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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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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

Produits pétroliers liquides - Détermination du délai d'inflammation et de l'indice de cétane dérivé (ICD) des distillats moyens - Méthode avec période d'injection fixe et chambre de combustion à volume constant

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

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Foreword

This document (EN 16144:2012) 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.

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of an identical text or by endorsement, at the latest by September 2012, and conflicting national standards shall be withdrawn at the latest by September 2012.

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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. 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 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 method 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 (φ), and “% (m/m)” the mass fraction (ω).

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)*

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 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

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 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 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.