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CIMAC Guideline

ISO 8217:2024 - FAQ

By CIMAC WG7 ‘Fuels’

The first edition of this CIMAC Guideline was approved by the members of the CIMAC WG7 ‘Fuels’ in May 2024.

Content

1 Introduction

With the introduction in 2012 of the fifth edition of ISO 8217 "*Petroleum products -- Fuels (class F) -- Specifications of marine fuels"*, a number of questions arose in the industry. These were directed to the ISO working group, ISO/TC 28/SC4/WG6, to answer. As a result of learnings from that process, on releasing the sixth edition, WG6 decided, in cooperation with CIMAC WG7, to make an up-front set of "frequently asked questions" (FAQ) to speed up the communication and the education process. As the FAQ was a success, ISO WG6 and CIMAC WG7 will repeat this process, issuing a new FAQ for future editions.

In 2024, a new edition of ISO 8217 (edition seven) has been published. In the absence of an in-depth discussion of the various reports and associated background documentation that helped form the basis for the revision, ISO WG6 has identified the most pertinent questions that may arise about this version of the standard.

In collaboration with the ISO/TC 28/SC4/WG6, CIMAC WG7 has collated and provided responses to these questions which reflect the collective thinking of the working group. This FAQ will provide the reader with the basis and reasoning for the changes made to the previous edition, ISO 8217:2017.

Should you have further questions, please do not hesitate to contact CIMAC WG7 or visit www.cimac.com

2 Questions and Answers related to ISO 8217:2024

2.1 Why has this FAQ been produced?

The FAQ to ISO 8217:2024 was drafted by the CIMAC Fuels Working Group (WG7), in cooperation with ISO/TC 28/SC 4/WG6 (ISO 8217 committee) to address questions that were expected to arise, especially around the inclusion of higher percentages of biofuel and concerning the rationale behind the changes made from the 2017 edition of the standard, in a clear, systematic, and easily understandable way.

2.2 Why is it important to use the latest version of ISO 8217?

The latest edition of the standard is based on the most up-to-date information in fuel formulations, test method types and limits, recent fuel statistics, operational experiences being fed back from the users, and adapts to the actual fuel quality available in the market today.

Particularly for this version, the change to allow FAME up to 100% plus the addition of two new tables, including a "VLSFO" table, enables the buyers and users to pinpoint exactly the fuel quality they need in today's market.

Of particular note is Table 2 for the VLSFO grades and the requirement for suppliers to provide the TSP test result, with TSA and TSE as "reporting", in order to address some of the stability concerns for VLSFOs. In addition, to alert the buyer on whether the minimum viscosity for the ordered grade can or cannot be achieved. These two important changes, in conjunction with many other changes, warrants the adoption of this edition to capitalise on the benefits of the amendments.

2.3 What happens to older versions of 8217?

According to the ISO procedure, standards retire when they are replaced and ISO 8217:2024 states that: ‘This seventh edition cancels and replaces the sixth edition (ISO 8217:2017), which has been technically revised.

However, as the ISO 8217 standard is used in a commercial transaction between buyer and seller and the available fuel quality may not align to the new standard in some areas, the bunker purchase is often commercially agreed to an older, outdated ISO 8217 edition.

Engine OEMs recommend using the latest version of ISO 8217.

2.4 What amendments and information should I be particularly mindful of in this new standard 2024?

As is usual when updating editions of ISO 8217, the main changes are listed in the "Foreword" of the new standard:

The main changes are as follows:

— terms and definitions (Clause 3) have been updated;

— the Scope and the general requirements in Clause 5 have been amended;

— Tables 2 and 3 have been added;

— former Table 2 has been modified and has become Table 4;

— changes to the distillate fuels, including the following:

— the requirement to report the fatty acid methyl ester(s) content (FAME) of DF grades has been changed, allowing up to 100 %;

— the distinction between winter and summer quality for cloud point and cold filter plugging point has been removed;

— the requirement to report the net heat of combustion for DF grades has been added;

— a minimum cetane number requirement for DF grades has been added;

— the requirement for oxidation stability for DF grades has been added;

— Clauses 9 and 10 have been added;

— new Annexes F, H and K have been added (the former Annex F has become Annex G, the former Annex G has become Annex I, and the former Annex H has become Annex J);

— existing annexes have been reviewed and updated.

2.5 Of all the alternative fuels being discussed in the industry, why does ISO 8217 only cover biofuels and not, for example methanol (MeOH)?

ISO 8217 (and ISO 8216) are standards setting the specifications and requirements for petroleum fuels and covers fuels containing hydrocarbons from petroleum crude oil, oil sands and shale oil or hydrocarbons with molecular structures that are indistinguishable from petroleum hydrocarbons.

It also allows for some fuel grades to be blends of these hydrocarbons with FAME, or paraffinic diesel which has similar properties compared to distillate DMA, and for the use of up to 100 % FAME as fuel.

FAME has been used since 2004 in the automotive industry and successfully trialled in the shipping industry progressively since 2007, while becoming more important due to maritime emission regulations. It was therefore logical to introduce FAME as a standardized bio product in the ISO 8217:2024 edition.

