SLOVENSKI STANDARD
SIST-TP CEN/TR 16389:2012

01-oktober-2012

Goriva za motorna vozila - Parafinsko dizelsko gorivo in izhodišča zahtevanih parametrov, mejnih vrednosti in določevanja

Automotive fuels - Paraffinic diesel fuel and Background to the parameters required and their limits and determination

Kraftstoff für Kraftfahrzeuge - Paraffinischer Dieselkraftstoff und Kraftstoff-Mischungen - Hintergrund zu den erforderlichen Parametern, den entsprechenden Grenzwerten und deren Bestimmung

Carburants pour automobiles - Gazole paraffinique - Historique sur la définition des paramètres requis, de leurs limites et de leurs déterminations respectives

Ta slovenski standard je istoveten z: **CEN/TR 16389:2012**

ICS:

75.160.20	Tekoča goriva	Liquid fuels

SIST-TP CEN/TR 16389:2012 **en**

TECHNICAL REPORT

RAPPORT TECHNIQUE

TECHNISCHER BERICHT

CEN/TR 16389

August 2012

ICS 75.160.20

English Version

Automotive fuels - Paraffinic diesel fuel and blends - Background to the parameters required and their respective limits and determination

Carburants pour automobiles - Gazole paraffinique - Historique sur la définition des paramètres requis, de leurs limites et de leurs déterminations respectives

Kraftstoff für Kraftfahrzeuge - Paraffinischer Dieselkraftstoff und Kraftstoff-Mischungen - Hintergrund zu den erforderlichen Parametern, den entsprechenden Grenzwerten und deren Bestimmung

This Technical Report was approved by CEN on 9 July 2012. It has been drawn up by the Technical Committee CEN/TC 19.

CEN members are the national standards bodies of 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 United Kingdom.

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

Management Centre: Avenue Marnix 17, B-1000 Brussels

Ref. No. CEN/TR 16389:2012: E

Contents

Page

Foreword

This document (CEN/TR 16389:2012) 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.

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 presents all decisions that led to the proposed draft of CEN/TS 15940 in order to support the enquiry ballot. This document includes all decisions that have been taken following comments and further investigations leading to the effective publication of the specification for paraffinic diesel from synthesis (XTL) or hydrotreatment (HVO).

1 Scope

This Technical Report explains the requirements and test methods for marketed and delivered paraffinic diesel from synthesis (XTL) or hydrotreatment (HVO) and of blends thereof with fatty acid methyl esters (FAME) according to European fuel specifications. It provides background information to judge the (approval of the) final text of the standard and gives guidance and explanations to the producers, blenders, marketers and users of paraffinic automotive diesel.

NOTE 1 This document is directly related to the development of CEN/TS 15940 and will be updated once further publications take place.

NOTE 2 For the purposes of this document, the term "% (*m/m*)" and "% (*V/V*)" are used to represent the mass fraction, *μ*, and the volume fraction, *φ*, respectively.

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 590:2009/A1:2010, *Automotive fuels – Diesel – Requirements and test methods*

EN 14214:2012[1)], *Liquid petroleum products — Fatty acid methyl esters (FAME) for use in diesel engines and heating applications — Requirements and test methods*

CEN/TS 15940, *Automotive fuels — Paraffinic diesel fuel from synthesis or hydrotreatment — Requirements and test methods*

3 Summary of the XTL-HVO taskforce work

Following the 68th CEN Technical Board meeting, CEN/TC 19 had been requested to check eventually existing conflicts between the scope of work as proposed for Workshop 61 on "Automotive fuels - Blends of paraffinic diesel from synthesis (XTL) or hydrotreatment (HVO) and fatty acid methyl esters (FAME) - Requirements and test methods". At a CEN/TC 19/WG 24 meeting on 30 November 2010, the consensus was that there was a possible conflict between EN 590 and the Workshop 61. The advice to both the proposers and CEN/TC 19 was to take upon the work on XTL/HVO. A TF under WG 24 was established in order to address the matter and also allowing specific paraffinic diesel fuel and engine experts to exchange information.

On 13 December 2010, the workshop 61 proposers had a teleconference with the TC Chairman and Secretary on the way forward for the agreed upon TF under WG 24. In the spirit of harmonisation, they thought it advisable that the already existing CWA 15940 should also be revised. That document had been developed in 2007 – 2009 by a CEN Workshop 38 and was meant for dedicated fleet usage. As already in 2010, XTL product were already reaching the EU and certain fleets had expressed interest in purchases on the basis of CWA 15940, the CWA would need to stay in place until any revisions had been completed.

