BRITISH STANDARD MARINE SERIES

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Specification for

Petroleum fuels for marine oil engines and boilers

ICS 75.160.20

Committees responsible for this British Standard

The preparation of this British Standard was entrusted to Technical Committee PTI/2, Liquid fuels, upon which the following bodies were represented:

Association of United Kingdom Oil Independents
Automobile Association
British Railways Board
Chemical Industries Association
Confederation of Passenger Transport UK
Consumer Policy Committee of BSI
Department of Transport
Federation of British Historic Vehicle Clubs
Federation of Petroleum Suppliers
Freight Transport Association
Institute of Petroleum
Institute of Road Transport Engineers
Institute of Trading Standards Administration
Ministry of Defence
Motor Cycle Industry Association Ltd.
National Farmers' Union
Petrol Pump Manufacturers' Association
Petrol Retailers Association
Retail Motor Industry Federation
Road Haulage Association Ltd.
Royal Automobile Club
Society of Motor Manufacturers and Traders Limited
United Kingdom Petroleum Industry Association Ltd.
World Wide Fund for Nature

The following bodies were also represented in the drafting of the standard, through subcommittees and panels:

British Marine Equipment Council
Chamber of Shipping
Lloyd's Register of Shipping
Nautical Institute

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National foreword

This British Standard has been prepared by Technical Committee PTI/2. It is identical with ISO 8217:1996 *Petroleum products — Fuels (class F) — Specifications of marine fuels* published by the International Organization for Standardization (ISO). ISO 8217 was prepared by Technical Committee ISO/TC 28, Petroleum products and lubricants, Subcommittee SC 4, Classification and specifications, in which the UK played an active part.

This British Standard supersedes BS MA 100:1989.

This British Standard takes account of the legal requirements laid down by the Department of Trade and Industry in accordance with the Merchant Shipping Act to date. It is recognized that products purchased with the stipulation that they are in accordance with this British Standard may be used in vessels within the jurisdiction of other authorities; users should however assure themselves that fuels specified within this British Standard are suitable for such applications.

This British Standard takes account of the changing pattern of petroleum sources and international refining technology, but it does not imply the availability of all classes of fuels at all ports.

It is recognized that there are some applications where, for technical or other reasons, either limits different from those given in this British Standard or additional requirements may be necessary. This British Standard does not cater for such special cases which are matters for arrangement between the purchaser and supplier.

If fuels complying with the requirements of a non-marine standard are available, e.g. certain classes of distillate fuels complying with BS 2869 *Fuel oils for non-marine use,* care should be taken that these fuels comply with the legal requirements for marine fuels and have properties acceptable to the purchaser.

The principal differences between this edition and BS MA 100:1989 are as follows.

a) Additional requirements for the determination of aluminium and silicon for DMC category and all categories of residual fuel are given.

b) An additional requirement for the determination of total existent sediment for DMC category is given.

c) An additional requirement for total potential sediment for all categories of residual fuel is given.

d) RML 35 category has been deleted.

e) Category RMK 55 has been added, and a requirement for the determination of densities for the three RMK categories has been added.

f) The method for the determination of carbon residue has changed.

g) An informatory annex giving a procedure for assessing ignition quality is included.

h) An alternative method for measuring density has been given.

i) A recommendation excluding added substances or chemical waste which adversely affects performance, is harmful to personnel, or contributes to additional air pollution has been included.

Cross-references

International standard	Corresponding British Standard
ISO 91-1:1992	BS 6441:1993 *Schedule for petroleum measurement tables* (Identical)
ISO 2719:1988	BS EN 22719:1994 *Methods of test for petroleum and its products. Petroleum products and lubricants. Determination of flash point. Pensky-Martens closed cup method* (Identical)
ISO 3015:1992	BS EN 23015:1994 *Petroleum products. Determination of cloud point* (Identical) BS 2000 *Methods of test for petroleum and its products*
ISO 3016:1994	Part 15:1995 *Petroleum products. Determination of pour point* (Identical)
ISO 3104:1994	Part 71 *Kinetic viscosity* Section 71.1:1995 *Petroleum products. Transparent and opaque liquids. Determination of kinematic viscosity and calculation of dynamic viscosity* (Identical) BS 3195 *Methods for sampling petroleum products*
ISO 3170:1988	Part 1:1989 *Manual sampling of liquid hydrocarbons* (Identical)
ISO 3171:1988	Part 2:1989 *Automatic pipeline sampling of liquid hydrocarbons* (Identical)
ISO 3675:1993	BS EN ISO 3675:1995 *Crude petroleum and liquid petroleum products. Laboratory determination of density or relative density. Hydrometer method* (Identical)
ISO 3735:1975	BS 4382:1980 *Method for determination of sediment in crude petroleum and fuel oils (extraction method)* (Identical)
ISO 4259:1992	BS EN ISO 4259:1996 *Petroleum products. Determination and applications of precision data in relation to methods of test* (Identical)
ISO 6245:1993	BS EN ISO 6245:1996 *Petroleum products. Determination of ash* (Identical)
ISO 8216-1:1996	BS 6843 *Classification of petroleum fuels* Part 1:1996 *Marine fuels* (Identical)

