INTERNATIONAL STANDARD

ISO 4264

Second edition
2007-08-15

Petroleum products — Calculation of cetane index of middle-distillate fuels by the four-variable equation

Produits pétroliers — Calcul de l'indice de cétane des distillats moyens par équation à quatre variables

Reference number
ISO 4264:2007(E)

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Published in Switzerland

Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

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

ISO 4264 was prepared by Technical Committee ISO/TC 28, *Petroleum products and lubricants*.

This second edition cancels and replaces the first edition (ISO 4264:1995), of which it constitutes a minor revision with the changes to Figures 1, 2 and 3 and the updating of the normative references in Clause 2.

Petroleum products — Calculation of cetane index of middle-distillate fuels by the four-variable equation

WARNING — The use of this International Standard may involve hazardous materials, operations and equipment. This International Standard does not purport to address all 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 describes a procedure for the calculation of the cetane index of middle-distillate fuels from petroleum-derived sources. The calculated value is termed the “cetane index by four-variable equation”. Throughout the remaining text of this International Standard, the term “cetane index” implies cetane index by four-variable equation.

This International Standard is not applicable to fuels containing additives for raising the cetane number, nor to pure hydrocarbons, nor to distillate fuels derived from coal. It is applicable to fuels containing non-petroleum derivatives from tar sand and oil shale.

NOTE 1 This International Standard was originally developed using a matrix of fuels, some of which contain non-petroleum derivates from tar sands and oil shale. Other cetane index equations have since been developed which can be more applicable to tar sands products.

NOTE 2 The cetane index is not an alternative way to express the cetane number; it is a supplementary tool, to be used with due regard for its limitations.

NOTE 3 The cetane index is used to estimate the cetane number of diesel fuel when a test engine is not available to determine this property directly, or when insufficient sample is available for an engine rating. In cases where the cetane number of a fuel has been previously established, the cetane index can be used to verify the cetane number of subsequent samples of that fuel, provided the fuel's source and mode of manufacture remain unchanged.

The recommended range of fuel properties for application of this International Standard is as follows:

Fuel property	**Recommended range**
Cetane number	32,5 – 56,5
Density at 15 °C, kg/m^3	805,0 – 895,0
10 % (*V*/*V*) distillation recovery temperature, °C	171 – 259
50 % (*V*/*V*) distillation recovery temperature, °C	212 – 308
90 % (*V*/*V*) distillation recovery temperature, °C	251 – 363

Within the recommended range of cetane number (32,5 to 56,5), the expected error of the prediction via the cetane index equation will be less than ± 2 cetane numbers for 65 % of the distillate fuels examined. Errors may be greater for fuels whose properties fall outside the recommended range of application.

2 Normative references

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.

ISO 91-1:1992, *Petroleum measurement tables — Part 1: Tables based on reference temperatures of 15 °C and 60 °F*

ISO 3405:2000, *Petroleum products — Determination of distillation characteristics at atmospheric pressure*

ISO 3675:1998, *Crude petroleum and liquid petroleum products — Laboratory determination of density — Hydrometer method*

ISO 12185:1996, *Crude petroleum and petroleum products — Determination of density — Oscillating U-tube method*

3 Principle

The density at 15 °C and the temperatures at which 10 % (*V/V*), 50 % (*V/V*) and 90 % (*V/V*) are recovered (distillation recovery temperatures) are determined by standard test methods and the cetane index is calculated from these test data using known correlations.

4 Procedure

4.1 Determine the density at 15 °C of the sample, to the nearest 0,1 kg/m^3, by the procedure described in ISO 3675 or ISO 12185, using the corrections given in ISO 91-1 if appropriate.

4.2 Determine the temperatures, to the nearest 1 °C, at which 10 % (*V/V*), 50 % (*V/V*) and 90 % (*V/V*) of the sample is recovered during distillation, corrected to standard barometric pressure, by the procedure described in ISO 3405.

