SLOVENSKI STANDARD
oSIST prEN 15195:2013

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Tekoči naftni proizvodi - Ugotavljanje zakasnitve vžiga in izpeljanega cetanskega števila (DCN) srednjih destilatov s sežigom v komori s stalno prostornino

Liquid petroleum products - Determination of ignition delay andderived cetane number (DCN) of middle distillate fuels by combustion in a constant volume chamber

Flüssige Mineralölerzeugnisse - Bestimmung des Zündverzugs und der abgeleiteten Cetanzahl (ACZ) von Kraftstoffen aus Mitteldestillaten in einer Verbrennungskammer mit konstantem Volumen

Produits pétroliers liquides - Détermination de délai d'inflammation et de l'indice de cétane dérivé (ICD) des distillats moyens par combustion dans une chambre à volume constant

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

Produits pétroliers liquides - Détermination de délai d'inflammation et de l'indice de cétane dérivé (ICD) des distillats moyens par combustion dans une chambre à volume constant

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This draft European Standard is submitted to CEN members for enquiry. It has been drawn up by the Technical Committee CEN/TC 19.

If this draft becomes a European Standard, CEN members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration.

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Recipients of this draft are invited to submit, with their comments, notification of any relevant patent rights of which they are aware and to provide supporting documentation.

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Foreword

This document (prEN 15195:2013) 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.

This document is currently submitted to the CEN Enquiry.

This document will supersede EN 15195:2007.

Based on new data sets used and experience in the field, the following main updates could be included:

— based on recent data from EI and ASTM correlation schemes precision of the method has been improved (by around 25 %) and a common global precision statement for EN 15195 has been incorporated (see also the Introduction);

— the ignition delay range has been expanded to 2,8 ms to 6,3 ms (70 DCN to 33 DCN), where it used to be 3,3 ms to 6,4 ms (61 DCN to 34 DCN);

— the scope has been expanded to from diesel blends with 7 % (*V/V*) up to 30 % (*V/V*) of FAME;

— the test procedure has been updated following experience in the market;

— the standard operating and test conditions have been more precisely defined;

— the calibration information has been improved;

— an alternative system cleaning procedure has been introduced in Annex B;

Introduction

This document is derived from joint standardization work in the Energy Institute and ASTM International. It has originally been based on IP 498/06 [1] published by the Energy Institute and harmonized with equivalent ASTM [2] Standards.

The described method is an alternative quantitative determination of the cetane number of middle distillate fuels intended for use in compression ignition engines. Correlation studies between this method and EN ISO 5165 have been done and the results of this are incorporated in this European Standard.

The basis of this method is the derived cetane number correlation equation as given in Clause 13. The on-going validation of the equation is monitored and evaluated through the existing monthly American and European fuel exchange programs. The validation data will be reviewed by CEN/TC 19 with a frequency of at least every two years. As a result of the review, CEN/TC 19 may make the decision to, if necessary, modify the existing equation/correlation or develop a new one. As part of this review, the sample types will be examined, and if certain types are underrepresented, further steps may be taken to evaluate how they perform.

For the moment the basics of one type of apparatus are described[1]. Once more correlation data on different types of derived cetane number testing equipment is available, CEN/TC 19 will consider revising this European Standard.

[1] The injection pump in the currently described apparatus is covered by a patent.

1 Scope

This European Standard specifies a test method for the quantitative determination of ignition delay of middle distillate fuels intended for use in compression ignition engines. The method utilizes a constant volume combustion chamber designed for operation by compression ignition, and employing direct injection of fuel into compressed air that is controlled to a specified pressure and temperature. An equation is given to calculate the derived cetane number (DCN) from the ignition delay measurement.

This standard is applicable to diesel fuels, including those containing fatty acid methyl esters (FAME) up to 30 % (*V/V*). The method is also applicable to middle distillate fuels of non-petroleum origin, oil-sands based fuels, blends of fuel containing biodiesel material, diesel fuel oils containing cetane number improver additives and low-sulphur diesel fuel oils. However, users applying this standard especially to unconventional distillate fuels are warned that the relationship between derived cetane number and combustion behaviour in real engines is not yet fully understood.