International standard	Corresponding British Standard
ISO 8754:1994	BS EN ISO 8754:1995 *Methods of test for petroleum and its products. Petroleum products. Determination of sulfur content. Energy-dispersive X-ray flourescence method.* (Identical) BS 2000 *Methods of test for petroleum and its products*
ISO 10307-1:1993	Part 375:1994 *Petroleum products. Total sediment in residual fuel oils. Determination of hot filtration* (Identical)
ISO 10307-2:1993	Part 390:1994 *Petroleum products. Total sediment in residual fuel oils. Determination using standard procedures for ageing* (Identical)
ISO 10370:1993	BS EN ISO 10370:1996 *Petroleum products. Determination of carbon residue. Micro method* (Identical) BS 2000 *Methods of test for petroleum and its products*
ISO 10478:1994	Part 377:1995 *Petroleum products. Determination of aluminium and silicon in fuel oils. Inductively coupled plasma emission and atomic absorption spectroscopy methods* (Identical)

The Technical Committee has reviewed the provisions of ISO 3733[1)], ISO 4261:1993, ISO 4264:1995, ISO 5165:1992, ISO 12185[1)], and ISO 14597[1)] to which normative reference is made in the text, and has decided that they are acceptable for use in conjunction with this standard.

A British Standard does not purport to include all the necessary provisions of a contract. Users of British Standards are responsible for their correct application.

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

Summary of pages

This document comprises a front cover, an inside front cover, pages i to iv, pages 1 to 12, an inside back cover and a back cover.

This standard has been updated (see copyright date) and may have had amendments incorporated. This will be indicated in the amendment table on the inside front cover.

[1)] In preparation.

Introduction

The specifications in this International Standard were prepared in cooperation with the marine and petroleum industries to meet the requirements for marine fuels supplied on a worldwide basis for consumption on board ships. Crude oil supplies, refining methods, ships' machinery and local conditions vary considerably. These factors have led historically to a large number of categories of residual fuel being available internationally, even though locally or nationally there may be relatively few categories. Several of the residual fuels are unique in origin to one country or area, but are nevertheless included in the specification because of their importance in the international marine fuel market.

This is the second edition of this International Standard. It reflects several important changes, particularly in the aspects of methodology. The number of categories remains the same, the one deletion being counter-balanced by one addition. This International Standard will be kept continuously under review.

At the time this International Standard was published, the International Maritime Organization was developing requirements to control air pollution from ships. Such requirements may be introduced during the lifetime of this International Standard. The requirements may contain prescriptions that are additional to, or more stringent than, those specified in this International Standard. It is the responsibility of the user to establish the existence and applicability of any such requirements.

WARNING — The handling and use of fuels as specified in this International Standard may be hazardous, if suitable precautions are not observed. 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 standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.

1 Scope

This International Standard specifies the requirements for petroleum fuels for use in marine diesel engines and boilers, for the guidance of interested parties such as marine equipment designers, and for suppliers and purchasers of marine fuels.

NOTE 1 For the purposes of this International Standard, the term "petroleum" is used to include oil from tar sands and from shale.

NOTE 2 Requirements for gas turbine fuels used in marine applications are given in ISO 4261.

This International Standard sets out the required properties of the fuels at the time and place of custody transfer.

This International Standard describes four categories of distillate fuel, one of which is for diesel engines for emergency purposes. It also describes fifteen categories of fuel containing residual components, two of which are specified without a density limit.

This International Standard takes into account the international requirements for flash point as given by the International Maritime Organization (see reference [1] in annex F).

Information on limitations of flash point, when applied to residual fuel oil grades as specified in Table 2, is given in annex E.

The categories of fuel have been classified in this International Standard in accordance with ISO 8216-1.

This International Standard does not imply the availability of all the categories of fuel at all ports.