Methanol has very different properties, not least a low flash point, and the characteristics require different test methods and regulatory compliance considerations which do not align with ISO 8217.

To this extent a separate marine standard for methanol is currently under development by ISO and is expected to be published by late 2024 or early 2025.

2.6 Why does ISO 8217:2024 now have four tables, when traditionally, all previous standards have had two tables?

Since the publication of the 6th edition of ISO 8217:2017, regulatory changes (especially the 2020 MARPOL Annex VI sulfur reduction to 0.50%, worldwide) and the requirement to decarbonize shipping have resulted in new blend formulations and an introduction of biofuels in the marine market, to help reduce the carbon footprint of the fuels consumed. As the nature of these new fuels/blends are more diverse compared to previous conventional fuel blends, they require a different focus or additional quality control parameters. It was therefore decided to separate the different types of fuels resulting in 4 tables setting the requirements for today's marine fuels, these are:

- Increased levels of FAME blending is allowed, and is reflected in Table 1;
- ULSFO and VLSFO have been given their own separate table (Table 2) giving a more detailed and better adapted testing range for these types of more paraffinic fuels;
- A table for bio-residual fuels has been added (Table 3);
- High sulfur fuels are now covered by Table 4.

2.7 Why does the standard have two separate tables for non-bio residual fuel grades?

Experience from the introduction of VLSFOs in 2019/20, made it clear that the more paraffinic VLSFOs had different properties requiring an adapted test slate and limits compared to the traditional HSFO. As such, the residual fuel table was split into 2 individual tables:

- ULSFO and VLSFO (Table 2 — Residual marine fuels with sulfur content below or at 0,50 % by mass)
- HSFO (Table 4 — Residual marine fuels with sulfur content above 0,50 % by mass) tables.

2.8 Which biofuels are allowed according to ISO 8217? Which renewable fuels are allowed?

ISO 8217 includes the use of FAME in accordance with EN 14214 (except for sulfur content, cloud point, cold filter plugging point and climate tables) or ASTM D6751 (except for sulfur content) as a blend component in both distillate and residual fuels up to 100 %.

Other national FAME standards, not referenced in this document, and alternative bio-based products such as off-spec FAME or FAME production distillation bottoms are all being considered to be used by the marine industry. However, it is important that they align with the minimum requirements set by the scope of this document, with comparisons being made against EN 14214 or ASTM D6751 and meeting Clause 5 of the ISO 8217:2024 standard.

Paraffinic diesel (by EN 15940) is also allowed in ISO 8217 (such as HVO, GTL, BTL) as a “drop in” fuel, that would say a fuel that cannot be distinguished from regular diesel through routine analysis and was already allowed in the previous editions of the standard since 2010 (see 2.31). FAME (according to EN 14214 or ASTM D6751) however is the only permitted “biofuel” which has so far fulfilled all the criteria and although already present since 2010 at “de minimis” levels and in 2017 edition as “DF” grades with max 7% FAME, FAME (meeting above mentioned EN/ASTM standard) can now be introduced into the marine market in higher concentrations, up to 100%.

There are however an increasing range of new potential off specification biofuels being offered to the marine bunker pool under the guise of a biofuel or bio-oil. Suppliers in these cases, should be transparent to the receiving ship as to the specific bio blend composition and feedstock source. Under these circumstances the ship’s classification society and OEMs should be approached and before accepting the product, should discuss their specific risk mitigation requirements for assessing the suitability of the fuel use prior to carrying out a sea trial.

2.9 Are the test parameters used for fossil fuels useful in evaluating the properties of biofuels?

The test methods used for biofuel (FAME) quality evaluation are included in EN 14214 and ASTM D6751, where these standards include test parameters additional to the ISO 8217 test slate. These additional tests are important to ensure whether the FAME is of sufficient quality for use as is, or as a blend component in marine fuel.

Once the final blend has been made, it is no longer possible to evaluate whether the FAME quality met EN 14214 or ASTM D6751 requirements. As such, FAME shall conform to the chosen specification before blending, whereas the finished fuel blend shall also conform to the chosen ISO 8217 grade.

2.10 How do you identify the content of FAME in marine fuels?

The content of FAME can be established via testing in accordance with the methods mentioned in the standard, this being:

Clause 6.9 of ISO 8217:

“The test methods specified in ASTM D7963 and IP 631 are applicable to all DM and RM, DF and RF grades. The test method specified in EN 14078 is not applicable to RM and RF grades at the time of preparation of this document. Test method specified in ASTM D7371 is applicable to DF grades. The reference test method shall be as specified in EN 14078 for DM and DF grades and ASTM D7963 or IP 631 for RM and RF grades. In case of disagreement concerning FAME content, all parties shall agree, prior to additional testing, upon the test method to be used.

FAME content can be reported in content by mass or content by volume according to the test method used. Alternatively, suppliers can report the FAME content by blend ratio on a mass or volume basis.

Note: Due to cost and simplicity, many labs decide to run EN 14078 on RM and RF grades too, however, as above, note that ASTM D7963 or IP 631 are the applicable methods.