Hence, a proposal to accept the idea of Workshop 61 as an active work under CEN/TC 19, followed by a revision of CWA 15940 was balloted. At the plenary meeting of May 2011, CEN/TC 19 accepted the two proposals for new work. In view of the time pressure, the paraffinic diesel - FAME blends needed to be specified via a CEN/TS.

The work on the specifications was developed during a series of Paraffinic diesel fuel and FAME blending Task Force (TF XTL-HVO) meetings between May and November 2011, and is presented by means of this Technical Report. The draft technical specification, now referenced by the identification CEN/TS 15940, comprises a set of properties and limit values to define an adequate quality of the paraffinic diesel fuel and recommendations for precautions to be taken.

1) Under publication

Discussion in the TF started with the task to handle only blends with FAME; CWA 15940 was to remain for the short term as an assurance for the industry for a non-FAME containing product. This meant that the actual situation from 0 % to 7 % as in EN 590 was copied. Because CWA 15940 allowed limited FAME blending for lubricity, the TF concluded that distinguishing (for instance via classes) between no FAME and up to 7 % FAME would be highly artificial. Therefore, a suggestion to CEN/TC 19 was made to draft the CEN/TS as a replacement of CWA 15940 and to use it for up to 7 % blending.

It should be noted that the draft standard has been considered on the basis of the FAME blend component specification EN 14214:2012 (FAME) and the last version of the EN 590 (diesel) standard. Revision discussion on those documents has been included in the discussions. However CEN/TS 15940 still contains some pending issues, which are noted as such in the text of this Technical Report.

Many of the test methods proposed by the test methods experts are being examined to determine their applicability to paraffinic fuel and to determine if their precision is sufficient to support the limit values proposed. This activity is being undertaken in several other CEN working groups where the specialists in methods are present.

4 Record of the work to date

4.1 Context

From an environmental perspective, paraffinic diesel is a high quality, clean burning fuel with virtually no sulfur and aromatics. Paraffinic diesel fuel can be used in existing diesel engines, substantially reducing regulated and unregulated emissions. In order to have the greatest possible emissions reduction, a specific calibration may be necessary. Paraffinic diesel fuel will also offer a meaningful contribution to the target of increased non-petroleum/renewable content in transportation fuel pool.

As some production processes result in a fuel containing cyclo-paraffins, next to n paraffins and iso paraffins, they show different cetane number compared to other paraffinic diesel fuels. Hence, two classes, showing improved ignition quality compared to regular diesel fuel, have been defined. Both are intended for use in dedicated diesel vehicle fleets.

Worldwide, energy policy makers are increasingly keen to move away from petroleum-based fuels to more diverse or renewable sources of energy for reasons of environmental protection, energy security and continued economic development. Amongst the available solutions are the synthetic paraffinic fuels, already discussed in a CEN workshop WS 38, which led to the workshop specification CWA 15940. Typical production processes, covered by that workshop, are:

1) Fischer Tropsch synthesis (XTL),

2) Hydrotreatment of vegetable oils (HVO), and

3) Conversion of olefins to distillates (COD).

The WS 38 activity in 2007 to 2009 covered the requirements and test methods for the B0 variants of paraffinic fuels (where B0 indicates no addition of FAME components). However, against the background of the EU Renewable Energy Directive (RED, 2009/28/EC [1]) and also the latest EN 590 regular diesel specification which allows B7 FAME blends, there is now a pressing requirement to allow for Bx variations of those paraffinic fuels, which are not already classified as being from renewable resources.

Allowing a Bx variant of paraffinic diesel up to B7, in the same way that the EN 590 specification allows for refinery diesel up to B7, would have the following advantages:

a) Gives flexibility of synthetic diesel supply within EU against the backdrop of both the Renewable Energy Directive and the Fuels Quality Directive (2009/30/EC [2]), which demand total fuel supply contains certain percentages of bio-components, to decrease fossil energy usage.

b) Brings a synthetic diesel CWA specification totally in line with the EU refinery diesel specification EN 590.

The original intention of CEN/TC 19 was to redraft the CWA into a CEN Technical Specification for the FAME blend up to 7 %, based on the publication of EN 14214 and EN 590. The aim of the TF was to keep the specification simple and straightforward, allowing blends to be introduced in the market for dedicated vehicles or fleets. The original idea was to ensure basic car functionality, for which the existing CWA succeeded. From the beginning it was felt advantageous for the market to first draft a FAME blend specification and thus not immediately replace the CWA. However, because technically one could not sufficiently distinguish the two and any "no-FAME" guarantee could only be given in a purchase contract, it was decided to continue on the path of replacing the CWA by a specification for paraffinic diesel fuel in general, assuming it could be blended up to 7 % (*V/V*) of FAME.

This document is the report on the work to date carried out by the TF XTL-HVO towards establishing a European Technical Specification for paraffinic diesel – FAME blends.