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

ISO 2719:1988, *Petroleum products and lubricants — Determination of flash point — Pensky-Martens closed cup method.*

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

ISO 3016:1994, *Petroleum products — Determination of pour point.*

ISO 3104:1994, *Petroleum products — Transparent and opaque liquids — Determination of kinematic viscosity and calculation of dynamic viscosity.*

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

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

ISO 3675:1993, *Crude petroleum and liquid petroleum products — Laboratory determination of density or relative density — Hydrometer method.*

ISO 3733:—[2], *Petroleum products and bituminous materials — Determination of water — Distillation method.*

ISO 3735:1975, *Crude petroleum and fuel oils — Determination of sediment — Extraction method.*

ISO 4259:1992, *Petroleum products — Determination and application of precision data in relation to methods of test.*

ISO 4261:1993, *Petroleum products — Fuels (class F) — Specifications of gas turbine fuels for industrial and marine applications.*

ISO 4264:1995, *Petroleum products — Calculation of cetane index of middle-distillate fuels by the four-variable equation.*

ISO 5165:1992, *Diesel fuels — Determination of ignition quality — Cetane method.*

ISO 6245:1993, *Petroleum products — Determination of ash.*

ISO 8216-1:1996, *Petroleum products — Fuels (class F) — Classification — Part 1: Categories of marine fuels.*

ISO 8754:1992, *Petroleum products — Determination of sulfur content — Energy-dispersive X-ray fluorescence method.*

ISO 10307-1:1993, *Petroleum products — Total sediment in residual fuel oils — Part 1: Determination by hot filtration.*

ISO 10307-2:1993, *Petroleum products — Total sediment in residual fuel oils — Part 2: Determination using standard procedures for ageing.*

ISO 10370:1993, *Petroleum products — Determination of carbon residue — Micro method.*

ISO 10478:1994, *Petroleum products — Determination of aluminium and silicon in fuel oils — Inductively coupled plasma emission and atomic absorption spectroscopy methods.*

ISO 12185:—[3], *Crude petroleum and petroleum products — Determination of density — Oscillating U-tube method.*

ISO 14597:—[3], *Petroleum products — Determination of vanadium and nickel in liquid fuels — Wavelength-dispersive X-ray fluorescence method.*

3 Sampling

The sampling of petroleum fuels for analysis, for the purposes of this International Standard, shall be carried out in accordance with the procedures given in ISO 3170, ISO 3171 or an equivalent national standard.

4 General requirements

4.1 The fuels shall be blends of hydrocarbons derived from petroleum refining. This shall not preclude the incorporation of small amounts of additives intended to improve some aspects of performance. The fuels shall be free from inorganic acid.

NOTE 3 The fuel should not include any added substance or chemical waste which

— jeopardizes the safety of ships or adversely affects the performance of the machinery; or

— is harmful to personnel; or

— contributes overall to additional air pollution.

4.2 The properties of the fuels shall not exceed the maximum values nor be less than the minimum values specified in Table 1 and Table 2, when tested by the methods referred to therein.

4.3 The presence of abrasive catalyst fines is controlled by measurement of content of aluminium plus silicon; further information on catalyst fines is given in annex D.

5 Determination of other properties

5.1 Equations for calculating the gross and net specific energies of fuels are given in annex A, if required.

5.2 It has not been possible to reach agreement on a direct method of handling ignition quality in a way that would enable this parameter to be included in the mandatory part of this International Standard. It is nevertheless recognized that a measure of ignition quality control already exists via density and viscosity within the mandatory standard. For engines and/or applications where ignition quality is known to be particularly critical, annex B provides a basis for suppliers and purchasers of marine bunker fuels to agree on acceptable ignition quality characteristics.

5.3 Approximate conversions of viscosity measurements to temperatures different to 100 °C are given in annex C.

[2] To be published. (Revision of ISO 3733:1976)

[3] To be published.

6 Test methods

6.1 General

The requirements in Table 1 and Table 2 shall be determined by use of the latest edition of the test methods cited therein.

6.2 Appearance

Visually inspect the sample in good light, free from glare and shadow, at a temperature between 10 °C and 25 °C. It shall appear clear and bright.

6.3 Density

When density is determined in accordance with ISO 3675, the hydrometer readings obtained at ambient temperature on distillate fuels, and at elevated temperatures of between 50 °C and 60 °C on fuels containing residual components, shall be converted to results at 15 °C using Table 53B of ISO 91-1. When density is determined in accordance with ISO 12185, an appropriate correction for glass expansion coefficient shall be applied to readings obtained by digital density analyser at any temperature other than 15 °C, before conversion and application of Table 53B of ISO 91-1.

6.4 Flash point

The flash point for all categories is determined in accordance with ISO 2719.

NOTE 4 For category DMX, alternative closed-cup methods may be agreed between supplier and user.

6.5 Cloud point

The cloud point is applicable only to category DMX and shall be determined in accordance with ISO 3015.

6.6 Sulfur content

The reference test for compliance with this International Standard is given in ISO 8754. In some geographical areas, other methods may be specified by national authorities for environmental control.

NOTE 5 In the event of a dispute between supplier and receiver concerning sulfur content, both parties should agree, prior to testing, upon a common sulfur calibration standard, certified by a responsible standards organization.

