TECHNICAL REPORT

RAPPORT TECHNIQUE

TECHNISCHER BERICHT

CEN/TR 16569

June 2013

ICS 75.160.20

English Version

Automotive fuels - Assessing the effects of E10 petrol on vehicle emissions and performance

Carburants pour automobiles - Evaluation des effets de l'essence E10 sur les émissions de véhicules et leurs performances

Kraftstoffe für Kraftfahrzeuge - Beurteilung der Auswirkung von E10-Kraftstoff auf Kraftfahrzeugemission und -leistung

This Technical Report was approved by CEN on 17 May 2013. It has been drawn up by the Technical Committee CEN/TC 19.

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COMITÉ EUROPÉEN DE NORMALISATION
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Ref. No. CEN/TR 16569:2013: E

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Foreword

This document (CEN/TR 16569:2013) 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.

1 Scope

This Technical Report describes a study executed to evaluate the performance of representative vehicles of current and recent production when operating on petrol fuels containing up to 10 % (*V/V*) ethanol. Vehicle performance evaluations included regulated and evaporative emissions as well as hot and cold weather driveability. The testing procedures used in each of the three main vehicle studies were adapted to the requirements of the testing facilities.

The studies were designed to demonstrate whether a relaxation in the $E70_{max}$, $E100_{max}$, and VLI limits in EN 228 would introduce unacceptable vehicle driveability or regulated emissions performance problems. The results were used to advise CEN/TC 19/WG 21 on the revision of the EN 228 petrol specification [1]. A procedure for future revision of EN 228 (see Annex A) was also developed.

2 Background

The former European EN 228 specification [1] included volatility requirements for unleaded petrol in order to ensure good performance of vehicles in real world driving conditions. These requirements were put in place following extensive technical studies in the 1990's at a time when vehicles were more sensitive to volatility than they are today and when blending of oxygenates, like ethanol, was not widespread. Different petrol volatility classes are included in the EN 228 specification that depend on climatic conditions. Minimum and maximum volatility limits for summer and winter petrols are included as well as additional limits for spring and autumn seasonal transitions.

Since these volatility requirements were put in place, the use of oxygenate blending components, such as ethanol and ethers, has increased, in response to the EU Renewable Energy Directive (RED, 2009/28/EC [3]). This Directive requires Member States to use at least 10 % renewable energy in transport fuels by 2020. Although biogas, renewable electricity, and other energy types are encouraged, only conventional and some advanced bio-blending components are likely to be available in sufficient volumes by 2020 to meet the mandate. The major bio-derived blending components until 2020 are likely to be bio-ethanol produced from sugar fermentation, ethers manufactured from bio-ethanol or bio-methanol, and esters and hydrocarbons produced from vegetable oils and animal fats.

Blending ethanol into gasoline at low concentrations alters the volatility characteristics of the resulting blend and the fuel refining and blending process shall account for this effect. In addition to increasing the vapour pressure of the ethanol/petrol blend, ethanol also changes the shape of the blend's distillation curve. This has the potential to impact the vehicle's regulated emissions and driveability performance in cold and hot weather. Furthermore, any change in the blend's distillation characteristics due to ethanol addition must be compensated in the refinery by changing the composition of the hydrocarbon-only petrol mixture into which the ethanol is ultimately blended.

Following the publication of the EU Fuels Quality Directive (FQD, 2009/30/EC [3]), CEN/TC 19 reviewed the European EN 228 unleaded petrol specification in order to enable the higher ethanol blending envisioned by the FQD from 5 % (*V/V)* up to 10 % (*V/V)*. As input to this review, CEN/TC 19 Working Group 21 (WG 21) reviewed a 2009 study of published literature [4] on the effect of blending up to 20 % (*V/V*) ethanol on E70[1] and E100[2] volatility parameters, as well as on hot and cold weather vehicle driveability performance. This literature review was completed to better understand the observed effects on the petrol distillation curve due to the addition of higher levels of ethanol to petrol [5].

Any changes to CEN specifications for fuel parameters beyond those required by EU legislation should be based on the best-available technical data and shall not impact the performance of the vehicle fleet. Based on its review of the existing literature, WG 21 concluded that additional vehicle studies were warranted in order to assess the effects of 10 % (*V/V)* ethanol in petrol on current and future engines (Euro 5 and 6), especially with respect to vehicle regulated and evaporative emissions, CO_2, and hot and cold weather driveability performance.

Summer and winter grade petrols containing 10 % (*V/V)* ethanol were specially blended for this study that had volatility specifications at today's EN 228 maximum limits and at higher limits consistent with CONCAWE's volatility relaxation proposal. The vapour pressures (measured as Dry Vapour Pressure Equivalent (DVPE)) targeted summer grade petrols with a maximum 60 kPa DVPE and winter grade petrols with a maximum 100 kPa DVPE. The DVPE of the test fuel was selected to be consistent with the type of vehicle test that was completed.

[1] The percentage of a petrol sample that evaporates at 70 °C

[2] The percentage of a petrol sample that evaporates at 100 °C