

BRITISH STANDARD

**BS EN ISO 5165
: 1998
BS 2000 :
Part 41 : 1998
ISO 5165 :1998**

Methods of test for

Petroleum and its products

**Part 41. Petroleum products - Determination
of the ignition quality of diesel fuels - Cetane
engine method**

(Identical with IP 41/99)

The European Standard EN ISO 5165 : 1998 has the status of a
British Standard

National foreword

This British Standard was published under the authority of the Materials and Chemicals Sector Board and comes into effect on 18th May 1998. It is the English language version of EN ISO 5165 : 1998 *Petroleum products - Determination of the ignition quality of diesel fuels - Cetane engine method*, published by the European Committee for Standardization (CEN), which endorses ISO 5165 : 1998, published by the International Organization for Standardization (ISO).

This British Standard supersedes BS 5580 : 1978, which will be withdrawn.

BS 2000 comprises a series of test methods for petroleum and its products that are published by the Institute of Petroleum (IP) and have been accorded the status of a British Standard. Each method should be read in conjunction with the preliminary pages of 'IP Standard methods for analysis and testing of petroleum and related products and British Standard 2000 Parts' which gives details of the BSI/IP agreement for publication of the series, provides general information on safety precautions, sampling and other matters, and lists the methods published as Parts of BS 2000.

Under the terms of the agreement between BSI and the Institute of Petroleum, BS 2000 : Part 41 / BS EN ISO 5165 will be published by the IP (in 'Standard methods for analysis and testing of petroleum and related products and British Standard 2000 Parts' and as a separate publication). The numbering of the Parts of BS 2000 follows that of the corresponding IP methods. BS 2000 : Part 41 : 1998 is thus identical with IP 41/99.

Compliance with a British Standard does not of itself confer immunity from legal obligations.

© The Institute of Petroleum
& BSI 1998

The following BSI references
relate to the work of this
standard:

Committee reference PTI/13
Draft for public comment no:
96/120192 DC

ICS 75.160.20

Descriptors: see ISO document

English version

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

Produits pétroliers - Détermination de la qualité
d'inflammabilité des carburants pour moteurs diesel -
Méthode cétane (ISO 5165:1998)

This European Standard was approved by CEN on 19 February 1998.

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. Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the Central Secretariat or to any CEN member.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CEN member into its own language and notified to the Central Secretariat has the same status as the official versions.

CEN members are the national standards bodies of Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and United Kingdom.



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

Central Secretariat: rue de Stassart, 36 B-1050 Brussels

Foreword

The text of the International Standard ISO 5165:1998 has been prepared by Technical Committee ISO/TC 28 "Petroleum products and lubricants" in collaboration with Technical Committee CEN/TC 19 "Petroleum products, lubricants and related products", the secretariat of which is held by NNI.

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 1998, and conflicting national standards shall be withdrawn at the latest by September 1998.

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and the United Kingdom.

Endorsement notice

The text of the International Standard ISO 5165:1998 was approved by CEN as a European Standard without any modification.

Petroleum products — Determination of the ignition quality of diesel fuels — Cetane engine method

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

1 Scope

This International Standard establishes the rating of diesel fuel oil in terms of an arbitrary scale of cetane numbers using a standard single cylinder, four-stroke cycle, variable compression ratio, indirect injected diesel engine. The cetane number provides a measure of the ignition characteristics of diesel fuel oil in compression ignition engines. The cetane number is determined at constant speed in a pre-combustion chamber-type compression ignition test engine. However, the relationship of test engine performance to full scale, variable speed, variable load engines is not completely understood.

This International Standard is applicable for the entire scale range from zero cetane number (CN) to 100 CN but typical testing is in the range of 30 CN to 65 CN.

This test may be used for unconventional fuels such as synthetics, vegetable oils, etc. However, the relationship to the performance of such materials in full scale engines is not completely understood.

Samples with fluid properties that interfere with the gravity flow of fuel to the fuel pump or delivery through the injector nozzle are not suitable for rating by this method.

NOTE 1 This International Standard specifies operating conditions in SI units but engine measurements are specified in inch-pound units because these are the units used in the manufacture of the equipment, and thus some references in this International Standard include these units in parenthesis.

NOTE 2 For the purposes of this International Standard, the expression “% (V/V)” is used to represent the volume fraction of a material.

2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this International Standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

ISO 3015:1992, *Petroleum products – Determination of cloud point.*

ISO 3170:1988, *Petroleum liquids – Manual sampling.*

ISO 3171:1988, *Petroleum liquids – Automatic pipeline sampling.*

ISO 3696:1987, *Water for analytical laboratory use – Specification and test methods.*

ISO 4787:1984, *Laboratory glassware – Volumetric glassware – Methods for use and testing of capacity.*

ASTM D 613-95, *Standard test method for cetane number of diesel fuel oils*.

ASTM E 832-81, *Specification for laboratory filter papers*.

3 Principle

The cetane number of a diesel fuel oil 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 using the bracketing handwheel procedure which varies the compression ratio (handwheel reading) for the sample and each of two bracketing reference fuels to obtain a specific ignition delay permitting interpolation of CN in terms of handwheel reading.

4 Definitions

For the purposes of this International Standard, the following definitions apply.