5 Calculation

5.1 Calculate the cetane index by one of the procedures given in 5.1.1 and 5.1.2.

5.1.1 Insert the measured values (see 4.1 and 4.2) in Equation (1) below and calculate the cetane index, CI.

$$CI = 45{,}2 + 0{,}089\,2T_{10N} + \left(0{,}131 + 0{,}901B\right)T_{50N} + \left(0{,}052\,3 - 0{,}42B\right)T_{90N} + \ldots$$
$$\ldots + 0{,}000\,49\left(T_{10N}^2 - T_{90N}^2\right) + 107B + 60B^2 \qquad (1)$$

where

$T_{10N} = T_{10} - 215$;

$T_{50N} = T_{50} - 260$;

$T_{90N} = T_{90} - 310$;

T_{10} is the 10 % (*V/V*) distillation recovery temperature, in degrees Celsius;

T_{50} is the 50 % (*V/V*) distillation recovery temperature, in degrees Celsius;

T_{90} is the 90 % (V/V) distillation recovery temperature, in degrees Celsius;

$B = [\exp(-0{,}003\,5 D_N)] - 1$;

$D_N = D - 850$;

D is the density at 15 °C, in kilograms per cubic metre.

5.1.2 Use the nomographs in Figures 1, 2 and 3 to derive the cetane index as follows:

a) insert the density and 50 % (V/V) distillation recovery temperature values in Figure 1 to estimate the fuel cetane index;

b) insert the density and 90 % (V/V) distillation recovery temperature values in Figure 2 to determine a correction factor for deviations in these parameters from average values;

c) insert the 10 % (V/V) and 90 % (V/V) distillation recovery temperature values in Figure 3 to determine a second correction factor for deviations in these parameters from average values;

d) sum the correction factors from Figures 2 and 3 with the estimated cetane index from Figure 1 to give the final cetane index.

5.2 The method of using the nomography is indicated by the example shown below for a fuel of cetane number 46,8.

5.2.1 Measured fuel properties

Density at 15 °C, kg/m^3	860,0
10 % (V/V) distillation recovery temperature, °C	220
50 % (V/V) distillation recovery temperature, °C	290
90 % (V/V) distillation recovery temperature, °C	340

5.2.2 Cetane index

Estimation from Figure 1		44,1
Correction from Figure 2		+ 0,4
Correction from Figure 3		+ 1,5
	$CI =$	46,0

6 Expression of results

Report the result to the nearest 0,1 as the cetane index by four-variable equation.

7 Precision

7.1 The calculation of the cetane index from measured density at 15 °C and measured 10 % (V/V), 50 % (V/V) and 90 % (V/V) distillation recovery temperatures is exact.

7.2 The precision of the cetane index equation is dependent on the precision of the original density and distillation recovery temperature determinations which enter into the calculation. The precision of these determinations is stated in ISO 3675, ISO 12185 and ISO 3405.

8 Test report

The test report shall contain at least the following information:

