SLOVENSKI STANDARD
SIST EN 16906:2017

01-oktober-2017

Tekoči naftni proizvodi - Ugotavljanje kakovosti vžiga dizelskih goriv - Motorna metoda BASF

Liquid petroleum products - Determination of the ignition quality of diesel fuels - BASF engine method

Flüssige Petroleumprodukte - Bestimmung der Zündwilligkeit von Dieselkraftstoffen - BASF-Prüfmotor Methode

Produits pétroliers liquides - Détermination de la qualité d'allumage des combustibles Diesel - Méthode avec le BASF-moteur

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75.160.20	Tekoča goriva	Liquid fuels

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EUROPEAN STANDARD

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English Version

Liquid petroleum products - Determination of the ignition quality of diesel fuels - BASF engine method

Produits pétroliers liquides - Détermination de la qualité d'allumage des combustibles Diesel - Méthode avec le BASF-moteur

Flüssige Mineralölerzeugnisse - Bestimmung der Zündwilligkeit von Dieselkraftstoffen - Verfahren mit BASF-Prüfmotor

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COMITÉ EUROPÉEN DE NORMALISATION
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European foreword

This document (EN 16906:2017) 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of an identical text or by endorsement, at the latest by February 2018, and conflicting national standards shall be withdrawn at the latest by February 2018.

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Introduction

The test method is based on DIN 51773 [1], which has been developed in DIN NA 062-06-43 AA "Engine testing of liquid fuels" and which is being used very successfully since more than 30 years. The described method is an alternative quantitative determination of the cetane number of middle distillate fuels intended for use in compression ignition engines. A correlation study between this method and EN ISO 5165:1998 [2] has been done and the results of this are incorporated in the precision report issued in 2014 [3].

The testing of pure FAME (which is in the scope of EN ISO 5165) has been excluded from the scope for the time being as there seem to be sample specific biases for such product. CEN will initiate appropriate causal studies.

1 Scope

This European Standard specifies a test method for the determination of cetane numbers (“*CN*”) in diesel fuel in the range from *CN* 45 to *CN* 63, using a standard single cylinder, four-stroke cycle, indirect injection engine. The cetane number provides a measure of the ignition characteristics of diesel fuels in compression ignition engines. The cetane number is determined at constant speed in a compression ignition test engine equipped with a swirl chamber.

This European Standard is applicable to distillate as well as paraffinic diesel fuels intended for use in diesel engines, including those containing fatty-acid methyl esters (FAME), ignition-improvers or other additives. The cetane number scale comprises a range from zero to 100, but typical testing is currently performed in the range from about 40 *CN* to about 75 *CN*.

This engine test procedure may be used for other fuels such as synthetics and vegetable oils. However, samples with fuel properties that interfere with the gravity-based pre-supply pressure to the fuel pump e.g. due to high viscosity can only be used to a limited extent. Precision data for such fuels are not available at this stage. Precision data for paraffinic diesel fuels are currently under development.

NOTE 1 For the purpose of this European Standard the expressions “%(m/m)” and “%(V/V)” are used to represent the mass faction and volume fraction respectively of a material.

NOTE 2 The test method is also suitable for determining cetane numbers outside the range of the scope, however, the precision statement only applies for fuels in the specified range.

WARNING — The use of this standard can 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 take appropriate measures to ensure the safety and health of personnel prior to application of the standard, and fulfil statutory and regulatory requirements for this purpose.

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)*

3 Terms and definitions

3.1
ignition quality
property of a fuel which causes a self-ignition under standard operating conditions in a diesel engine

3.2
ignition delay
ID
period of time between the start of fuel injection and the start of combustion expressed in degrees of crank angle rotation

3.3
cetane number
CN
measure of an ignition quality of a diesel fuel obtained by comparing it with reference fuel blends of known cetane numbers and the fuel to be measured in a standardized test engine under controlled conditions

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.

4 Principle

The cetane number of a fuel is determined by comparing its combustion characteristics in a test engine with those for blends of reference fuels of known cetane number under standard operating conditions. This is accomplished by comparing the intake air mass at a given ignition delay. A multiple calibration procedure may also be applied for the comparison of intake air mass.

5 Reagents and materials

5.1 Reference materials

5.1.1 n-hexadecane (n-Cetane), primary reference fuel

This reference material with a minimum purity of 99,0 %(*m*/*m*) shall be used as the designated cetane number of 100. The purity may be determined by a gas chromatography test method.

