INTERNATIONAL STANDARD

ISO 8217

Second edition
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Petroleum products — Fuels (class F) — Specifications of marine fuels

Produits pétroliers — Combustibles (classe F) — Spécifications des combustibles pour la marine

Reference number
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Contents

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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.

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.

International Standard ISO 8217 was prepared by Technical Committee

fications and specifications.

This second edition cancels and replaces the first edition (ISO 8217:1987), which has been technically revised.

Annexes A to F of this International Standard are for information only.

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 counterbalanced 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.

Petroleum products — Fuels (class F) — Specifications of marine fuels

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.

NOTES

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

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.*

suitable precautions are not observed. This International Standard does not purport to address all of the

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:—[1], *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:—[2], *Crude petroleum and petroleum products — Determination of density — Oscillating U-tube method.*

ISO 14597:—[2], *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 tables 1 and 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.

1) To be published. (Revision of ISO 3733:1976)

2) To be published.

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.

6 Test methods

6.1 General

The requirements in tables 1 and 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.	1)	890,0	900,0	920,0	ISO 3675 or ISO 12185 (see also 6.3)
Viscosity at 40 °C, mm^2/s 2)	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 3) — winter quality — summer quality	 max. max.	 — —	 – 6 0	 0 6	 0 6	 ISO 3016 ISO 3016
Cloud point, °C	max.	– 16 4)	—	—	—	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)

1) In some geographical areas, there may be a maximum limit.

2) 1 mm^2/s = 1 cSt.

3) 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.

4) 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 [1]	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 [2] — winter quality — summer quality	max. max.	0 6	24 24		30 30	30 30		30 30			30 30			30 30			ISO 3016 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)

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

2) 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

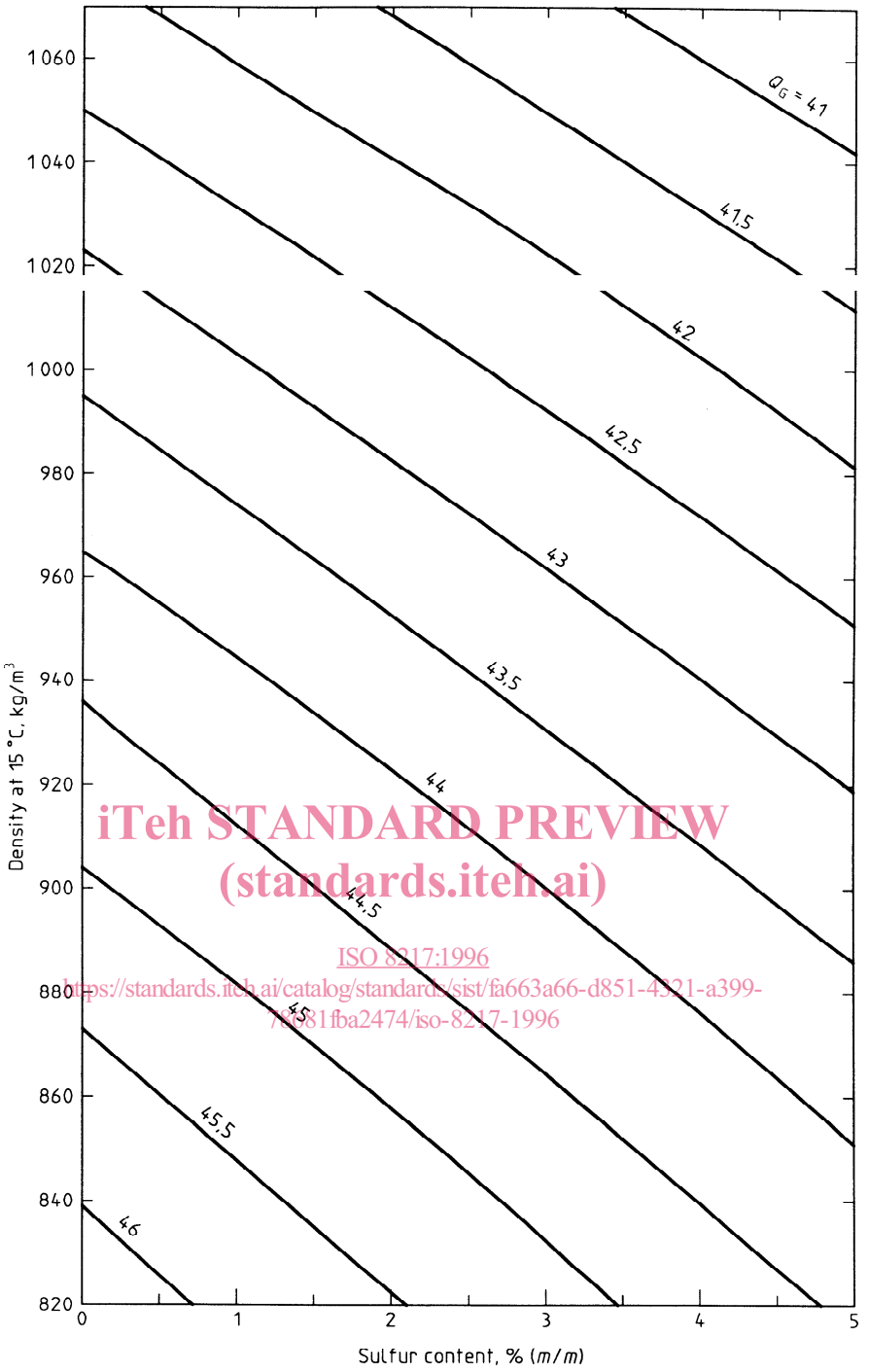
ρ is the density at 15 °C, in kilograms per cubic metre;

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 figures A.1 and 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