SLOVENSKI STANDARD
oSIST prEN 16144:2010

01-oktober-2010

Tekoči naftni proizvodi - Ugotavljanje zakasnitve vžiga in izpeljanega cetanskega števila (DCN) v srednje destilatnih gorivih - Fiksno območje injekcijskega časa, metoda konstantne prostornine

Liquid petroleum products - Determination of ignition delay and derived cetane number (DCN) of middle distillate fuels - Fixed range injection period, constant volume combustion chamber method

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Flüssige Mineralölerzeugnisse - Bestimmung des Zündverzugs und der abgeleiteten Cetanzahl (ACZ) von Mitteldestillatkraftstoffen - Verfahren mit festen Einspritzzeiten in einer Verbrennungskammer konstanten Volumens

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Produits pétroliers liquides - Détermination due délai d'inflammation et de l'indicel'indice de cétane dérivé (ICD) des distillatsmoyens - Méthode avec periode d'injection avec une range fixé et combustion dans une chambre à volume constant

Ta slovenski standard je istoveten z: **prEN 16144**

ICS:

75.160.20	Tekoča goriva	Liquid fuels

oSIST prEN 16144:2010 **en,de**

2003-01.Slovenski inštitut za standardizacijo. Razmnoževanje celote ali delov tega standarda ni dovoljeno.

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EUROPEAN STANDARD

NORME EUROPÉENNE

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August 2010

ICS 75.160.20

English Version

Liquid petroleum products - Determination of ignition delay and derived cetane number (DCN) of middle distillate fuels - Fixed range injection period, constant volume combustion chamber method

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

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Foreword

This document (prEN 16144:2010) 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.

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Introduction

This document is derived from joint standardization work in the Energy Institute and ASTM International. It is based on IP 567/09 [1] published by the Energy Institute and technically equivalent with ASTM D7170 [2].

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 5165:1998 [3] 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 12. The ongoing 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.

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

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1 Scope

This document 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 FAME. The method is also applicable to middle distillate fuels of non-petroleum origin, although users applying this standard are warned that the relationship between ignition characteristics and engine performance in unconventional fuels is not yet fully understood. The standard covers the ignition delay range from 2,9 ms to 5,0 ms (60 DCN to 35 DCN).

NOTE 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

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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.

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

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

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EN ISO 3696, *Water for analytical laboratory use - Specification and test methods (ISO 3696:1987)*

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

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

DIN 73372, *Fuel injection nozzles, size T and U*

3 Terms and definitions

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

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

NOTE In the context of this standard, this period is determined by movement and pressure sensors in the instrument.

3.3
derived cetane number
DCN
calculated 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 The value may be that derived from scientific principles assigned by an accredited organization, or 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

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

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

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4 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 two preliminary combustion cycles to ensure apparatus equilibrium and 25 subsequent test cycles to obtain ignition delay values. The average ignition delay (ID) of these 25 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 [3].

5 Reagents and materials

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

5.2 Coolant system fluid, 50:50 volumetric mixture of commercial grade ethylene glycol-type radiator antifreeze with water (5.1).

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.

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5.3 Calibration reference fluid, heptane of a purity of minimum 99,5 % (*m/m*) to be used as the designated 3,15 ms accepted ignition delay reference value material. If the initial purity is not known and during a long-time stored reference fluid, it is advised to check the purity in accordance with IP 537 [4].

5.4 Verification reference fluid, methylcyclo-hexane of a purity of minimum 99,0 % (*m/m*) to be used as the designated 10,1 ms ignition delay accepted reference value material. If the initial purity is not known and during a long-time stored reference fluid, it is advised to check the purity in accordance with IP 537 [4].

NOTE Experience has found some MCH meeting the purity specification but not meeting the Ignition Delay requirements (typically 1 to 1,5 ms shorter). It is recommended that new material be qualified prior to use.

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

5.6 Charge air, of oxygen content 20,9 % (*V/V*) ± 1,0 % (*V/V*), containing less than 0,5 ppm carbon monoxide, less than 1,0 ppm carbon dioxide, less than 5 ppm water, less than 0,1 ppm oxides of nitrogen, less than 0,1 ppm sulfur dioxide, and containing less than 0,1 ppm total hydrocarbons.

6 Apparatus

6.1 Combustion analyzer

6.1.1 General

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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 standard system consists of a heated combustion chamber (6.1.2) with fluid cooling of designated areas, external chamber inlet and exhaust valves and associated piping, a pneumatically-driven fuel injection pump, a fuel delivery system, a recirculating coolant system, solenoids, sensors, controls and connection fittings for the compressed gas utilities. Figure 1 gives a schematic outline of the analyser.

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6.1.2 Combustion chamber, a steel combustion chamber of capacity 0,60 l ± 0,03 l. Annex A gives further details.

6.2 Filter medium, Type I, Class A filter paper (see ASTM E832 [5]) or nominal pore size 3 µm to 5 µm filter media of glass fibre, polytetrafluorethylene (PTFE) or nylon, of a size appropriate to the apparatus being used for sample filtration (see 7.5).

7 Sampling

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

7.2 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 [6].

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 and in a cold (below 10 °C) environment.