5.1.2 1-Methylnaphthalene (AMN), primary reference fuel

This reference material with a minimum purity of 95,0 %(*m*/*m*) shall be used as the designated cetane number of zero. The purity may be determined by a gas chromatography test method.

5.1.3 2,2,4,4,6,8,8-Heptamethylnonane (HMN), primary reference fuel

This reference material with a minimum purity of 98,0 %(*m*/*m*) shall be used as the designated 15 cetane number component. The purity shall be determined by a gas chromatography test method.

Primary reference fuel blends are volumetrically proportioned mixtures of these materials, which define the *CN* scale.

NOTE Store and use primary reference fuels in the dark or in amber containers at temperatures of 20 °C or higher to avoid solidification of n-Cetane which has a melting point of 18 °C.

5.2 Reference fuel dispensing equipment

For preparing the required blends of reference fuels calibrated burettes or volumetric ware with a maximum of 500 ml capacity and a maximum volumetric tolerance of ± 0,2 % shall be used. The burettes shall be outfitted with a delivery valve and a delivery tip to accurately control the dispensed volumes. The delivery tip shall be of such size and design that shut-off tip discharge does not exceed 0,5 ml. The rate of delivery from the dispensing system shall not exceed 500 ml/min. The set of burettes or volumetric ware shall be installed in such a manner that all components of each batch or blend are dispensed at the same temperature.

Other blending systems that allow the preparation of volumetrically-defined blends or volumetrically-defined blends by gravimetric measurements based on the density of the individual components are also permitted, provided the system meets the requirement for maximum 0,2 % tolerance limits.

5.3 Check fuels

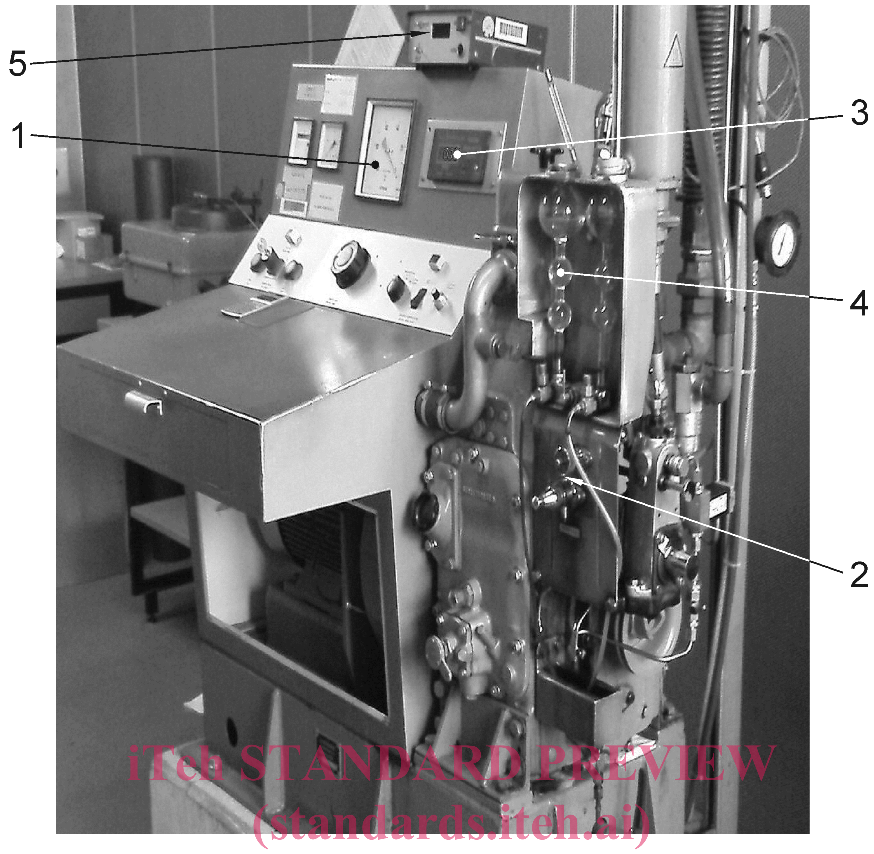
Diesel fuels with known cetane number calibrated by interlaboratory studies with other test engines may be used for checking the engine qualification only. The typical cetane number range of a check fuel is from 50 *CN* to 65 *CN*.