4.2 Paraffinic diesel fuel and FAME blending Task Force

CEN, requested CEN/TC 19/WG 24 to convene a task force and begin work on a draft paraffinic diesel fuel and FAME blend standard. A call was made to the industries concerned for experts to participate in the TF XTL-HVO. The experts that have contributed to the work during the years are listed in Table 1.

Table 1 — Membership of the taskforce

Name	Organisation	Country
Andras Hollo	MOL	MSZT
Andreas Eklund	EcoPar	SIS
Benoit Engelen	Total	NBN
Gérald Crépeau	PSA	AFNOR
Jörg Ullmann	Robert Bosch	DIN
Jose Gomez-Martinech	Cepsa	AENOR
Ludivine Pidol	IFP	AFNOR
Markku Kuronen	Neste Oil	SFS
Pascal Manuelli	Total	AFNOR
Piet Roets	Sasol	TC19
Richard Clark	Shell	NEN
Róbert Auer	MOL	MSZT
Sören Eriksson	Preem	SIS
Thierry Chapus	IFP	AFNOR
Thomas Wilharm	ASG Analytik-Service	DIN
Ulrich Nowak	MB Holding	UPEI
Wolfgang Dörmer	BP Europe SE Global Fuels Technology	DIN
Wolfgang Lueke *	Shell	NEN

The task force has met on the following occasions:

0) 24 October 2010, Brussels, kick-off meeting WS 61
1) 6 May 2011, Brussels, first meeting
2) 7 June 2011, Brussels, second meeting
3) 21 July 2011, Paris, third meeting
4) 7 September 2011, Brussels, fourth meeting
5) 7 November 2011, Brussels, fifth meeting

4.3 Planning

The initial planning of the paraffinic diesel fuel specification was: CEN/TS enquiry text to be provided to WG 24 in November 2011, enquiry ballot to start in February 2012, comments to be handled July 2012 and the final text to be delivered to CEN/CMC in October 2012.

5 The draft paraffinic diesel fuel specification

5.1 Parameters included

The original CWA had been established for dedicated vehicle use, although it was at that time felt that there would be no need to exclude other uses as long as someone would guarantee the engine functioning. The first scope of work given to the task force was to present a specification for captive fleets. At the third meeting that limitation was accepted and it was suggested copying the captive fleet description of the B30 TF. As it presented some further understanding difficulties towards the original CWA scope, that was reformulated into: "This document specifies requirements and test methods for marketed and delivered paraffinic diesel fuel blended with fatty acid methyl ester (FAME) up to a level 7 % (*V/V*), for use in diesel engine vehicles. Paraffinic diesel fuel originates from synthesis or hydrotreatment processes."

All parameters discussed in this document are either based on the paraffinic nature of the XTL and HVO (and thus of importance for the replacement of CWA 15940) and on the introduction of FAME complying with EN 14214 as a blending component (thus specific to the Bx-blend specification).

The parameters chosen by the TF are those presented in Table 1 (general requirements) and in 5.7 (seasonal requirements) of CEN/TS 15940:2012. After the 4th meeting, all-but-two of the parameters were agreed upon in full consensus, where the seizure and cavitation prevention needed further clarification from outside the taskforce. All the test methods applicability had been checked within CEN/TC 19 or are under improvement process (like EN 116). An overview of the assessment is presented in Table 2, the last three columns. These respectively present an idea on the applicability of the test method as is, where a test method revision is needed to incorporate paraffinic diesel fuel in the scope or where an assessment by a full Round Robin study is required.

NOTE 1 Exact references to the test methods are given in CEN/TS 15940.

NOTE 2 Parameters not included are presented in 5.3.

Table 2 — Test methods' assessment

Property	Unit	Test method	Applicability	Precision not available	Assessment needed
Cetane number		EN ISO 5165	X		X
		EN 15195	X		X[a]
Density at 15 °C	kg/m^3	EN ISO 3675	X		
		EN ISO 12185	X		
Flash point	°C	EN ISO 2719	X		
Viscosity at 40 °C	mm^2/s	EN ISO 3104	X	X	
Distillation	°C or % recovered	EN ISO 3405	X		
Lubricity, corrected wear scar diameter (wsd 1,4) at 60 °C	µm	EN ISO 12156-1[b]	X	X	
FAME content	% (*V/V*)	EN 14078	X	X	
Total aromatics content	% (*m/m*)	EN 12916	X		X
		SIS 155116	X		X
Sulfur content	mg/kg	EN ISO 20846	X	X[c]	
		EN ISO 20884	X	X[c]	
Carbon residue (on 10 % distillation residue)	% (*m/m*)	EN ISO 10370	X	X	
Ash content	% (*m/m*)	EN ISO 6245	X		
Water content	mg/kg	EN ISO 12937	X		
Total contamination	mg/kg	EN 12662 [b]	X	X	
Copper strip corrosion (3 h at 50 °C)	rating	EN ISO 2160	X		
Oxidation stability	g/m^3	EN ISO 12205	X		
	h	EN 15751	X		
CFPP	°C	EN 116 [b]	X	X	
Cloud point	°C	EN 23015	X		
Cetane index		EN ISO 4264 [3] [b]			X

