

---

---

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

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

**iTeh STANDARD PREVIEW**  
**(standards.iteh.ai)**

[ISO 8217:2005](https://standards.iteh.ai/catalog/standards/sist/7a1526a4-2188-4c00-a5c2-eaac6f6cd9dd/iso-8217-2005)

[https://standards.iteh.ai/catalog/standards/sist/7a1526a4-2188-4c00-a5c2-  
eaac6f6cd9dd/iso-8217-2005](https://standards.iteh.ai/catalog/standards/sist/7a1526a4-2188-4c00-a5c2-eaac6f6cd9dd/iso-8217-2005)



**PDF disclaimer**

This PDF file may contain embedded typefaces. In accordance with Adobe's licensing policy, this file may be printed or viewed but shall not be edited unless the typefaces which are embedded are licensed to and installed on the computer performing the editing. In downloading this file, parties accept therein the responsibility of not infringing Adobe's licensing policy. The ISO Central Secretariat accepts no liability in this area.

Adobe is a trademark of Adobe Systems Incorporated.

Details of the software products used to create this PDF file can be found in the General Info relative to the file; the PDF-creation parameters were optimized for printing. Every care has been taken to ensure that the file is suitable for use by ISO member bodies. In the unlikely event that a problem relating to it is found, please inform the Central Secretariat at the address given below.

**iTeh STANDARD PREVIEW**  
**(standards.iteh.ai)**

[ISO 8217:2005](#)

<https://standards.iteh.ai/catalog/standards/sist/7a1526a4-2188-4c00-a5c2-eaac6f6cd9dd/iso-8217-2005>

© ISO 2005

All rights reserved. Unless otherwise specified, no part of this publication may be reproduced or utilized in any form or by any means, electronic or mechanical, including photocopying and microfilm, without permission in writing from either ISO at the address below or ISO's member body in the country of the requester.

ISO copyright office  
Case postale 56 • CH-1211 Geneva 20  
Tel. + 41 22 749 01 11  
Fax + 41 22 749 09 47  
E-mail [copyright@iso.org](mailto:copyright@iso.org)  
Web [www.iso.org](http://www.iso.org)

Published in Switzerland

## Contents

Page

Foreword.....	iv
Introduction .....	v
1 Scope .....	1
2 Normative references .....	1
3 Application .....	2
4 Sampling.....	2
5 General requirements.....	3
6 Other properties of fuels .....	3
7 Test methods.....	3
7.1 Density .....	3
7.2 Flash point.....	3
7.3 Sulfur content.....	4
7.4 Appearance .....	4
7.5 Total sediment existent.....	4
7.6 Total sediment potential.....	4
7.7 Used lubricating oil (ULO).....	4
7.8 Vanadium.....	4
7.9 Aluminium plus silicon .....	4
8 Precision and interpretation of test results .....	4
Annex A (informative) Specific energy.....	8
Annex B (informative) Ignition quality.....	10
Annex C (informative) Viscosity conversions .....	12
Annex D (informative) Catalyst fines.....	13
Annex E (informative) Flash point — Residual fuel oils.....	14
Annex F (informative) Examples of precision and interpretation of test results.....	15
Annex G (informative) Sodium and vanadium in marine fuels .....	17
Annex H (informative) Used lubricating oils in marine fuels .....	19
Annex I (informative) Acidity in marine fuels .....	21
Bibliography .....	22

## 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 8217 was prepared by Technical Committee ISO/TC 28, *Petroleum products and lubricants*, Subcommittee SC 4, *Classifications and specifications*.

This third edition cancels and replaces the second edition (ISO 8217:1996), in which the Introduction and Table 1 and Table 2 have been revised. (standards.iteh.ai)

ISO 8217:2005  
<https://standards.iteh.ai/catalog/standards/sist/7a1526a4-2188-4c00-a5c2-eaac6f6cd9dd/iso-8217-2005>

## Introduction

### 0.1 General

The specifications in this International Standard were prepared in co-operation with the marine and petroleum industries to meet the requirements for marine fuels supplied on a world-wide 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 fuels being available internationally, even though locally or nationally there might be relatively few categories. Several of the residual fuels are unique in origin to one country or area, but nevertheless are included in the specification because of their importance in the international marine fuel market.