2.11 What are the differences between ASTM D6751 and EN 14214 - ISO 8217 refers to both ASTM D6751 and EN 14214 for FAME – are they the same or different?

EN 14214 “Fatty acid methyl esters (FAME) for use in diesel engines and heating applications — Requirements and test methods” is the standard used in Europe and includes mono-di-tri glyceride content.

ASTM D6751 “Standard Specification for Biodiesel Fuel Blend Stock (B100) for Middle Distillate Fuels” is the standard used in the US.

The two standards were developed by different standardization bodies at different times to reflect the need in the different regions in which they apply and therefore take a different approach. One of the main differences between ASTM D6751 and EN 14214 is that ASTM D6751 does not define the FAME content, nor does it specify a testing requirement thereof. Further, ASTM D6751 defines the cold flow properties through Cold Soak Filterability test (ASTM D7501) and not by the Cold Filter Plugging Point (CFPP), included in EN 14214. Lastly there is a difference in oxidation stability requirements, 3 hours for ASTM D6751 and 8 hours for EN 14214.

Despite the different approaches, both standards provide sufficient quality assurance for the FAME, where ASTM D6751 is more defined by operational requirements compared to EN14214 with more quantitative compositional requirements.

2.12 What does the FAME content value of Table 3 mean? What does it mean that “The supplier may report the FAME content as per blend ratio”?

The FAME content in table 3 is, according to the test method, reported by mass percentage. However, Clause 6.9 allows suppliers to report the FAME content as per blend ratio (stating whether it is a mass or volume ratio) as an alternative to using the stated lab test methods, as the exact amount of FAME to be delivered may not be exactly known until delivery as, e.g. in road fuel delivery, suppliers often use flowmeters to measure the blend ratio and as evidence of compliance with renewable fuel regulations. As such, flowmeters, being just as precise as lab blending, may well also be used in marine. See CIMAC Guideline “Marine-fuels containing FAME”, chapter 6., on FAME content.

2.13 Will ISO 8217 help to identify the source of the biofuel?

No, the final ISO 8217 quality, combined with either EN 14214 or ASTM D6751 FAME quality, only indicates the quality of the delivered fuel or blended FAME. The sustainability criteria are taken care of from the statutory/sustainability side, with certification of the feedstock and the source of FAME being documented separately. The origin of the FAME therefore should be verified by the supplier, where a PoS (Proof of Sustainability) document, or a supplier declaration, may accompany the FAME.

2.14 How to read Clause 5.1? “The fuel composition shall consist of predominantly hydrocarbons” – does this mean that 49% of the fuel can be a non-hydrocarbon?

In the past, the use of “predominantly” was intended to be "mostly" in order to connect the fuel in the standard to the title. However, in 2024 version of the standard the word “predominantly” refers to the fossil component as mentioned in Clause 5, which states that the fossil fraction of the fuel shall contain “predominantly hydrocarbons from petroleum sources”. The word predominantly was used to not exclude non-hydrocarbon fossil components/elements of the fuel which are typically present at low concentrations in fuels.

Use of the word “predominantly” was not intended to allow for other non-hydrocarbon components in the fuel as Clause 1 of ISO 8217:2024 defines and restricts the fuels to which the standard applies.

2.15 Why are organic chlorides limited through EN 14077 rather than through GCMS analysis?

Put simply, EN 14077 provides a total content figure whereas the GCMS methods, which are not standardised, only target specified chemical species and as such could miss picking up an organic chloride of another species.

The total organic chlorine content correlates with the presence and concentration of organic chlorides. As such, fuels can be screened for any presence of organic chlorides by testing for total organic chlorine, through the test method EN 14077 “Determination of organic halogen content”. Early indications from test data show that fuels with a chlorine content below 50 mg/kg do not contain notable levels of organic chlorides and as such the “de minimis” limit was set at 50 ppm. ("A fuel shall be considered to be free from organic chlorides (chlorinated hydrocarbons) when the total organic halogen content as chlorine is not exceeding 50 mg/kg when tested in accordance with EN 14077"). Should the chlorine concentration exceed 50 mg/kg, the specific organic chlorides can still be identified through the standardised GCMS test, ASTM D7845 (“Determination of Chemical Species in Marine Fuel Oil”), if deemed necessary. However currently, the list of chemical species in ASTM D7845 does not include organic chlorides, but according to the scope of the method, the test method can be used with correct calibration and precision using the appropriate standards for the determination of other species, if necessary.

2.16 Why are there no limits for TSA and TSE in Table 2 and 3?

One of the consequences of the introduction of VLSFO and potentially bio-VLSFO into the marine fuel market is an increasing variety of the composition of the fuel, with consequences on the fuels’ stability and stability reserve. While it is not possible to set suitable limits on sediment, other than TSP, that would reflect the state and the expected behaviour of a fuel when stored or used onboard a ship, the knowledge of the different sediment test results is very useful to understand a fuel, in terms of its overall stability. Although TSP remains the reference test method, the new requirement for suppliers to report TSE and TSA will yield valuable additional information regarding the stability and stability reserve of the tested fuels. This data will assist users in proactively addressing stability issues before they become problematic and will contribute important insights for the next revision of the Standard. More information on the interpretation of total sediment test results is available in CIMAC guideline 03 |2024 - Overview and interpretation of total sediment test results in the context of ISO 8217:2024.