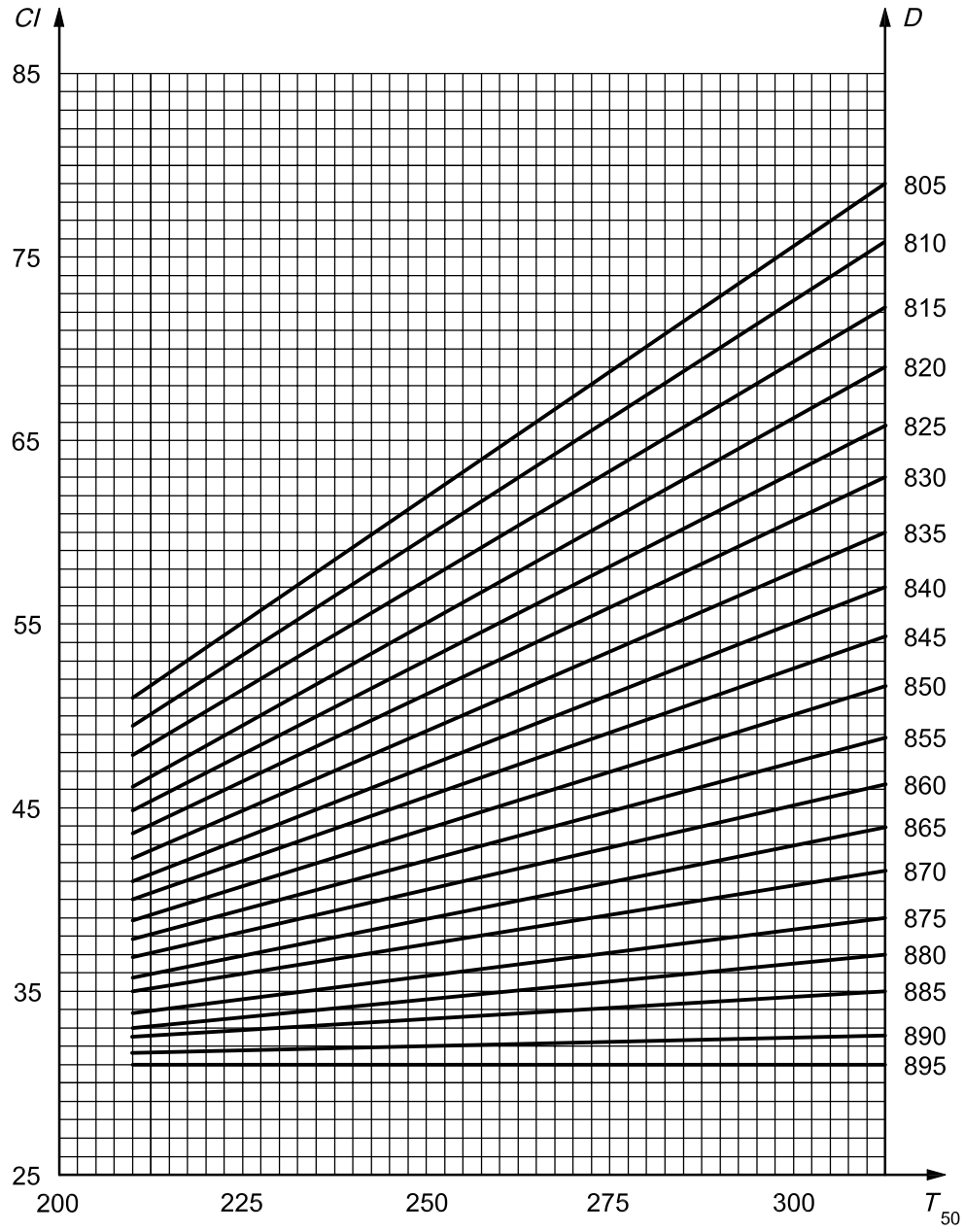
a) a reference of this International Standard;

b) the type and identification of the product tested;

c) the result of the test (see Clause 6);

d) any deviation, by agreement or otherwise, from the procedure specified;

e) the date of the test.