The test method is also applicable to the quantitative determination of the ignition characteristics of FAME, especially the ignition delay. However the correlation data available were inconclusive about the precision of the equation. So the determination of derived cetane number for FAME fuel, also known as B100, has not been included in the precision determination as in Clause 13[2)].

The standard covers the ignition delay range from 2,8 ms to 6,3 ms (70 DCN to 33 DCN). The combustion analyser can measure shorter or longer ignition delays, but precision can be affected. For these shorter or longer ignition delays the correlation equation for DCN is given in NOTE 2 under Clause 13.

NOTE 1 There is no information about how DCNs outside the 33 to 70 range compares to EN ISO 5165.

NOTE 2 For the purpose of this European Standard, the expression "% (*V/V*)" is used to represent the volume fraction and "% (*m/m*)" the mass fraction.

WARNING — The use of this standard may involve hazardous materials, operations and equipment. This standard does not purport to address all of the safety problems associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.

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 ISO 3170, *Petroleum liquids — Manual sampling (ISO 3170)*

EN ISO 3171, *Petroleum liquids — Automatic pipeline sampling (ISO 3171)*

EN ISO 3696, *Water for analytical laboratory use - Specification and test methods (ISO 3696)*

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

ISO 1998-2:1998, *Petroleum industry – Terminology - Part 2: Properties and tests*

ISO 4010, *Diesel engines — Calibrating nozzle, delay pintle type*

2) A further Round Robin study for B100 samples is being considered by CEN.

IP 537, *Determination of the purity of Derived Cetane Number reference materials — Gas chromatography method*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 1998-2:1998 and the following apply.

3.1
cetane number
CN
measure of the ignition performance of a fuel in a standardized engine test on a scale defined by reference fuels

Note 1 to entry: It is expressed as the percentage by volume of hexadecane (cetane) in a reference blend having the same ignition delay as the fuel for analysis. The higher the cetane number, the shorter the ignition delay.

Note 2 to entry: ISO 1998-2 expresses it as "number on a conventional scale, indicating the ignition quality of a diesel fuel under standardized conditions", but for this document the definition as given is chosen.

3.2
ignition delay
ID
period of time, in milliseconds, between the start of fuel injection and the start of combustion

Note 1 to entry: In the context of this standard, this period is determined by movement and pressure sensors in the instrument.

3.3
derived cetane number
DCN
value using an equation that correlates a combustion analyser ignition delay result to the cetane number

3.4
accepted reference value
ARV
value agreed upon as a reference for comparison

Note 1 to entry: The value is derived as (1) a theoretical or established value, based in scientific principles, (2) an assigned value, based on experimental work of some national or international organization, or (3) a consensus value based on collaborative experimental work under the auspices of a scientific or engineering group.

3.5
quality control sample
stable and homogenous material(s) similar in nature to the materials under test, properly stored to ensure integrity, and available in sufficient quantity for repeated long-term testing

3.6
calibration reference fluid
stable and homogenous fluid used to calibrate the performance of the combustion analyzer

3.7
verification reference fluid
stable and homogenous fluid used to verify the performance of the combustion analyzer

4 Symbols and abbreviations

*T*3 combustion chamber pressure sensor temperature

*T*4 charge air temperature

*T*6 injector nozzle coolant passage temperature

5 Principle

A test portion of the material under test is injected into a heated temperature-controlled constant volume combustion chamber which has previously been charged with compressed air. Sensors detect the start of injection and the start of combustion for each single-shot cycle. A complete test sequence consists of 15 preliminary combustion cycles to ensure apparatus equilibrium and 32 subsequent test cycles to obtain ignition delay values. The average ignition delay (ID) of these 32 cycles is inserted into an equation to obtain the derived cetane number (DCN). The DCN obtained by this procedure is an estimate of the cetane number (CN) obtained from the conventional large-scale engine test EN ISO 5165.

6 Reagents and materials

6.1 Water, unless otherwise specified, meeting the requirements for grade 3 of EN ISO 3696.

6.2 Coolant system fluid, 50:50 volumetric mixture of commercial grade radiator antifreeze (aluminium-compatible, ethylene glycol-type) with water (6.1).

