

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

EESTI STANDARDI EESSÕNA

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English Version

**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 du délai
d'inflammation et de l'indice de cétane dérivé (ICD)
des distillats moyens par combustion dans une
chambre à volume constant

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

This European Standard was approved by CEN on 13 February 2023.

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COMITÉ EUROPÉEN DE NORMALISATION
EUROPÄISCHES KOMITEE FÜR NORMUNG

CEN-CENELEC Management Centre: Rue de la Science 23, B-1040 Brussels

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European foreword

This document (EN 15195:2023) 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of an identical text or by endorsement, at the latest by September 2023, and conflicting national standards shall be withdrawn at the latest by September 2023.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN shall not be held responsible for identifying any or all such patent rights.

This document supersedes EN 15195:2014.

The main changes compared to the previous edition are listed below:

- the Scope has been extended to paraffinic diesel from synthesis or hydrotreatment, in line with the outcome of the interlaboratory study organized by CEN/TC 19 in 2013 [1];
- based on a review of PT data from EI and NEG correlation schemes, the lower end of the ignition delay range has been expanded up to 2,58 ms (76,8 *DCN*), where it used to be up to 2,8 ms (71 *DCN*);
- the Introduction has been updated with historical information on the method development;
- Annex D on equation outside the method scope range has been removed.

Any feedback and questions on this document should be directed to the users’ national standards body. A complete listing of these bodies can be found on the CEN website.

According to the CEN-CENELEC Internal Regulations, the national standards organisations of the following countries are bound to implement this European Standard: Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Republic of North Macedonia, Romania, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Türkiye and the United Kingdom.

Introduction

This document is derived from joint standardization work in the Energy Institute and ASTM International. It was originally based on IP 498/06 [2] published by the Energy Institute and harmonized with the equivalent ASTM standard test method [3].

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 document.

The basis of this method is the derived cetane number correlation equation as given in Clause 12. The equation that relates ignition delay to derived cetane number, originally developed in 1997 [4], was: $DCN = 83,99(ID-1,512)^{(-0,658)} + 3,547$. This equation was derived from a correlation test programme, comprising ASTM National Exchange Group (NEG) check fuels, heptamethylnonane, cetane and in-house check fuel. In 2005, the equation was re-evaluated by the EI and ASTM through the correlation of cetane number data from the IP and the National Exchange Group (NEG) Diesel Fuel Engine Correlation Schemes and ignition delay data on the same samples from the IP and NEG IQT Correlation Schemes collected over a number of years [5]. In 2006, another ASTM evaluation [6] led to the actual equation, which showed an optimal fit over the range of the scope.

On 13 July 2021 ASTM International granted usage of its national Diesel Exchange group program data which enabled the lower end of the ignition delay scope to be expanded from 2,8 ms to 2,58 ms (from 71 *DCN* up to 76,8 *DCN*). The relevant subcommittee ASTM D02.01 has not endorsed this scope expansion and therefore did not adopt the conclusions for its equivalent standard [3]. Supporting data have been filed at CEN/TC 19 Secretariat.

The on-going validation of the equation as in Formula (1) 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 that review, CEN/TC 19 decides to, if necessary, modify the existing equation/correlation or develop a new one. As part of that 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 document.

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 document covers the ignition delay range from 2,58 ms to 6,34 ms (76,8 *DCN* to 33,9 *DCN*). The combustion analyser can measure shorter or longer ignition delays, but precision is not known.

This document 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-sulfur diesel fuel oils. Furthermore, the method is applicable to paraffinic diesel from synthesis or hydrotreatment, containing up to a volume fraction of 7 % FAME [1]. However, users applying this document 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, analysis of the data available, regarding correlation with EN ISO 5165, is inconclusive. 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 12.

NOTE For the purpose of this document, the expression “% (V/V)” is used to represent the volume fraction and “% (m/m)” the mass fraction.

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

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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)*

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

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

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