### 0.2 Classification

The categories of fuel in this International Standard have been classified in accordance with ISO 8216-1<sup>[3]</sup>. The sub categories (M) and (H) of ISO-F-D categories, as described in ISO 8216-99<sup>[4]</sup>, have not been used in this International Standard since the distillate categories described can fall into either or both of these sub categories.

iTeh STANDARD PREVIEW  
(standards.iteh.ai)

### 0.3 International statutory requirements

This International Standard takes account of the international requirements for flash point, as given by the International Maritime Organization (IMO)<sup>[6]</sup> and of the international requirements for the sulfur content given by the IMO in a protocol adopted in September 1997 and in force since May 2005<sup>[7]</sup>. Additionally, regional and/or national bodies may introduce their own local requirements for the sulfur content of marine fuels during the lifetime of this International Standard, for example by the European Communities<sup>[8]</sup>. These might be more stringent than those prescribed by the IMO Protocol, and it is the users' responsibility to establish the existence of any such requirements, their applicability and compliance with them.

### 0.4 Informative annexes

Important information to support this International Standard is given in the informative Annexes A to I. The subjects covered are specific energy, ignition quality, viscosity conversions, catalyst fines, limitations of flash point, precision and interpretation of test results, sodium and vanadium, used lubricating oil and acidity.

## 0.5 Changes from previous editions of this International Standard

This is the third edition of this International Standard. It reflects several important changes, particularly in the viscosity classification of residual fuels, in the number of categories of residual fuels, which are now reduced to ten, and in the alignment of limits on sulfur to those currently being ratified by the International Maritime Organization as mentioned above. For the residual fuel categories, the maximum water content is reduced to 0,5 % (V/V) and density limits for the lower viscosity categories have been lowered. The reference temperature for viscosity limits for all residual fuel grades have been changed from 100 °C to 50 °C. While measurement at 100 °C gives better precision, it is at variance with the reality of the bunker market. Previous editions of this International Standard have used a reference temperature of 100 °C, but most of the bunker market has in practice continued to refer to kinematic viscosity measured at 50 °C for commercial transactions. The reference temperature has, therefore, been changed in this edition to 50 °C in recognition of commercial practice. It also has to be recognized that viscosity is not a very critical parameter as far as the shipboard technical requirement is concerned and that the better precision of 100 °C is of no meaningful consequence in this respect. The inclusion of used lubricating oil is now controlled by limits on levels of zinc, phosphorus and calcium in all the residual fuel categories and in distillate category DMC.

NOTE For the purposes of this International Standard, the terms "% (m/m)" and "% (V/V)" are used to represent the mass and volume fractions, respectively.

## 0.6 Further changes

This International Standard will be kept continually under review.

**iTeh STANDARD PREVIEW**  
**(standards.iteh.ai)**

[ISO 8217:2005](https://standards.iteh.ai/catalog/standards/sist/7a1526a4-2188-4c00-a5c2-eaac6f6cd9dd/iso-8217-2005)

<https://standards.iteh.ai/catalog/standards/sist/7a1526a4-2188-4c00-a5c2-eaac6f6cd9dd/iso-8217-2005>

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

**WARNING** — The handling and use of products 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 users 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 specifies the requirements for petroleum fuels for use in marine diesel engines and boilers, prior to appropriate treatment before use.

This International Standard specifies four categories of distillate fuel, one of which is for diesel engines for emergency purposes. It also specifies ten categories of residual fuel.

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

NOTE 2 Appropriate guidance about fuel treatment systems for diesel engines is published by the International Council on Combustion Engines (CIMAC) (see Reference [9]).

NOTE 3 Requirements for gas turbine fuels used in marine applications are specified in ISO 4261<sup>[1]</sup>.

The specifications for marine residual fuels in this International Standard can also be applicable to stationary diesel engines of the same or similar make and type as those used for marine purposes.

## 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 2719:2002, *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 3675:1998, *Crude petroleum and liquid petroleum products — Laboratory determination of density — Hydrometer method*

ISO 3679:2004, *Determination of flash point — Rapid equilibrium closed cup method*

ISO 3733:1999, *Petroleum products and bituminous materials — Determination of water — Distillation method*

## ISO 8217:2005(E)

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

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

ISO 6245:2001, *Petroleum products — Determination of ash*

ISO 8754:2003, *Petroleum products — Determination of sulfur content — Energy-dispersive X-ray fluorescence spectrometry*

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

ISO/TR 13739:1998, *Petroleum products — Methods for specifying practical procedures for the transfer of bunker fuels to ships*

ISO 14596:1998, *Petroleum products — Determination of sulfur content — Wavelength-dispersive X-ray fluorescence spectrometry*

ISO 14597:1997, *Petroleum products — Determination of vanadium and nickel content — Wavelength-dispersive X-ray fluorescence spectrometry*

IP 470/03, *Determination of aluminium, silicon, vanadium, nickel, iron, calcium, zinc and sodium in residual fuel oil by ashing, fusion and atomic absorption spectrometry*

IP 500/03, *Determination of the phosphorus content of residual fuels by ultra-violet spectrometry*

IP 501/03, *Determination of aluminium, silicon, vanadium, nickel, iron, sodium, calcium, zinc and phosphorus in residual fuel oil by ashing, fusion and inductively coupled plasma emission spectrometry*

### 3 Application

When used in connection with commercial transactions, this International Standard specifies the required properties for marine fuels at the time and place of custody transfer. Samples for quality verification can be taken in any location agreed between the parties.