4.1

cetane number

Measure of the ignition performance of a diesel fuel oil obtained by comparing it to reference fuels in a standardized engine test. Ignition performance is understood to mean the ignition delay of the fuel as determined when the standard test engine is operated under controlled conditions of fuel flow rate, injection timing and compression ratio.

4.2

compression ratio

The ratio of the volume of the combustion chamber including the pre-combustion chamber with the piston at bottom dead center (b.d.c.) to the comparable volume with the piston at top dead center (t.d.c.)

4.3

ignition delay

Period of time between the start of fuel injection and the start of combustion. It is expressed in degrees of crank angle rotation.

4.4

injection timing; injection advance

Time in the combustion cycle at which fuel injection into the combustion chamber is initiated. It is expressed in degrees of crank angle.

4.5

handwheel reading

Arbitrary numerical value, related to compression ratio, obtained from a micrometer scale that indicates the position of the variable compression plug in the pre-combustion chamber of the engine.

4.6

cetane meter; ignition delay meter

An electronic instrument which displays injection advance and ignition delay derived from input pulses of multiple transducers (pickups).

4.7

injector opening pressure

Fuel pressure that overcomes the resistance of the spring which normally holds the injector nozzle pintle closed, and thus forces the pintle to lift and release an injection spray from the nozzle.

4.8

reference pickup

Transducer(s) mounted over the flywheel of the engine, triggered by a flywheel pointer, used to establish a t.d.c. reference and a time base for calibration of the ignition delay meter.

4.9**injector pickup**

Transducer to detect motion of the injector pintle, thereby indicating the beginning of injection.

4.10**combustion pickup**

Pressure transducer exposed to cylinder pressure to indicate the start of combustion.

4.11**primary reference fuels**

Hexadecane (cetane), heptamethylnonane (HMN) and volumetrically proportioned mixtures of these materials which now define the CN scale by the relationship given in the following equation:

$$\text{CN} = \% \text{ cetane} + 0,15 (\% \text{ HMN}) \quad \dots (1)$$

NOTE 3 The arbitrary CN scale was originally defined as the volume percent of cetane in a blend with 1-methylnaphthalene (AMN) where cetane had an assigned value of 100 and AMN an assigned value of zero. A change from 1-methylnaphthalene to heptamethylnonane as the low CN ingredient was made in 1962 to utilize a material of better stability and availability. Heptamethylnonane was determined to have a CN of 15 based on engine calibration by the ASTM Diesel National Exchange Group, using blends of cetane and AMN as primary reference fuels. The use of 1-methylnaphthalene as a primary reference fuel is allowed.

4.12**secondary reference fuels**

Volumetrically proportioned blends of two selected hydrocarbon mixtures designated "T fuel" (high CN) and "U fuel" (low CN) where each numbered paired set of "T fuel" and "U fuel" is calibrated by the ASTM Diesel National Exchange Group in various combinations by comparison to primary reference fuel blends.

4.13**check fuels**

Diesel fuel oils calibrated by the ASTM Diesel National Exchange Group which provide a guide for an individual laboratory to check the cetane rating performance of a specific engine unit.

5 Reagents and reference materials

5.1 Cylinder jacket coolant, water conforming to grade 3 of ISO 3696. Water shall be used in the cylinder jacket for laboratory locations where the resultant boiling temperature is $100\text{ }^{\circ}\text{C} \pm 2\text{ }^{\circ}\text{C}$. Water with commercial glycol-based antifreeze added in sufficient quantity to meet the boiling temperature requirement shall be used when the laboratory altitude dictates. A commercial multi-functional water-treatment material should be used in the coolant to minimize corrosion and mineral scale that can alter heat transfer and rating results.

5.2 Engine crankcase lubricating oil. An SAE 30 viscosity grade oil meeting service classification SF/CD or SG/CE shall be used. It shall contain a detergent additive and have a kinematic viscosity of $9,3\text{ mm}^2/\text{s}$ to $12,5\text{ mm}^2/\text{s}$ at $100\text{ }^{\circ}\text{C}$ and a viscosity index of not less than 85. Oils containing viscosity index improvers shall not be used. Multigraded lubricating oils shall not be used.

5.3 Cetane primary reference fuel, hexadecane with a minimum purity of 99,0 %, as determined by chromatographic analysis, shall be used as the designated 100 cetane number component.

5.4 Heptamethylnonane primary reference fuel, 2,2,4,4,6,8,8-heptamethylnonane with a minimum purity of 98 % as determined by chromatographic analysis shall be used as the designated 15 cetane number component.

5.5 Secondary reference fuels, volumetric blends of two diesel fuels having widely different cetane numbers that have been round-robin engine calibrated by a recognized exchange testing group.

NOTE 4 Blends of "T fuel" and "U fuel" that have been engine calibrated by the ASTM Diesel National Exchange Group may be and typically are used for routine testing. The calibration data are incorporated in blend tables that list the cetane numbers assigned for various volume percentage blends of "T fuel" and "U fuel". "T fuel" typically is in the range of 73 CN to 75 CN and "U fuel" typically is in the range of 20 CN to 22 CN. These fuels are available from Phillips 66 Company, Bartlesville, OK, USA and are examples of suitable products available commercially. This information is given for the convenience of users of this International Standard and does not constitute an endorsement by ISO of these products.