[a] Depending on the outcome of the work of CEN/TC 19/WG 35

[b] Method under revision

[c] Depending on the outcome of consultation of CEN/TC 19/WG 27

5.2 Considerations on the parameters

5.2.1 Cetane number

Cetane number is a measure of the compression ignition behaviour of a fuel; it influences cold startability, exhaust emissions and combustion noise. The cetane number is measured on a test engine or determined by DCN equipment and reflects the combination of the natural self-ignition properties and the effects of cetane improver additives.

The choice of 2 different classes originates from the aspect of the differences between the processes that result in different chemical composition. The processes are the low-temperature and high-temperature Fischer-Tropsch (LTFT and HTFT). Because, a higher cetane number is an advantage for some applications, the specific distinction between regular diesel class (minimum cetane of 51) and a high-cetane fuel (minimum 70) has been incorporated in the CEN/TS.

As the composition of LTFT GTL is highly paraffinic, the linear paraffins of these diesel fuels have very high cetane numbers, in excess of 73. Generally, a high cetane number leads to a reduction in white smoke, noise, engine misfire, emissions and improve cold starting in some engines, especially in engines without pilot injection. HTFT GTL will in general be produced with a cetane between 52 and 65. A clear cut for the LTFT and HVO processes was 70, it being a clear identification of the products advantage. The number has been based on good experience, also looking at the test method's precision. In earlier discussions in the CWA a maximum cetane had been considered by the OEMs, but such would at this stage be difficult to correctly measure.

In the CWA 15940 the goal was to clarify that the product had an improved cetane. Therefore originally a minimum of 55 had been included. The OEMs wished to have a certain band in order to tune the engine where possible. The original band was 55 to 70. Because 55 was really borderline for the HTFT producers, the minimum was lowered to 51 and the maximum to 66 in order to preserve the band width.

At the fourth meeting, of the new TF, the classes were reviewed. Based on the test method precision the two classes cannot correctly be distinguished. With the four points gap, it might happen that a producer has a correct product for the high cetane class, but cannot constantly measure 68 due to the test method imprecision. At such moment the producer would not be be allowed to sell a correct product. The taskforce agreed to remove the middle ground and to delete the maximum on class B (regular cetane).

The effective correlation between DCN and CN for regular diesel and paraffinic diesel fuel is still under study. Pending further clarification within CEN/TC 19, the limits need to be assessed again.

5.2.2 Density

Paraffinic diesel fuel density is often lower than a diesel fuel in the field. FAME density is higher than that of fossil diesel fuel, with the specific values depending on fatty acid composition and purity. Most batches of FAME contain only about ten different molecules with densities usually within a very narrow range. Contamination can significantly affect FAME density, so this property can be used to indicate contamination by some unwanted compounds and to monitor fuel quality.

The diesel fuel injection is controlled volumetrically or by timing of the solenoid valve. Variations in fuel density (and viscosity) result in variations in engine power and, consequently, in engine emissions and fuel consumption. Therefore, in order to optimise engine performance and tailpipe emissions, OEMs prefers both minimum and maximum density limits be defined in a fairly narrow range. Moreover, the (volumetric) injection quantity is a control parameter for other emission control systems like the exhaust gas recirculation (EGR). Variations in fuel density therefore result in non-optimal EGR-rates for a given load and speed point in the engine map and, as a consequence, influence the exhaust emission characteristics.

Car makers prefer a narrow range of density for a good driveability. For durability a minimum limit and for exhaust emission a maximum limit is important, therefore the range should be maximum 40 points.

Generally, FAME is known to have density values in the region of 0,880 kg/l, which are higher than the density values of paraffinic diesel fuels such as LTFT diesel. Therefore, it is expected that the blending of most FAME fuels with paraffinic diesel fuels will increase the density of the resulting blends. Work carried at Sasol on blends of FAME and (LTFT) paraffinic diesel confirmed that the density of the resulting blends is higher than the paraffinic diesel (see Table 3 and Figure 1).

At the fifth TF meeting, information was presented by one producer that density ranges for some production facilities will be just below the 770 kg/m^3 lowest limit of class A. In order not to unnecessarily exclude any actual paraffinic diesel process routes, the group agree to lower the limit to 765 kg/m^3. As this differs from earlier ranges, it may create additional validation needs.