillate fuels (ISO 12205:1995)*

EN ISO 12937:2000, *Petroleum products - Determination of water - Coulometric Karl Fischer titration method (ISO 12937:2000)*

EN ISO 13759:1996, *Petroleum products - Determination of alkyl nitrate in diesel fuels - Spectrometric method (ISO 13759:1996)*

2) Under revision.

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EN ISO 20846:2011, *Petroleum products - Determination of sulfur content of automotive fuels - Ultraviolet fluorescence method (ISO 20846:2011)*

EN ISO 20884:2011, *Petroleum products - Determination of sulfur content of automotive fuels - Wavelength-dispersive X-ray fluorescence spectrometry (ISO 20884:2011)*

3 Sampling

Samples shall be taken as described in EN ISO 3170 or EN ISO 3171 and/or in accordance with the requirements of national standards or regulations for the sampling of automotive diesel fuel. The national requirements shall be set out in detail or shall be referred to by reference in a National Annex to this European Standard, should it be adopted on a national level.

In view of the sensitivity of some of the test methods referred to in this document, particular attention shall be paid to compliance with any guidance on sampling containers which is included in the test method standard.

4 Pump marking

[A1] Information to be marked on dispensing pumps and nozzles used for delivering paraffinic diesel fuel, and the dimensions of the mark shall be in accordance with EN 16942. **[A1]**

[A1] Deleted text **[A1]**

Labelling shall be clearly visible, easily legible and displayed at any point where paraffinic diesel with metallic additives is made available to consumers. In that case, the label shall contain "Contains metallic additives" in the national language(s) and shall be laid down in the National Annex to this document.

Further indication on dispensing pumps in the national language of "Not suitable for all vehicles; consult vehicle manufacturer **[A1]** deleted text **[A1]** or manual before use" is also recommended.

5 Requirements and test methods**5.1 Dyes and markers**

The use of dyes or markers is allowed.

5.2 Additives**5.2.1 General**

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 to avoid deterioration of driveability and emissions control durability. Other technical means with equivalent effect may also be used.

NOTE Deposit forming tendency test methods suitable for routine control purposes have not yet been identified and developed.

5.2.2 Methylcyclopentadienyl Manganese Tricarbonyl (MMT)

[A1] When methylcyclopentadienyl manganese tricarbonyl (MMT) is used, a specific labelling is required (see also Clause 4). The presence of the MMT is limited via a manganese content limit as in Table 1. **[A1]**

5.3 Fatty acid methyl ester (FAME)

Paraffinic diesel fuel may contain up to 7,0 % (V/V) of FAME complying with EN 14214:2012+A1:2014, in which case the climate-dependent requirements set out in EN 14214:2012+A1:2014, 5.4.2 do not apply.

NOTE 1 A suitable method for the separation and identification of FAME is given in EN 14331 [4].

Climate-dependent requirements for FAME as a blending component for use in paraffinic diesel according to this document are set out in 5.4.3 of EN 14214:2012+A1:2014. The specific grades shall be specified on a national basis according to local climatic conditions and the FAME volume in the diesel fuel.

The finished blend of paraffinic diesel fuel shall also comply with the climate-related requirements set out in 5.7 of this document.

Cold flow additives, when used in FAME, should be specifically matched to the base diesel fuel and FAME quality to ensure correct performance consistent with the requirements set out in this European Standard. The choice could result in incompatibility between the cold flow additives used in the FAME and the diesel fuel.

NOTE 2 Cold flow requirements for FAME as a blend component in paraffinic diesel fuel are set out in Tables 3a and 3b and the National Annex of EN 14214:2012+A1:2014, in order to control maximum content of saturated monoglycerides in the final paraffinic diesel fuel to ensure trouble-free operation. Work is on-going to identify a suitable test method for saturated monoglycerides or a performance test to control this aspect of low temperature performance.

In order to improve the oxidation stability of FAME, it is strongly recommended to add oxidation stability enhancing additives to FAME at the production stage and before storage, providing an oxidation stability similar to that obtained with 1 000 mg/kg of 2,6-di-tert-butyl-4-hydroxytoluene (BHT, officially designated by IUPAC as 2,6-bis(1,1-dimethylethyl)-4-methylphenol).

The similar action may be read as providing oxidation stability performance at least equal to that obtained with 1 000 mg/kg of BHT.

CAUTION — There is a potential risk of precipitate formation with oxidation stability enhancing additives at low temperatures in paraffinic diesel fuel. Caution should therefore be taken in the choice of oxidation stability enhancing additives to FAME.

5.4 Cavitation prevention

Fuels with an initial boiling point (IBP) below 160 °C, as determined by EN ISO 3405, may impose a risk of cavitation damage.

The IBP of paraffinic diesel fuels shall be measured and reported using EN ISO 3405.

NOTE The precision for IBP in EN ISO 3405 is better than the precision of IBP in EN ISO 3924. Therefore, only EN ISO 3405 is referred. This issue is being studied further by CEN. For explanation on the risks, see CEN/TR 16389 [2].

5.5 Seizure protection

There has been successful usage of paraffinic fuels since at least the start of the millennium, whilst no issues due to insufficient lubricity have been reported. However, there are indications that diesel fuel high in paraffin content does not always protect fuel system components sufficiently against seizure. The lubricity requirement in Table 1 ensures protection against wear but not necessarily also against seizure. Appropriate seizure protection shall be provided by using suitable fuel additives or by blending of minimum 2 % (V/V) of FAME.

NOTE For further information, see Annex A.

5.6 Generally applicable requirements and related test methods

5.6.1 When tested by the methods indicated in Table 1, paraffinic diesel fuel shall be in accordance with the limits specified in Table 1 for either Class A (high cetane paraffinic diesel fuel) or Class B (normal cetane paraffinic diesel fuel).