### 4 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/TR 13739:1998, Clause 10, or an equivalent National Standard.



## 5 General requirements

**5.1** The fuels shall be homogeneous 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 acids and from used lubricating oils.

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

- a) jeopardizes the safety of ships or adversely affects the performance of the machinery; or
- b) is harmful to personnel; or
- c) contributes overall to additional air pollution.

**5.2** Fuels shall comply with the requirements in Tables 1 and 2 when tested by the methods referred to therein.

## 6 Other properties of fuels

**6.1** It has not been possible to reach agreement on a direct method of handling ignition quality for residual fuels 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 the density and viscosity requirements within the mandatory part of this International 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 residual fuels to agree on acceptable ignition quality characteristics.

**6.2** While it is not considered necessary to include specification limits in this International Standard for additional metal elements, such as sodium, concerns about the influences of metals in marine fuels upon ash deposition and high temperature corrosion are well recognized. Information on the subject is given, therefore, in Annex G. Similarly, this International Standard does not include any limits for acids in fuels, information on which is given in Annex I.

## 7 Test methods

### 7.1 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 91-1:1992. 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 91-1:1992.

The reference method shall be ISO 3675.

### 7.2 Flash point

The flash point for all categories of fuels in Table 1 shall be determined in accordance with ISO 2719, Procedure A. If the flash point of a category DMX sample is less than 40 °C, it shall be determined in accordance with ISO 3679.

The flash point of all categories of fuels in Table 2 shall be determined in accordance with ISO 2719, Procedure B.

### 7.3 Sulfur content

The reference method for compliance with this International Standard shall be ISO 8754. In some geographical areas, other methods may be specified by national authorities for environmental control purposes.

In the event of a dispute concerning sulfur content, all parties should agree, prior to testing, upon the same sulfur certified reference material.

### 7.4 Appearance

For categories DMX, DMA and DMB, the appearance of samples shall be assessed by visual inspection in good light, free from glare and shadow, at a temperature between 10 °C and 25 °C.

- DMX and DMA categories samples shall appear clear and bright.
- If the clarity of DMB category samples affords visual inspection, and if they appear free from visible sediment and water, testing for total sediment existent and for water is not required.

### 7.5 Total sediment existent

The total sediment existent shall be determined in accordance with ISO 10307-1 for all DMB category samples that fail the visual inspection prescribed in 7.4.

### 7.6 Total sediment potential

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

### 7.7 Used lubricating oil (ULO)

The reference test method for compliance with this International Standard shall be IP 501.

### 7.8 Vanadium

The reference test method for compliance with this International Standard shall be ISO 14597.

### 7.9 Aluminium plus silicon

The reference test method for compliance with this International Standard shall be ISO 10478.

## 8 Precision and interpretation of test results

The test methods specified in Table 1 and Table 2 all contain a statement of precision (repeatability and reproducibility). Attention is drawn to ISO 4259:1992, Clause 9 and Clause 10, which cover the use of precision data in the interpretation of test results; this method shall be used in cases of dispute. Information about precision and interpretation of test results is also given in Annex F.