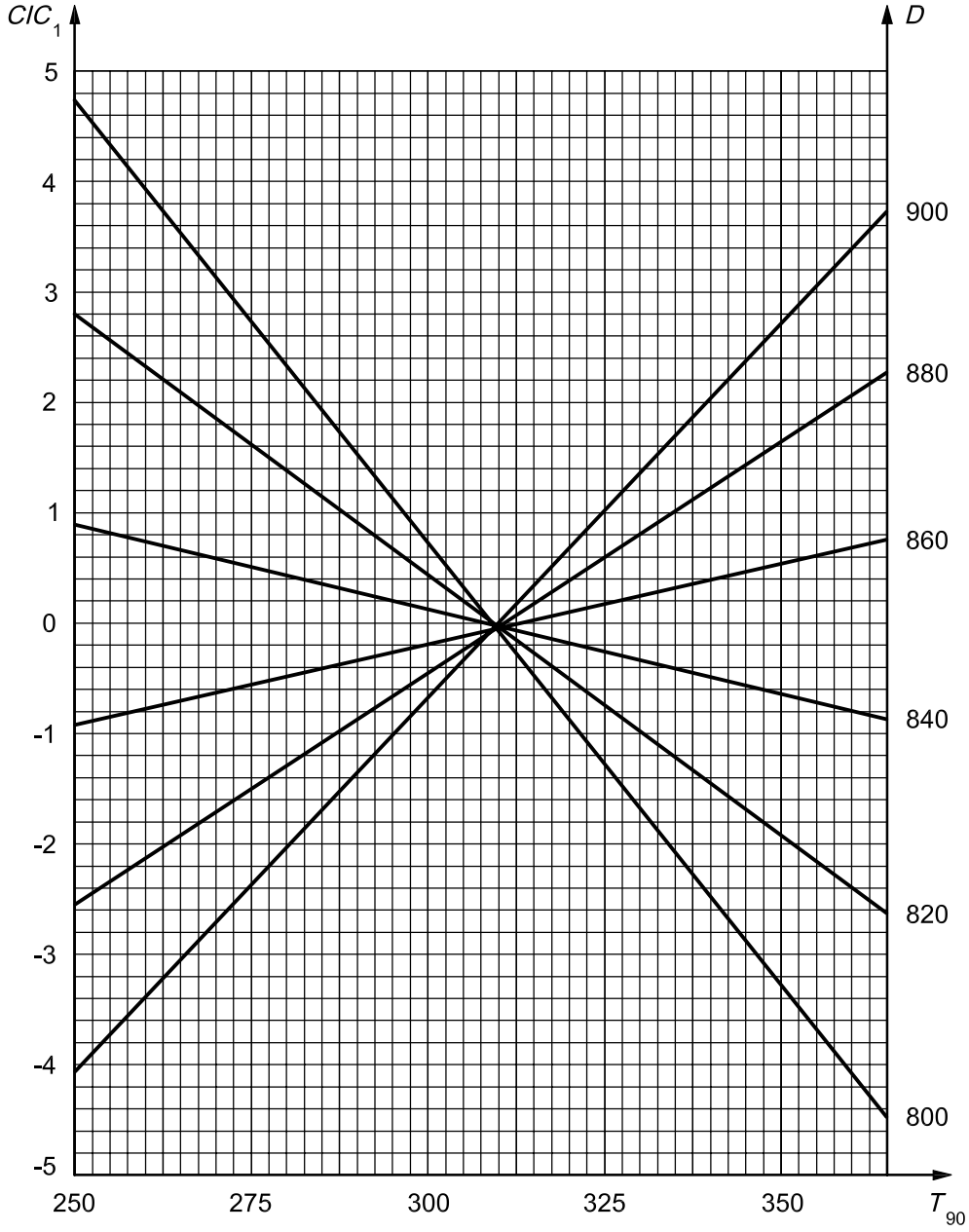
Key

CI cetane index

T_{50} 50 % distillation recovery temperature, °C

D density at 15 °C, kg/m^3

Figure 1 — Cetane index — Estimate based on density and 50 % distillation recovery temperature