NOTE This mixture meets the boiling point requirements and gives adequate protection of the coolant system against corrosion and mineral scale that can alter heat transfer and rating results. See the manufacturer's manual for the correct ethylene glycol-type antifreeze quality.

6.3 Calibration reference fluid, heptane of a purity of minimum 99,5 % (*m/m*) to be used as the designated 3,78 ms ignition delay accepted reference value material.

If the initial purity is not known the purity shall be checked in accordance with IP 537.

6.4 Verification reference fluid, methylcyclohexane of a purity of minimum 99,0 % (*m/m*) to be used as the designated 10,4 ms ignition delay accepted reference value material.

If the initial purity is not known the purity shall be checked in accordance with IP 537.

Even if the verification reference fluid meets the purity specification, it may not meet the Ignition Delay requirements (see Table 2). It is recommended to test a new material prior to its use as a verification reference fluid.

6.5 Quality control sample, stable and homogeneous material(s), similar in nature to the materials under test (see 3.5)

6.6 Combustion charge air, of oxygen content 20,9 % (*V/V*) ± 1,0 % (*V/V*), and containing less than 0,003 % (*V/V*) hydro-carbons and less than 0,025 % (*V/V*) water.

NOTE 1 Oxygen content of combustion charge compressed air can vary between batches (cylinders). Significant variation will lead to changes in ignition delay (higher oxygen content leads to a shorter ignition delay).

NOTE 2 The effects of oxygen concentration have been investigated [3].

6.7 Actuating air, oil-free compressed air containing less than 0,1 % (*V/V*) water supplied at a minimum sustained pressure of 1,5 MPa.

6.8 Compressed nitrogen, of minimum purity 99,9 % (*V/V*).

7 Apparatus

7.1 Combustion analyzer

7.1.1 General

The apparatus is described in more detail in Annex A. For the installation and set-up procedures, and for detailed system description, refer to the manufacturer's manual.

The system described in this standard comprises: an insulated heated, constant volume combustion chamber (see 7.1.2) with fluid cooling of designated areas; external, pneumatically actuated, chamber inlet and exhaust valves, and associated piping; a heated, pneumatically-actuated, fuel injection pump; a constant pressure fuel delivery system; a re-circulating coolant system; solenoids; sensors; controls; connection fittings for the compressed gas utilities; and a computer to control test sequencing. Figure 1 gives a schematic outline of the analyzer.

7.1.2 Combustion chamber, steel combustion chamber of capacity 0,213 l ± 0,002 l, further detailed in Annex A.

7.2 Filter medium, with a nominal pore size 3 µm to 5 µm, made of glass fibre, polytetrafluorethylene (PTFE) or nylon, of a size appropriate to the apparatus being used for sample filtration (see 8.5).

8 Sampling

8.1 Unless otherwise specified, obtain samples in accordance with the procedures given in EN ISO 3170 or EN ISO 3171.

8.2 Collect and store samples in an opaque container to minimize exposure to UV emissions that can induce chemical reactions, which may affect ignition delay measurements. If the sample is not to be analyzed within 24 h, retain in a dark, cool/cold environment, and preferably under an inert gas.

NOTE 1 Exposure of petroleum fuels to UV wavelengths of less than 550 nm for even a short period of time has been shown to affect ignition delay [4].

NOTE 2 The formation of peroxides and radicals, which affect the ignition delay, is minimized when the sample is stored in the dark, under a nitrogen blanket in a cool environment.

8.3 Inspect the sample before testing for wax precipitation. If precipitants are present, bring the test sample to a temperature of approximately 14°C above the expected cloud point of the material being tested, taking care not to lose any lower boiling range components. Agitate the sample to return precipitants back in to the solution, ensuring the sample is homogeneous before filtering.

8.4 Bring the laboratory sample to 18 °C to 32 °C before testing.

8.5 Filter the laboratory sample through the filter medium (see 7.2) at ambient temperature, without vacuum. Use a positive pressure filtration system. Immediately collect the filtered sample in an opaque container.

WARNING — If a glass syringe is used to filter the sample, ensure that the filter capsule is correctly located on the syringe fitting. Do not apply excessive force to the plunger as this could result in the glass syringe shattering. It is recommended that protective gloves are worn during the filtering operation.