2.17 Why are no changes made to the limits on catalytic fines (Aluminium plus Silicon)?

Data and evidence received from the industry do not support a change to the catalyst fines limits, as there have been little to no reports of off-specification catalyst fines above the current limit causing operational challenges. For VLSFOs in particular, being the most widely used fuel grades, due to their generally lower density and viscosity, settling and separation of catalyst fines is, according to Stokes law, even more effective compared to traditional, higher density and viscosity product, like HSFO, as the comparatively heavier catalyst fines particles separate more easily.

2.18 Why is there no maximum limit for potassium?

Statistically there was not enough evidence of the need therefore, as the potassium content is covered by the overall ash content, no limits were added. Potassium content in fossil marine fuels is not typically seen at elevated levels. Note, at the moment, potassium content in FAME is limited at 5 ppm in EN and ASTM standards and some engine OEMs require a maximum potassium limit in their engines.

2.19 Why is it relevant to report the net heat of combustion for biofuels?

For conventional petroleum hydrocarbon fuels ISO 8217 has a formula for net (NCV) and gross calorific value (GCV) for both residual and distillate fuels, which uses the tested density, sulfur, water, and ash content. This has been shown to be sufficiently precise for ships to gauge their fuel consumption and, where the engines require, to be mapped into the engine control system. In view of the variability of the new fuel blends and the focus on energy management, this has become of greater importance, but the formulae used within the standard are only applicable for fossil fuels. Biofuels per definition have a lower calorific value, so this will have an impact, proportionally to the blend ratio (see 2.20).

2.20 Why is the energy content measured by physical test method, ASTM D240 and not by the calculation method?

Where the petroleum fuel blend includes a percentage of a biofuel now becoming a more frequent request to meet carbon emission reduction targets, the formulae included in ISO 8217 for the calculation of the energy value will be inaccurate, and the figure is usually too high. At present there is no official calculation method available and so where a ship needs a specific and as precise as possible value, then the ASTM D 240 determination of the heat of combustion by Bomb Calorimeter is used. Noting that energy value of FAME is typically 37 MJ/kg compared with a residual fuel value of about 41 MJ/kg.

2.21 Why was Wax Appearance Temperature (WAT) and Wax Disappearance Temperature (WDT) not included in the specification?

Both test methods provide potentially useful information on the use of a product, operationally, onboard a vessel, however this will always need to be reviewed within the framework of the bigger picture of the operational conditions. Further, the test provides a temperature when waxes appear and disappear, but has no indication on the amount of wax, nor the effect on the fuel; ASTM D8420 does not quantify the amount of wax, nor determines the size of the crystals formed, which means that one can have a high WAT & WDT but will not necessarily experience operational issues.

Also noting that in order to avoid excessive and prolonged oxidation and thermal stress in storage fuels should not be overheated. Therefore the 'pour point' remains the critical temperature to maintain, below which the fuel will become unpumpable and re-liquifying is not a straightforward process. If wax crystals are forming, the fuel can still be pumped through to the settling tank where the temperature is elevated.

2.22 Which are the new annexes and why were they included?

Annex F, H and K are new annexes.

Annex F provides more information on cold flow properties and testing thereof. The introduction of VLSFO and biofuels in the marine market has resulted in cold flow properties becoming more important especially in the context of storage and handling of these fuels.

Annex H provides information on the stability of marine fuels and on the different test methods that can be used for testing of sediment in residual marine fuels. In the past, when only HSFO were used by ships, accelerated total sediment (TSA) was a quick alternative test in comparison to potential total sediment (TSP) and when TSA was meeting the specification limit, also TSP would also generally meet the limit. This is however no longer the case with VLSFO and this has resulted in fuels of Table 2 and 3 having to meet the potential total sediment content (TSP) of 0,10 % by mass, whilst for Table 4, for HSFO, the TSA may be used initially, however in any dispute TSP remains the reference test method.

The requirement to report the existent and accelerated sediment provides additional useful information on the stability characteristics of the fuel (sediment in the fuel at time of testing and behaviour of the fuel when exposed to both chemical and mild thermal stress). More detailed information is available in CIMAC guideline 03 |2024 - Overview and interpretation of total sediment test results in the context of ISO 8217:2024.

Annex K covering the characterization of residual marine fuels, was introduced to respond to a request from the IMO to investigate the possibility to provide the shipping industry with an informative indicator to define whether a residual fuel tends to be more aromatic or paraffinic in nature.

2.23 How should ISO 8217 be used in claims cases / when can a fuel be deemed off specification? How to interpret reproducibility?

ISO 8217 should be taken into consideration in its entirety, with ISO 4259 as an integral part of every test method included within the specification. For each characteristic, its calculated variance should be taken into consideration when assessing its result compared to the specification limit.