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

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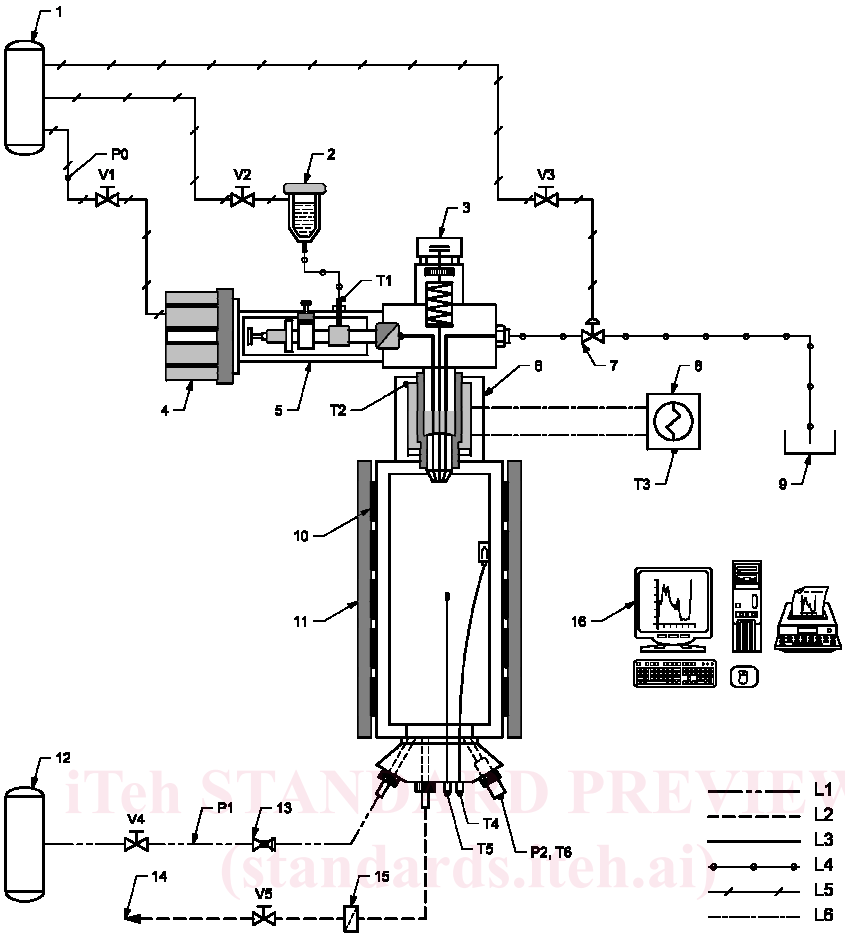

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Key

Digital signals
V1: actuator air valve
V2: sample fuel reservoir valve
V3: sample wave flush valve
V4: change air valve
V5: exhaust valve
E1: control power to chamber heating
N1: injector nozzle motion sensor
P2: injector actuator air pressure switch gauge (manual)

Analogue signals
P0: chamber static pressure sensor
P1: chamber dynamic pressure sensor
T1: chamber charge air temperature
T2: chamber inner wall temperature
T3: chamber pressure sensor temperature
T4: fuel injection pump temperature
T5: injection nozzle cooling jacket temperature
T6: coolant reservoir temperature (manual adjustment)

: charge air line
: exhaust
: fuel supply/flush line
: pneumatic lines
: coolant water
: fuel injector pressure line

Mechanical system

1. pneumatic air supply
2. fuel sample reservoir
3. nozzle motion sensor
4. sample waste flush valve
5. actuator
6. fuel pump
7. nozzle cooling jacket
8. circulator coolant system
9. sample waste drain
10. heat shield
11. charge air supply
12. safety valve
13. exhaust ventilation
14. filter
15. electronic card data acquisition and control
16. computer control
17. electrical heater elements

Figure 1 — Schematic overview of combustion analyser

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7.4 Inspect the sample for wax precipitation. If precipitants are present, bring the test sample to a temperature of at least 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 proceeding.

7.5 Sample may be filtered through a Type I, Class A filter at room temperature and pressure before testing (see ASTM E832 [5]), or through a nominal (3 to 5) µm porosity filter element using a syringe, to prepare a test portion of at least 220 ml. Immediately collect the filtered test portion 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.

8 Apparatus assembly and installation

The apparatus requires placement on a level floor with facilities for the hook-up of all utilities and engineering and technical support. The user shall ensure compliance with all local and national regulations and codes. The apparatus assembly and installation are described in more detail in Annex A and Annex B.

9 Preparation of apparatus

9.1 System start-up and warm-up

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9.1.1 For more details refer to the manufacturer's manual.

9.1.2 Switch on power to the combustion analyzer, the external cooling bath and the computer.

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9.1.3 Warm up the system.

9.1.4 Set the injection actuator air pressure (P2) to 0,75 MPa ± 0,05 MPa.

9.1.5 Set the coolant reservoir temperature (T6) to achieve an injector coolant passage temperature (T5) of 32 °C ± 0,5 °C. T5 is determined and recorded by the computer. A temperature outside the range given during a 25 combustion cycle measurement indicates a possible malfunctioning of the cooling system.

9.2 Standard operating conditions

9.2.1 Set the fuel injection pump temperature (T4) to 35 °C ± 2 °C.

9.2.2 Chamber static pressure (P0): the average of 25 combustion cycles for chamber static pressure is required to be within 2,40 MPa ± 0,02 MPa.

9.2.3 Check the sealing of the combustion chamber by measuring the pressure drop during a charge test in accordance with the manufacturer's manual. Follow the diagnostic procedures given in the manual when the pressure drop is higher than specified.

NOTE A high-pressure drop indicates unsatisfactory sealing of the combustion chamber.

9.2.4 Set the chamber charge air temperature (T1) at 510 °C ± 50 °C.

9.2.5 The chamber inner wall temperature (T2) is initially set by the manufacturer, the surface temperature set-point is monitored and controlled by the computer. Operator adjustment of the controller set-point is required in accordance with the calibration procedure.