6.7 Cetane number

The cetane numbers of categories DMX, DMA, and DMB shall be determined in accordance with ISO 5165.

NOTE 6 If an engine is not available to carry out this determination, ISO 4264 may be used for determination by calculation, with the same limiting values.

6.8 Aluminium and silicon

These elements shall be determined in accordance with ISO 10478, using either atomic absorption spectroscopy or inductively coupled plasma emission spectroscopy. The sum of the two elements shall be reported.

6.9 Total sediment potential

The method given in ISO 10307-2 for determination of potential sediment (Procedure A) shall be the reference method.

NOTE 7 The method for determination of accelerated sediment (Procedure B) in the same International Standard may be used for quality control purposes.

7 Precision and interpretation of test results

7.1 General

The test methods specified in clause **6** all contain a statement of precision (repeatability and reproducibility). Attention is drawn to ISO 4259:1992, clauses **9** and **10**, which cover the use of precision data in the interpretation of test results, and this method shall be used in cases of dispute.

7.2 Cloud point results

For cloud point, the testing margin described in ISO 4259:1992, **8.2** shall not apply. If a single test result is above – 16 °C, the procedure specified in ISO 4259:1992, clause **9** shall apply.

Table 1 — Requirements for marine distillate fuels

Characteristic	Limit	Category ISO-F-				Test method reference
		DMX	DMA	DMB	DMC	
Appearance		Visual		—	—	See **6.2**
Density at 15 °C, kg/m^3	max.	[a]	890,0	900,0	920,0	ISO 3675 or ISO 12185 (see also **6.3**)
Viscosity at 40 °C, mm^2/s[b]	min. max.	1,40 5,50	1,50 6,00	— 11,0	— 14,0	ISO 3104 ISO 3104
Flash point, °C	min.	43	60	60	60	ISO 2719 (see also **6.4**)
Pour point (upper), °C[c]						
— winter quality	max.	—	– 6	0	0	ISO 3016
— summer quality	max.	—	0	6	6	ISO 3016
Cloud point, °C	max.	– 16[d]	—	—	—	ISO 3015 (see also **6.5**)
Sulfur, % (*m*/*m*)	max.	1,0	1,5	2,0	2,0	ISO 8754 (see also **6.6**)
Cetane number	min.	45	40	35	—	ISO 5165 (see also **6.7**)
Carbon residue [micro method, 10 % (*V*/*V*) distillation bottoms], % (*m*/*m*)	max.	0,30	0,30	—	—	ISO 10370
Carbon residue (micro method), % (*m*/*m*)	max.	—	—	0,30	2,50	ISO 10370
Ash, % (*m*/*m*)	max.	0,01	0,01	0,01	0,05	ISO 6245
Sediment, % (*m*/*m*)	max.	—	—	0,07	—	ISO 3735
Total existent sediment, % (*m*/*m*)	max.	—	—	—	0,10	ISO 10307-1
Water, % (*V*/*V*)	max.	—	—	0,3	0,3	ISO 3733
Vanadium, mg/kg	max.	—	—	—	100	ISO 14597
Aluminium plus silicon, mg/kg	max.	—	—	—	25	ISO 10478 (see also **6.8**)

[a] In some geographical areas, there may be a maximum limit.
[b] 1 mm^2/s = 1 cSt.
[c] Purchasers should ensure that this pour point is suitable for the equipment on board, especially if the vessel operates in both the northern and southern hemispheres.
[d] This fuel is suitable for use without heating at ambient temperatures down to – 15 °C.

Table 2 — Requirements for marine residual fuels

Characteristic	Limit	Category ISO-F-															Test method reference
		RMA 10	RMB 10	RMC 10	RMD 15	RME 25	RMF 25	RMG 35	RMH 35	RMK 35	RMH 45	RMK 45	RML 45	RMH 55	RMK 55	RML 55	
Density at 15 °C, kg/m^3	max.	975,0	981,0		985,0	991,0		991,0		1 010,0	991,0	1 010,0	—	991,0	1 010,0	—	ISO 3675 or ISO 12185 (see also **6.3**)
Kinematic viscosity at 100 °C, mm^2/s[a]	max.	10,0			15,0	25,0		35,0			45,0			55,0			ISO 3104
Flash point, °C	min.	60			60	60		60			60			60			ISO 2719 (see also **6.4**)
Pour point (upper), °C[b]																	
— winter quality	max.	0	24		30	30		30			30			30			ISO 3016
— summer quality	max.	6	24		30	30		30			30			30			ISO 3016
Carbon residue, % (*m*/*m*)	max.	10		14	14	15	20	18	22		22		—	22		—	ISO 10370
Ash, % (*m*/*m*)	max.	0,10			0,10	0,10	0,15	0,15	0,20		0,20			0,20			ISO 6245
Water, % (*V*/*V*)	max.	0,5			0,8	1,0		1,0			1,0			1,0			ISO 3733
Sulfur, % (*m*/*m*)	max.	3,5			4,0	5,0		5,0			5,0			5,0			ISO 8754 (see also **6.6**)
Vanadium, mg/kg	max.	150		300	350	200	500	300	600		600			600			ISO 14597
Aluminium plus silicon, mg/kg	max.	80			80	80		80			80			80			ISO 10478 (see also **6.8**)
Total sediment, potential, % (*m*/*m*)	max.	0,10			0,10	0,10		0,10			0,10			0,10			ISO 10307-2 (see also **6.9**)