01 | 2024 CIMAC Guideline, The Interpretation of Marine Fuel Analysis Test Results (Updated Apr 2024), By CIMAC WG7 Fuels was written in cooperation with ISO 8217 WG6 Working Group, to give the industry an easy-to-read, simple understanding of the complexities of accurate measurement compared to a specification, plus how to interpret a test result whether you are a recipient or a supplier.

If a test parameter is deemed off-specification, then its operational significance to the ship's machinery plant, will depend on the parameter itself and the degree of off-specification from the prescribed tabled parameter limit; this will determine whether operationally the product can or cannot still be used. Just as meeting the limits within the tables does not always mean that the product is meeting the ISO 8217 standard if Clause 5 is found not to have been met.

2.24 Can ISO 8217 be used to evaluate the CO_2 reduction potential and does the standard address carbon content and the Green House Gas (GHG) reduction process, for example the Carbon Intensity Indicator (CII)?

No, neither CO_2 nor carbon are listed parameters in ISO 8217. As all traditional fossil fuels have similar carbon content and IMO having already defined carbon factors in their GHG emission regulations, no additional carbon test was deemed necessary. Furthermore, suppliers of FAME (bio fuel) and renewable blend components, are currently obligated to demonstrate their sustainability credentials through feedstock tracking. Going forward, all fuels will be subject to inclusion in the International Maritime Organization's (IMO) Life Cycle Analysis.

2.25 How did ISO choose the min viscosity levels for the tables? Why are they different?

The minimum viscosity of grades RMA 20 and RF 20 were set at 2 mm²/s which is the technical limit for fuel injection at engine inlet, notwithstanding the temperature. However, there is an additional note in tables 2 and 3 that recommends checking the minimum viscosity requirement of the engine with the OEM (Original Equipment Manufacturer) when the viscosity at 50°C is in the range of 2mm²/s to 5mm²/s.

The minimum viscosity of grades RME 180, RF 80 and RMG 180 was set at 20 mm²/s which is again, a technical limit for handling and use.

Table 3 (bio-residual marine fuels) contains an additional grade compared to table 2. In the objective of the simplification of table 2 there was no technical justification to keep an intermediate grade with a maximum viscosity of 80 mm²/s. On the other hand, considering the lack of projection of the future market demand for biofuels and the tendency of existing biofuels to exhibit a low viscosity, it was agreed, on the request of shipowners, to have an intermediate grade, RF 80, for bio-residual marine fuels. It was also agreed not to have an overlap on viscosity between RF 80 and RF 180 because there is no technical reason for such a viscosity overlap. Therefore, the minimum viscosity of grade RF 180 corresponds to the maximum viscosity of grade RF 80.

On the other hand, grades with maximum viscosity of 380 mm²/s have been harmonized; the minimum viscosity of RMG 380 (table 2 and table 4) and RF 380 was set up at 120 mm²/s in order to ensure the ship will get a sufficiently high viscosity fuel when ordering a 380 mm²/s grade. Moreover, a statistical analysis based on the data shared by the testing agencies emphasized that the total sediment contents can increase with the decrease of viscosity. A minimum viscosity of 120 mm²/s reduces the risk for sediment deposition in an area where the degree of sedimentation could be reduced by temperature control (above 120 mm²/s the centrifuge has to be set at the maximum permitted temperature) whereas in the range from 80 to 120 mm²/s there is still a margin for adjusting the temperature to attempt to mitigate instability issues.

2.26 Some suppliers say they cannot meet the minimum viscosity limit for the ordered grade. How should a buyer/supplier manage this and operationally, can the buyer still take the fuel?

If suppliers cannot meet the minimum viscosity limit, this should be handled in the same way as for any other parameter, where the supplier advises the buyer that the bunker to be supplied will be of

a lower viscosity. The grade ordered should be the preferred grade for the engine and cleaning system onboard, but most engines are capable of handling a whole range of fuels from the ISO grades, so as such, if one particular grade isn't available, the customer and supplier need to agree on which grade to be supplied. It's also possible to buy fuel to a specific grade with a viscosity exception.

2.27 Is FAME, or blended FAME, included in the scope of all test methods?

All test parameters, apart from cetane index (CI) and the calculation of specific energy content, have proven to give realistic results when tested on fuels blended with FAME. However, most methods used have not included these blends when the precision was assessed and are therefore not included in the scope of these methods. This will change as these methods are systematically reviewed, but as long as the standard is contractually agreed, the results from the test methods stand.

2.28 What is a "reference method" and how are they chosen?

The test methods listed in the ISO 8217 tables are "primary" test methods. Primary test methods are those methods that are considered, by the subject matter technical experts, of being capable to provide representative results to characterize a property, and the results from the primary methods allow comparison against a specification to determine conformance.

Reference test methods listed in ISO 8217 are those methods that that have been selected by the subject matter technical experts as providing the right answer in case of a dispute. The selection of the reference method is usually based on a statistical analysis of the data produced to determine the precision of the test method.

The primary test methods for a property may or may not follow the same technical principles, but the outcomes from all the primary test methods are considered comparable. If there is a bias between a primary method and a reference method, then this is stated in the test method and corrected results can be reported as a reference method corrected result. ISO 8217 details which of the primary methods allowed is the reference method.