Table 1 — Requirements for marine distillate fuels

Characteristic	Unit	Limit	Category ISO-F-				Test method reference
			DMX	DMA	DMB	DMC <sup>a</sup>	
Density at 15 °C	kg/m <sup>3</sup>	max.	—	890,0	900,0	920,0	ISO 3675 or ISO 12185 (see also 7.1)
Viscosity at 40 °C	mm <sup>2</sup> /s <sup>b</sup>	min. max.	1,40 5,50	1,50 6,00	— 11,0	— 14,0	ISO 3104 ISO 3104
Flash point	°C	min. min.	— 43	60 —	60 —	60 —	ISO 2719 (see also 7.2)
Pour point (upper) <sup>c</sup> — winter quality — summer quality	°C	max. max.	— —	- 6 0	0 6	0 6	ISO 3016 ISO 3016
Cloud point	°C	max.	-16 <sup>d</sup>	—	—	—	ISO 3015
Sulfur	% (m/m)	max.	1,00	1,50	2,00 <sup>e</sup>	2,00 <sup>e</sup>	ISO 8754 or ISO 14596 (see also 7.3)
Cetane index	—	min.	45	40	35	—	ISO 4264
Carbon residue on 10 % (V/V) distillation bottoms	% (m/m)	max.	0,30	0,30	—	—	ISO 10370
Carbon residue	% (m/m)	max.	—	—	0,30	2,50	ISO 10370
Ash	% (m/m)	max.	0,01	0,01	0,01	0,05	ISO 6245
Appearance <sup>f</sup>	—	—	Clear and bright		f	—	See 7.4 and 7.5
Total sediment, existent	% (m/m)	max.	0,10	—	0,10 <sup>f</sup>	0,10	ISO 10307-1 (see 7.5)
Water	% (V/V)	max.	—	—	0,3 <sup>f</sup>	0,3	ISO 3733
Vanadium	mg/kg	max.	—	—	—	100	ISO 14597 or IP 501 or IP 470 (see 7.8)
Aluminium plus silicon	mg/kg	max.	—	—	—	25	ISO 10478 or IP 501 or IP 470 (see 7.9)
<u>Used lubricating oil (ULO)</u>						The fuel shall be free of ULO <sup>g</sup>	
- Zinc	mg/kg	max.	—	—	—	15	IP 501 or IP 470
- Phosphorus	mg/kg	max.	—	—	—	15	IP 501 or IP 500
- Calcium	mg/kg	max.	—	—	—	30	IP 501 or IP 470 (see 7.7)

<sup>a</sup> Note that although predominantly consisting of distillate fuel, the residual oil proportion can be significant.

<sup>b</sup> 1 mm<sup>2</sup>/s = 1 cSt

<sup>c</sup> 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.

<sup>d</sup> This fuel is suitable for use without heating at ambient temperatures down to - 16 °C.

<sup>e</sup> A sulfur limit of 1,5 % (m/m) will apply in SO<sub>x</sub> emission control areas designated by the International Maritime Organization, when its relevant protocol enters into force. There may be local variations, for example the EU requires that sulphur content of certain distillate grades be limited to 0,2 % (m/m) in certain applications. See 0.3 and reference [7].

<sup>f</sup> If the sample is clear and with no visible sediment or water, the total sediment existent and water tests shall not be required. See 7.4 and 7.5.

<sup>g</sup> A fuel shall be considered to be free of used lubricating oils (ULOs) if one or more of the elements zinc, phosphorus and calcium are below or at the specified limits. All three elements shall exceed the same limits before a fuel shall be deemed to contain ULOs.

Table 2 — Requirements for marine residual fuels

Characteristic	Unit	Limit	Category ISO-F-										Test method reference		
			RMA 30	RMB 30	RMD 80	RME 180	RMF 180	RMG 380	RMH 380	RMK 380	RMH 700	RMK 700			
Density at 15 °C	kg/m <sup>3</sup>	max.	960,0	975,0	980,0	991,0	991,0	991,0	991,0	1010,0	991,0	1010,0	1010,0	1010,0	ISO 3675 or ISO 12185 (see also 7.1)
Kinematic viscosity at 50 °C	mm <sup>2</sup> /s <sup>a</sup>	max.	30,0		80,0	180,0	180,0			380,0			700,0		ISO 3104
Flash point	°C	min.	60		60	60	60			60			60		ISO 2719 (see also 7.2)
Pour point (upper) <sup>b</sup> - winter quality - summer quality	°C	max. max.	0 6	24 24	30 30	30 30	30 30	30 30	30 30	30 30	30 30	30 30	30 30	30 30	ISO 3016 ISO 3016
Carbon residue	% (m/m)	max.	10		14	15	20	18	22				22		ISO 10370
Ash	% (m/m)	max.	0,10		0,10	0,10	0,15	0,15	0,15				0,15		ISO 6245
Water	% (V/V)	max.	0,5		0,5	0,5	0,5	0,5	0,5				0,5		ISO 3733
Sulfur <sup>c</sup>	% (m/m)	max.	3,50		4,00	4,50	4,50	4,50	4,50				4,50		ISO 8754 or ISO 14596 (see also 7.3)
Vanadium	mg/kg	max.	150		350	200	500	300	600				600		ISO 14597 or IP 501 or IP 470 (see 7.8)
Total sediment potential	% (m/m)	max.	0,10		0,10	0,10	0,10	0,10	0,10				0,10		ISO 10307-2 (see 7.6)
Aluminium plus silicon	mg/kg	max.	80		80	80	80	80	80				80		ISO 10478 or IP 501 or IP 470 (see 7.9)

iTech STANDARD PREVIEW  
(standards.iteh.ai)

https://standards.iteh.ai/catalog/standards/sist/7a1526a4-2188-4c00-a5c2-  
ca2515cd9dd/iso-8217-2005