[a] Annex C gives a brief viscosity/temperature table, for information purposes only. 1 mm^2/s = 1 cSt.

[b] Purchasers should ensure that this pour point is suitable for the equipment on board, especially if the vessel operates in both the northern and southern hemispheres.

Annex A (informative) Specific energy

A.1 Specific energy is not controlled in the manufacture of fuel except in a secondary manner by the specification of other properties.

Specific energy, in megajoules per kilogram, can be calculated with a degree of accuracy acceptable for normal purposes from the equations given below.

Specific energy (gross),

$$Q_G = (52,190 - 8,802\rho^2 10^{-6}) \times \times [1 - 0,01\,(x + y + s)] + 9,420\,(0,01s)$$

Specific energy (net),

$$Q_N = (46,704 - 8,802\rho^2 10^{-6} + 3,167\rho 10^{-3}) \times \times [1 - 0,01\,(x + y + s)] + 0,01\,(9,420s - 2,449x)$$

where

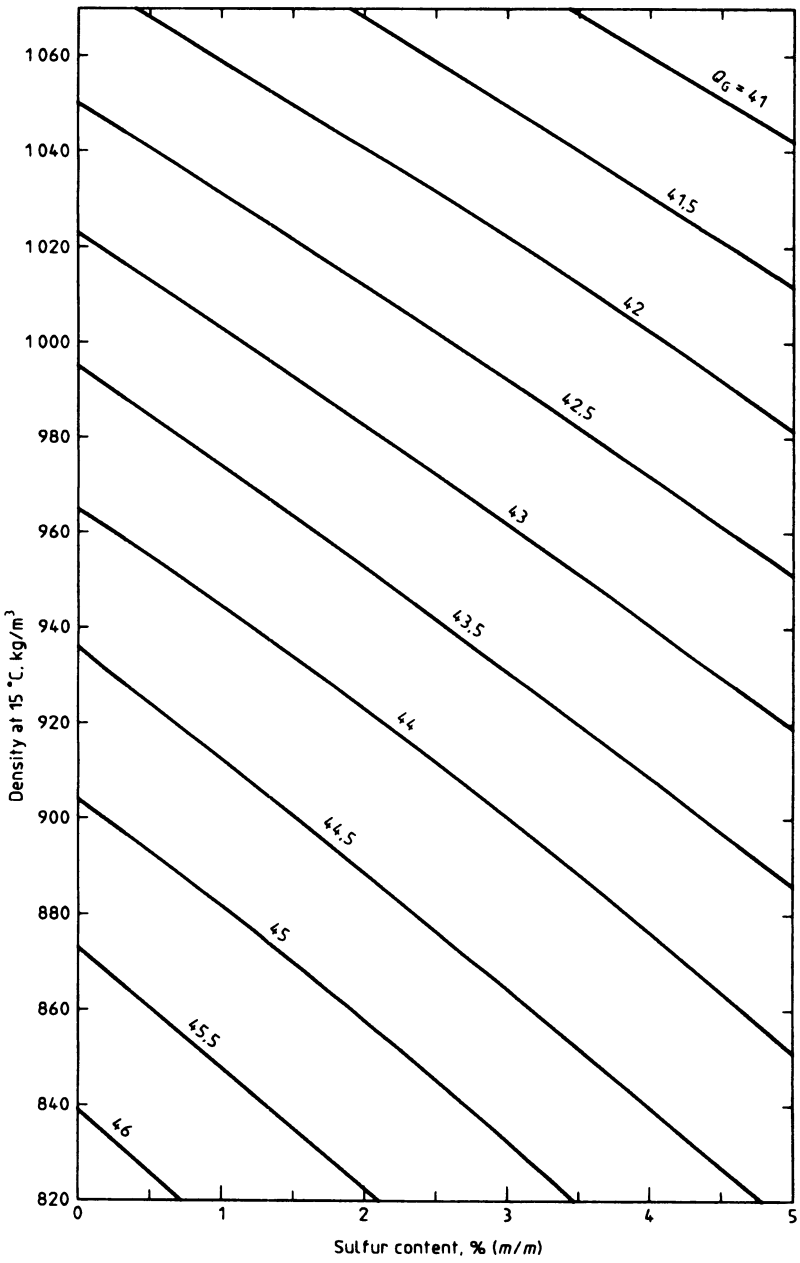
ρ is the density at 15 °C, in kilograms per cubic metre;

x is the water content, expressed as a percentage by mass;

y is the ash content, expressed as a percentage by mass;

s is the sulfur content, expressed as a percentage by mass.