2.29 Where can I get hold of further guidance on the topics of fuel stability and handling biofuels?

01 | 2019 CIMAC Guideline Marine fuel handling in connection to stability and compatibility

03 | 2023 – CIMAC Guideline Update: Recommendation for Design and Operation of Fuel Cleaning Systems for Diesel Engines

03 | 2024 – CIMAC Guideline Overview and interpretation of total sediment test results in the context of ISO 8217:2024

04 | 2024, CIMAC Guideline, Marine fuels containing FAME: A guideline for shipowners and operators.

2.30 Why are more chemicals, that have been supposedly linked to operational problems, not listed in Annex B?

GC-MS, the most commonly used method for detecting unknown, chemical species, is ultimately a research and development tool, with many different in-house methods in use between the different laboratories. When testing GC-MS isolates different, previously unobserved compounds and, where necessary, alerts raised; if such alerts are raised, there needs however to be a due diligence process in place to actually demonstrate that the compound is in fact relevant, plus that it is actually present in a concentration high enough to be above the detection limit of the test method, and if detected, a causation link is made to specific reported problems when using the individual fuels.

Due to the lack of proven cause-and-effect between onboard challenges/ issues and chemical species / compounds detected over time and considering the current limitation of the standardized test methods in place, and limitations on benchmark feedback, adding specifically named compounds becomes a complex task.

A sound technical basis for inclusion of any chemical species needs to be made before any inclusion in the ISO 8217 can be considered, following the protocol for any other of the tested parameters and their given limits. Failure to follow this protocol runs the danger of compounds become an unwilling, unproven focus. which ultimately could condemn a good fuel reducing the availability of the bunker pool.

2.31 Can we tell if the fuel is more paraffinic or aromatic in nature?

Paraffinic, defined as “like paraffin”, i.e. waxy, and aromatic fuels, defined as “organic compounds containing one or more aromatic rings”, have historically made up the marine fuel pool, with the aromatic fuel being more dominant in the finished products. After 2020, more paraffinic fuels have found their way into the blending pool and as such, the definitions have become more unclear.

As such, the Working Group embarked on the best, least complex and least expensive way to try to better define a fuels aromaticity or paraffinic character.

After thorough investigation and in-depth collection of different methods, historical data and statistics, the WG issued the technical report ISO/TR 18588:2023 – Petroleum products. Characterization of marine fuels by viscosity-gravity constant (VGC) – to allow a better understanding of a fuels’ composition. The Technical Report provides an indicator for defining whether a petroleum-derived residual fuel which does not include FAME, as supplied to a ship, is more aromatic or paraffinic in nature.

The calculation gives results in a range and ASTM D2501 refers to values of VGC near 0,800 indicating samples of paraffinic character, while values close to 1,00 indicate a preponderance of aromatic structures.

2.32 Why has Table 1 two different oxidation stability test methods and limits?

With the introduction of FAME into marine distillate blends it was necessary to adapt some of the requirements. According to the scope of ISO 12205, the test method is not applicable to fuels containing residual components, or any significant component from a non-petroleum source. This test method is therefore maintained for DM grades only.

As the FAME content of DF grades is not limited, it was necessary to evaluate the oxidation stability of these fuels with a suitable test method. Therefore EN 15751, specifically developed for biodiesel blends, was introduced for DF grades.

This test method is applicable for biodiesel blends from 2% to 100% FAME and adding this aligns this specification with fuels specifications used within the automotive and mobility sectors.

2.33 Flash point at IMO and in ISO 8217

IMO's Marine Safety Committee and flashpoint: MSC 106 adopted the following amendments to SOLAS chapter II-2 in relation to flashpoint (minimum flash point is 60 degrees Celsius) which will enter into force on 1 January 2026:

1. Ships carrying oil fuel shall prior to bunkering be provided with a declaration signed and certified by the fuel oil supplier's representative that the oil fuel supplied is in conformity with regulation SOLAS II.2/4.2.1 and the test method used for determining the flashpoint. As of 1st May 2024, a bunker delivery note (BDN) for the fuel delivered to the ship shall contain the flashpoint specified in accordance with standards acceptable to the Organization, or a statement that flashpoint has been measured at or above 70°C.

2. The Contracting Governments undertake to ensure that appropriate authorities designated by them inform the Organization for transmission to Contracting Governments and Member States of the Organization of all confirmed cases where oil fuel suppliers have failed to meet the requirements specified in SOLAS regulation II-2/4.2.1; and

3. The Contracting Governments undertake to ensure that appropriate authorities designated by them take action as appropriate against oil fuel suppliers that have been found to deliver fuel that does not comply with regulation SOLAS regulation II-2/4.2.1.

A confirmed case (low flashpoint) is defined as when a representative sample analysed in accordance with standards acceptable to the Organization by an accredited laboratory reports the flash point as measured to be below 60°C. Furthermore, in a footnote "ISO 2719:2016- Determination of flash point – Pensky-Martens closed cup method, Procedure A (for Distillate Fuels) or Procedure B (for Residual Fuels)." Is referred to as standards acceptable to the organization.