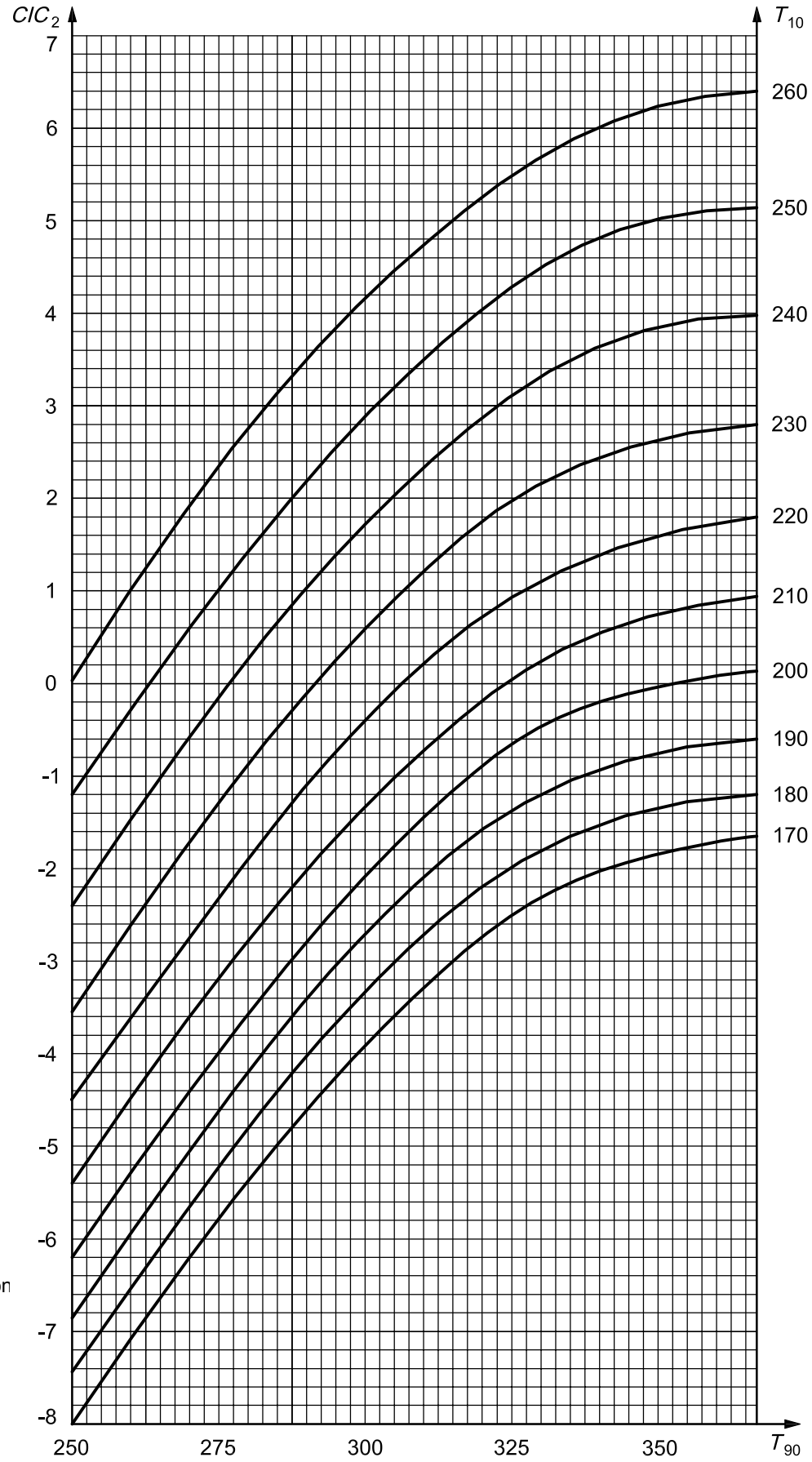
Key

CIC_1 cetane index correction

T_{90} 90 % distillation recovery temperature, °C

D density at 15 °C, kg/m^3

Figure 2 — Cetane index correction for deviations from average values in density and 90 % distillation recovery temperature



Key

CIC_2	cetane index correction
T_{90}	90 % distillation recovery temperature, °C
T_{10}	10 % distillation recovery temperature, °C

Figure 3 — Cetane index correction for deviations from average values in 10 % and 90 % distillation recovery temperatures

ICS 75.160.20

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