A.2 Alternatively, for the purposes of rapid estimation, the gross and net specific energies may be conveniently read off from Figure A.1 and Figure A.2, which have been derived from the equations given in clause **A.1**. However, the values obtained may be only approximate.

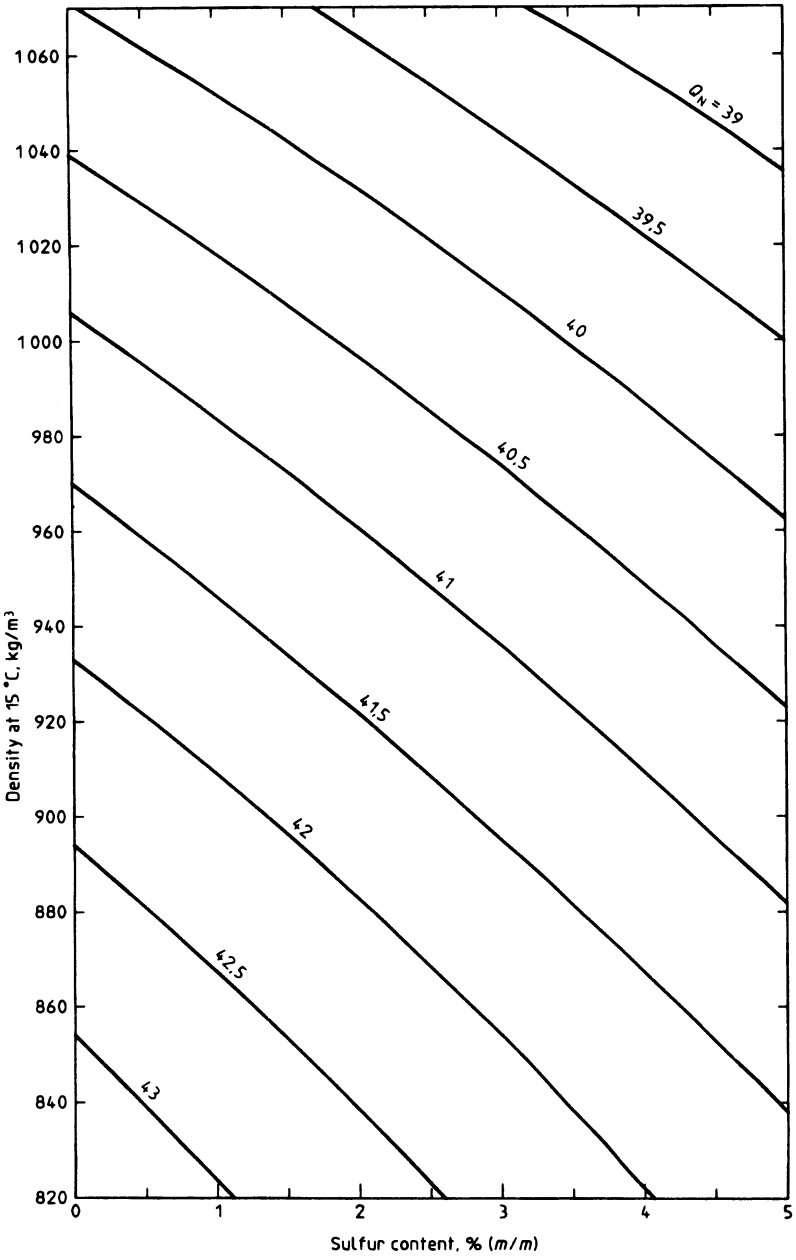


NOTES

1 To correct for ash and water, subtract $0{,}01Q_G$ (% ash + % water) from gross specific energy (Q_G) read from this graph.

2 Values read from this figure may not agree exactly with the calculated values (see clause A.2), and should be considered as approximate.

Figure A.1 — Gross specific energy, in megajoules per kilogram, of marine fuels



NOTES

1 To correct for ash and water, subtract $0{,}01Q_N$ (% ash + % water) from net specific energy (Q_N) read from this graph.

2 Values read from this figure may not agree exactly with the calculated values (see clause A.2), and should be considered as approximate.