As the standard is acceptable to the organization, it must be noted that the said standard does, according to ISO 8217 and further ISO 4259, include inherent statements on accuracy, listing reproducibility and repeatability limits for both recipient and supply tested samples.

2.34 Why test the FAME quality pre-blending?

When blending FAME into DF and RF fuel blends, the FAME content must be known before blending, as after blending it is impossible to isolate and test the properties of the blended FAME, as the resultant blend makes it impossible to isolate and test the necessary parameters of the FAME used.

As such, all FAME for blending should be tested, allowing the quality to be evaluated, before blending.

The main reason for this testing is to confirm the quality of parameters not listed in ISO 8217, but listed in EN 14214/ASTM D6751, e.g. mono-di and tri glyceride content, which can affect the finished blended fuel's quality, but cannot be seen in the finished blend test methods.

2.35 Do IMO and ISO define fuel oil differently?

IMO and ISO are different organisations with different scope and objectives – e.g. IMO/ MARPOL covers only safety and emissions, pollution, environmental aspects whereas ISO 8217 aims to define the technical and operating requirements for marine fuels supplied for consumption on board ships (after onboard fuel handling) and therefore the definitions may not always align.

Regulation 18.3 of MARPOL Annex VI stipulate the specific requirements applicable to fuel oil for combustion purposes delivered to and used on board ships and is based on ISO 8217:2010 Clause 5, General requirements text, with the addition of NOx emission regulation.

ISO 8217 Scope and General Requirements have developed, by revision, and the text used at IMO has since been revised two times, to include the addition of bio and renewables into the specification.

In addition, ISO 8217 lists tabled max/min specifications for all relevant fuel quality parameters, where MARPOL Annex VI is covering only safety and emissions, with the additional general no harm statement on quality (Defined in Reg 18.3.1 and 18.3.2 and addressed under the UI MEPC.1 /Circ. 795/ Rev 8)

2.36 Feedstock – can you see the feedstock from ISO 8217 parameters?

No.

ISO 8217 in its entirety, including the characteristics and limits in Tables 1 to 4, are established to meet* the technical and operating requirements for marine fuels supplied for consumption on board ships (after onboard fuel handling).

These parameters are not established to identify the feedstock used, nor the sustainability of the feedstocks, rather the overall quality of the final product.

The 2024 revision of ISO 8217 allows increased blending of FAME and paraffinic diesel fuels (e.g. HVO) and includes hydrocarbons from recycled sources which have different feedstocks to conventional fuels (i.e. from petroleum crude oil).

Fuels produced from different feedstocks can have similar characteristics and are often blended to meet the ISO 8217 parameters listed in the tables. Due to the overlap of characteristics and often complex blending of marine fuels, it is not possible to identify the feedstocks using ISO 8217 parameters.

The content of FAME can be determined as detailed in the tables, but not the feedstock used to produce the FAME.

There are some sophisticated test methods which can, for example, identify FAME feedstock speciation, and to determine the age of organic materials (Radiocarbon dating /carbon-14 dating), however these test methods are not included in ISO 8217 as they are not intended to determine if a fuel meets the technical and operating requirements for marine fuels supplied for consumption on board ships.

*The parameters listed in the tables of ISO 8217 do not alone ensure the fuel is acceptable for use, as further explained throughout the standard, and in particular clause in 5.2.

2.37 Why is sulfur stated as "0,1" and "0,5" in some of the grade names in ISO 8216 and ISO 8217, and not with two decimals?

Basis the shipping companies represented in ISO WG6, when ordering a fuel, it is typically done as “I want an RMG 380 point 5”, therefore an exception was made in the category names in order to accommodate their need for recognising what to order and buy.

2.38 Why was an annex regarding characterisation of residual marine fuels added?

The annex was added to provide additional onboard handling information for residual marine fuels. The characterization of petroleum derived fuels not including FAME, in terms of their aromatic and paraffinic nature, has become increasingly of interest by the marine industry, having moved to lower sulfur fuels which resulted in moving away from the dominance of high sulfur heavier residual fuels of the past. The annex provides a consistent approach in defining whether a petroleum-derived fuel, not including FAME, is more aromatic or paraffinic in nature.

After thorough investigation and in-depth collection of different methods, historical data and statistics, the WG issued the technical report ISO/TR 18588:2023 - Petroleum products. Characterization of marine fuels by viscosity-gravity constant (VGC) - to allow a better understanding of a fuels’ composition using parameters already included in ISO 8217. The Technical Report provides an indicator for defining whether a petroleum-derived residual fuel which does not include FAME, as supplied to a ship, is more aromatic or paraffinic in nature.

The calculation gives results in a range and ASTM D2501 refers to values of VGC near 0,800 indicating samples of paraffinic character, while values close to 1,00 indicate a preponderance of aromatic structures.

2.39 What is the significance of CCAI in the standard and is it relevant for today’s residual fuel blends?

In respect to the CCAI, it should be recalled that this was incorporated into the 2010 ISO 8217 standard as a means of identifying anomalous fuels rather than as an indicator of ignition performance.