Regular testing of check fuels is highly recommended as the use of standard quality control charting provides a means to evaluate and document the overall performance of the engine and operators. Using quality control charts and regular interpretation of the control charts is strongly advised by accreditation authorities (see [3]).

6 Apparatus

6.1 General

The 4-stroke single cylinder engine developed by BASF SE on the basis of a MWM/KHD model KD12E engine as shown in Figure 1 and comprises a standard crankcase with fuel pump assembly and a cylinder head assembly of the pre-combustion type, a thermal-siphon recirculating jacket coolant system, double fuel tank system with selector valving, injector assembly with specific injector nozzle, electrical controls and a suitable exhaust pipe. The engine shall be connected to a special electric power-absorption motor, which acts as a motor driver to start the engine and as a means to absorb power at constant speed when combustion is occurring.



Key

1 air flow meter

2 control device for start of injection and fuel amount

3 display for start of injection

4 assembly for fuel flow measurement

5 display for ignition delay

Figure 1 — BASF test engine assembly

6.2 Mechanical equipment:

6.2.1 Fuel injection pump and nozzle.

The fuel injection pump including leakage oil stop (BOSCH Type PE 1A M50), nozzle holding assembly (BOSCH KB 42 SDAV) and the injection nozzle BOSCH DLOS 103.

NOTE The [BOSCH Type PE 1A M50, BOSCH KB 42 SDAV, BOSCH DLOS 103] are trade names of a product supplied by BOSCH. This information is given for the convenience of users of this European Standard and does not constitute an endorsement by CEN or CENELEC of the product named. Equivalent products may be used if they can be shown to lead to the same results.

6.2.2 Injection-timing adjustment.

The fuel pump, installed on a panel, is driven by the camshaft and adjusted using an injection timing device.

6.2.3 Fuel flow measurement system.

To keep the fuel flow constant the control rod of the injection pump is equipped with a micro-adjustment. Using two switchable burettes the measurement of the fuel consumption and the injected amount of fuel per pump stroke is adjusted by the fuel injection control to the specified value.

6.2.4 Air flow control device.

For adjustment of the ignition delay under constant values for injection timing and the quantity of fuel injected the intake air is adjusted by the air-supply control lever.

6.2.5 Display for the air-fuel ratio.

The adjusted intake air mass is shown as a dimensionless value by the indicating instrument which consists of a measuring jet and a vacuum gauge.

6.2.6 Surge tank.

In order to absorb any pulsation from the engine or fuel pump and to absorb any vibration to the vacuum indicator a surge tank with a volume of 10 l is installed between the engine and the measuring jet. A throttle orifice at the Venturi tube between the measuring jet and the vacuum indicator further reduce vibrations at the display.

6.3 Electrical equipment:

6.3.1 Electric motor.

A 230 V/400 V AC three-phase motor with a power of 4 kVA at 1000 r/min (RPM) is used to start the engine and keep the revolutions per minute constant during operation of the engine through balanced synchronization. The constant speed is important for measuring the ignition delay in milliseconds but measurement readings are taken by crank angles in degrees (°CA).

6.3.2 Solenoid switch.

A solenoid switch is used to start and shut down the engine by pressing a push button at the control board.

6.3.3 Key switch.

A key operated switch is used to shut down the whole engine system to prevent unauthorized use.

6.3.4 Measuring device.

The measurement of the ignition delay is performed by an electronic metering device. An electric pulse at start of injection (SOI) and start of combustion (SOC) is generated by using two sensors and the conforming time difference between SOI and SOC represents the ignition delay.

A magnetic-induction pulse generator on the injector nozzle turns an electronic switch on and the combustion pressure sensor turns it off. The ignition delay in °CA is given by means of the switch-on current and the base setting of the ignition delay meter.

The measuring device consists of:

— a pickup for the start of injection,

— a pickup for the start of combustion,

— two pickups for calibration located at the flywheel at 12,5 ° crank angle before top dead centre (BTDC) and directly at the top dead centre (TDC), and

— a combustion delay measuring device, containing a differentiation and an amplification stage for the pulse processing, an arrestor to avoid double impulses of the pickups and an indicating device with calibration control unit located at the control panel.

NOTE The engine equipment of BASF AG (see NOTE 6.2.1) on the basis of a MWM/KHD model KD12E engine has been found to be suitable.