Figure A.2 — Net specific energy, in megajoules per kilogram, of marine fuels

Annex B (informative) Ignition quality

B.1 Application

Ignition performance requirements of residual fuels in marine diesel engines are primarily determined by engine type and, more significantly, by engine operating conditions. Fuel factors influence ignition characteristics to a much lesser extent. For this reason no general limits for ignition quality can be applied, since a value which may be problematical to one engine under adverse conditions may perform quite, satisfactorily in many other instances. If required, further guidance on acceptable ignition quality values should be obtained from the engine manufacturer.

B.2 Use of the nomogram

The extension of a straight line connecting the viscosity and the density of a fuel oil can be used to give either its calculated ignition index (*CII*, see reference [3] in annex F) or calculated carbon aromaticity index (*CCAI*, see reference [4] in annex F) value, which allow ranking of its ignition performance. These values can also be calculated using the following equations.

$$CII = (270{,}795 + 0{,}103\,8T) - 0{,}254\,565\rho + \\ + 23{,}708 \lg\left[\lg\left(\nu + 0{,}7\right)\right]$$

and

$$CCAI = \rho - 81 - 141 \lg\left[\lg\left(\nu + 0{,}85\right)\right] - \\ - 483 \lg\left(\frac{T + 273}{323}\right)$$

where

T is the temperature, in degrees Celsius, at which the kinematic viscosity is determined;

ν is the kinematic viscosity, in square millimetres per second;

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

NOTE 8 In this International Standard, marine distillate categories DMX, DMA and DMB (see Table 1) have a minimum specified cetane number (see ISO 5165). If an estimation of the actual ignition quality of distillate fuels specified in Table 1 is required, it is suggested that ISO 4264 may provide a better approximation of ignition quality than the CCAI or CII parameters, which were primarily developed to be used for residual fuels of the type specified in Table 2.

NOTE 9 Work is continuing in a number of countries to identify alternative techniques for determining the overall combustion behaviour of residual fuels.

NOTE 10 lg is the logarithm to base 10.