As an identifier, it could be seen that its role has been enhanced over the last few years as we experience a far wider range of viscosity/density combinations than existed previously. It has never been intended as a go/no-go characteristic, even as an ignition/ combustion indicator since different engines and different operating conditions have different sensitivities to ignition characteristics.

It remains a characteristic which is determined from the readily available viscosity-density data and hence at no additional charge to the user, it goes therefore to continue to alert the user to any anomaly between the viscosity and density relationship and so prompt further investigative analysis and or at least caution when starting to use the fuel in a diesel engine.

2.40 How is Clause 5, 2024, different from that of the 2017 edition?

Clause 5 in ISO 8217:2024 allows any fossil, synthetic or bio fuel mentioned in this clause to be used at 100 % or blends of any of these.

It also limits FAME content of grades designed to not contain FAME at approximately 0.5 %. At the same time, it specifies additional requirements for fuels containing FAME.

ISO 8217:2024 Clause 5 also requires the fuel to be free of organic chlorides (chlorinated hydrocarbons) where 'free of' means that the total organic halogen content as chlorine is not exceeding 50 mg/kg when tested in accordance with EN 14077.

2.41 Determination of the net heat of combustion on fuels containing FAME by ASTM D240 (Heat of Combustion of Liquid Hydrocarbon Fuels by Bomb Calorimeter) requires the hydrogen content of the fuel to be known.

ASTM D 240 has requirements for 'H' content when a non-fossil fuel has been blended. Where the hydrogen content is required to be determined for the net specific energy (NSE) calculation, then either ASTM D 5291 or ASTM D 7171 may be used to determine the H content in % mass, as applicable.

2.42 How can the vessel be sure they will receive the agreed fuel quality at delivery?

The fuel supplier should provide the receiving ship with sufficient information to allow the ship's crew to deal with that fuel safely and effectively in terms of storage, handling, treatment, and use of the fuel on board. The supplier also has an obligation to communicate clearly to the receiving ship the quantities and grades that they have arranged to supply, as has the customer/vessel to engage and understand the same; this information from the supplier should be provided in enough time to enable the ship's crew to prepare for the bunker delivery and the appropriate storage of the fuel on board. A certificate of quality (COQ) of the fuel quality should be forwarded to the purchaser as early as possible before the delivery and a copy given to the vessel on delivery.

2.43 What should I do, technically, if I ordered a residual fuel oil with a de minimis level of FAME and the analysis result exceed this de-minimis?

The presence of FAME in a fuel ordered as RM grade is unlikely to render the fuel unsuitable for use. Much however will depend on the amount of FAME present and whether the ship has used FAME in the bunkers before and the onboard engineers are knowingly prepared for effective fuel management.

Reference can be made to the '04 | 2024, CIMAC Guideline, Marine fuels containing FAME: A guideline for shipowners and operators.' which covers all operational considerations in order to make an informed operational decision for your specific ship. OEM's do also provide for the most part, updates on their guidelines for use of such fuels for you ship specific machinery.

Operationally however we can expect the viscosity and density of the received being lower than anticipated and this may impact the on-board fuel handling requirements (e.g. fuel preheating and centrifuge temperature).

A lower net specific energy (NSE) of the FAME can be expected, which may have an impact on the required quantity of fuel to complete the intended voyage, again subject to the degree of FAME present.

In its favour, the FAME can improve the combustion profile, however, FAME has a solvency power which might bring sediment accumulated in tanks into solution and cause filter clogging in the early stages of the fuel being used. Material compatibility over a prolonged may have impact particularly on certain seal types listed in the CIMAC guide 04 | 2024.

2.44 Why does ISO 8217:2024 require CFPP and CP to be reported for DF grades?

Depending on the ambient conditions, of a ship's operating region, where the fuel will be used, knowledge on the cold flow properties of DM/DF grades, especially in non-heated systems, is important and can be useful. Note, however, DMB has no "report" requirement and when not bright and clear, measurement of CFPP and CP may not be possible and other means to evaluate suitability of the fuel should be considered.

2.45 What does "Report" mean in the tables?

In the tables, "Report" means there is a requirement to report the specific parameter to inform the buyer in advance to enhanced fuel management, however the reported result is not a specification limit.

2.46 Are "ULSFO", "VLSFO" or "HSFO" a part of ISO 8217?

Fuel category generalizations, like VLSFO are not defined under ISO 8217, where marine fuel naming is defined in ISO 8216. As such ISO 8217 grades are clearly named and defined in the specifications.

The generalized names have been made to distinguish between different types of fuel depending on their sulfur content (ultra low, very low and high sulfur fuel oil), however, each generalization can contain multiple fuel grades within each, so the only way to be accurate is to name the fuels according to their exact, specific ISO 8216 name. For example, VLSFO (very low sulfur fuel oil) can be any residual fuel grade within the specification (RMA, RME, RMG, or even RMK), as long as the sulfur is below 0.50% (defining the "very low"). So, when ordering fuels, the specific tabled grades meeting the specific requirement should always be stated.

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