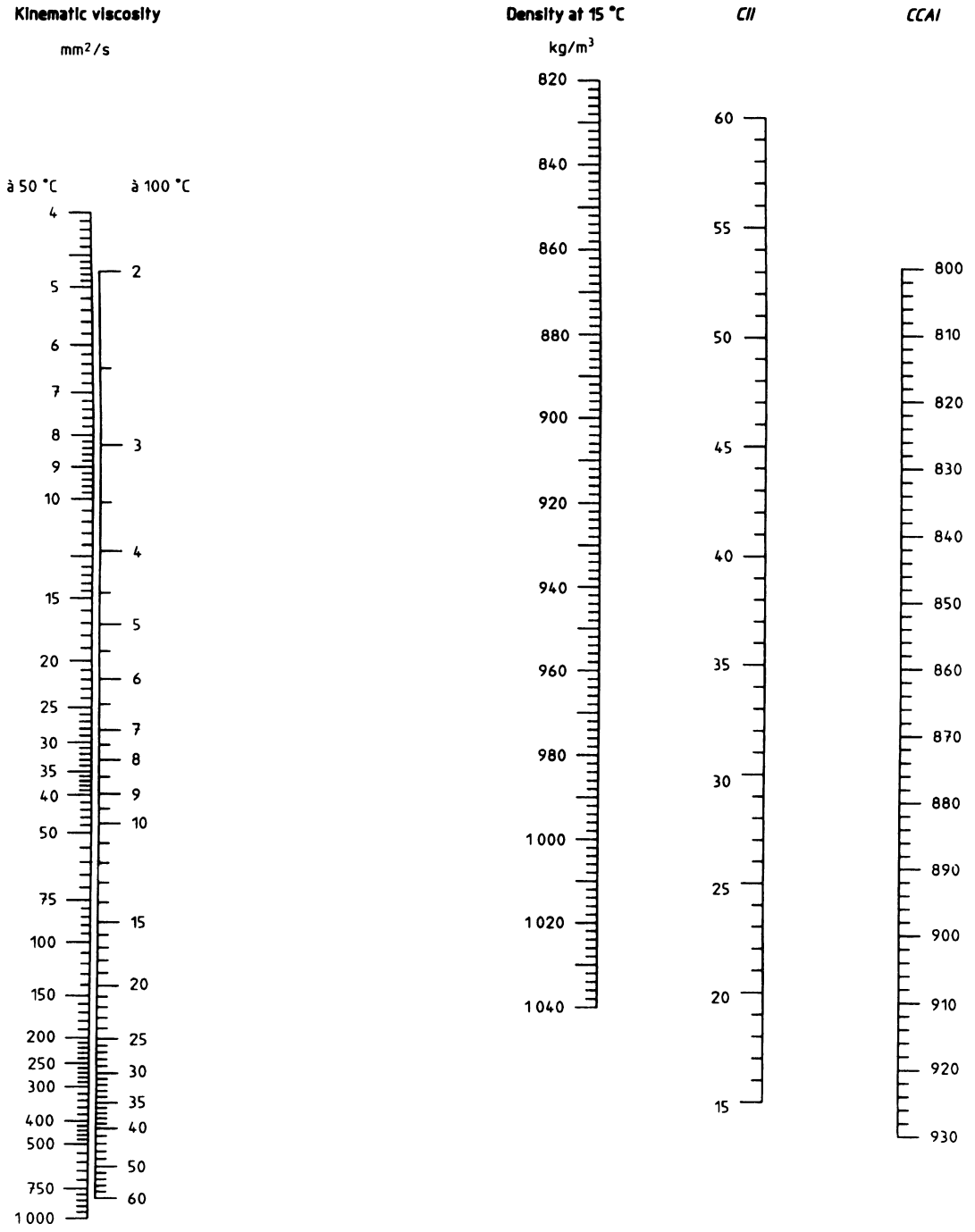


Figure B.1 — Nomogram for deriving *CCAI* and *CII*

Annex C (informative) Viscosity conversions

This International Standard specifies limiting values of kinematic viscosity at 100 °C for the fuel categories contained in Table 2. In some cases kinematic viscosity may be measured or quoted at other temperatures, and Table C.1 below gives approximate relationships.

The data should be used with caution, firstly since the precision of measurements at temperatures other than 100 °C may differ, and secondly because the variability of composition of residual fuels may cause variations in viscosity-temperature relationships.

Table C.1 — Viscosities estimated from those measured at 100 °C

Kinematic viscosity, mm^2/s[a]				
Measured at 100 °C	Approximate estimation at			
	40 °C	50 °C	80 °C	130 °C
10,0	80	50	17	5,5
15,0	170	100	28	7,5
25,0	425	225	50	11,0
35,0	780	390	75	14,5
45,0	1 240	585	105	17,5
55,0	1 790	810	130	20,5

[a] 1 mm^2/s = 1 cSt.

Annex D (informative) Catalyst fines

The main source of potentially abrasive particulates in bunker fuels is catalyst fines. The selected control parameter, aluminium plus silicon, with limit values for all fuels in Table 2 and category DMC in Table 1, is intended to limit catalyst fines contamination to a level that will ensure minimum risk of abrasive wear, given that adequate fuel pretreatment is carried out.

There are significant variations from refinery to refinery in the proportions of the aluminium and the silicon compounds that comprise catalyst fines. The combined aluminium and silicon limit value of 80 mg/kg is intended, therefore, to ensure that catalyst contamination would be no higher on average than would have been implied by the limit of 30 mg/kg, previously proposed for aluminium only, thus reflecting such variations.

The aluminium plus silicon requirement of 80 mg/kg maximum is therefore to be used in place of, not in combination with, a 30 mg/kg aluminium-only limit.

The lower limit for aluminium plus silicon applied to category DMC (25 mg/kg) is based on the proportion of residual fuel that may be expected to be part of this product.

Annex E (informative) Flash point — Residual fuel oils

Whilst flash point is a valid indicator of the fire hazard posed by residual fuel oil, information is available which shows that it is not a reliable indicator of the flammability conditions that can exist within the headspaces of tanks containing such fuel oils. This means that residual fuel oil can have the potential to produce a flammable atmosphere in the tank headspace, even when stored at a temperature below the measured flash point.

Consequently residual fuel oils should be considered to be potentially hazardous and capable of producing light hydrocarbons which could result in tank headspace atmospheres being near to, or within, the flammable range. Appropriate precautions are necessary therefore to ensure the safety of people and property. Further information and advice on precautionary measures are given in references [5] and [6] in annex F.

Annex F (informative)
Bibliography

[1] International Maritime Organization (IMO), Convention for *Safety of Life at Sea* (SOLAS) 1974, Amendment 1, Chapter 11-2, Regulation 15.

[2] ISO 8216-0:1986, *Petroleum products — Fuels (class F) — Classification — Part 0: General.*

[3] Barnes G.K, Liddy J.P. and Marshall E.G., *The Ignition Quality of Residual Fuels*, CIMAC paper 25, Warsaw, June 1987.

[4] Newbery P.J., Davies T.A.C. and Chomse K.M., *Heavier Residual Fuels for Marine Diesel Engines*, 6th International Motorship Conference, London, March 1984.

[5] *The Flammability Hazards associated with the Handling, Storage and Carriage of Residual Fuel Oil.* Published by the Oil Companies International Marine Forum (OCIMF), December 1989.

[6] *International Safety Guide for Oil Tankers and Terminals* (ISGOTT). Published by the International Chamber of Shipping.

List of references

See national foreword.

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