Hydrocarbon management

HM 50

Guidelines for the preparation of tanks and lines for marine tank vessels carrying petroleum and refined products

6th edition

energy institute

HM 50
GUIDELINES FOR THE PREPARATION OF TANKS AND LINES FOR MARINE TANK VESSELS CARRYING PETROLEUM AND REFINED PRODUCTS

Sixth edition

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FOREWORD

The Energy Institute (EI) Hydrocarbon Management Committee is responsible for the production and maintenance of standards and guidelines covering various aspects of static and dynamic measurement of petroleum. The Hydrocarbon Management Subcommittee 4 (HMC-4) deals primarily with the measurement and loss of crude oil and oil products, focusing in particular on transport in the marine environment.

HMC-4 is made up of experts from the oil industry, cargo inspectors, ship owners and representatives from marine terminals. It is a truly international panel with representatives from most Western European countries, the Middle East, Far East, and North and South America. Equipment manufacturers and experts with specific knowledge of measurement techniques are regularly invited to present papers to the committee.

The EI maintains liaison with parallel working groups of the American Petroleum Institute's (API) Committee on Petroleum Measurement, and other organisations concerned with quantitative measurement in other countries and in other industries. The API is a permanent invitee to meetings of the HMC-4 commitee.

The EI Hydrocarbon Management guidelines (formerly Petroleum Measurement Manual and Petroleum Measurement papers) are widely used by the petroleum industry and have received recognition in many countries by consumers and the authorities. In order to promote international good practice, the EI works via the British Standards Institute to develop standards through the International Organization for Standardization (ISO) technical committee TC 28 Petroleum and related products, fuels and lubricants from natural or synethetic sources and its subcommittee TC 28/ SC 2 Measurement of petroleum and related products.

A full list of Hydrocarbon Management guidelines is available on request from the EI. The EI Hydrocarbon Management guidelines are recommended for general adoption but should be read and interpreted in conjunction with safety, environmental, weights and measures, customs and excise, and other regulations in force in the particular country in which they are to be applied. Such regulatory requirements have precedence over corresponding clauses in the EI document except where the requirements of the latter are more rigorous, when its use is recommended. Users should also consider contractual constraints imposed by charterers, cargo owners, ship owners and any other interested party.

Although it is believed that adoption of the recommendations of this guideline will assist the user, the EI cannot accept any responsibility, of whatsoever kind, for damage or alleged damage arising or otherwise occurring on vessels or in or about premises where this document has been applied as final responsibility for adequate preparation of the vessel to receive a cargo lies with the parties controlling this task.

Users of these guidelines are invited to send comments, suggestions or details of relevant experience to:

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Aviation Fuel Management issues have been reviewed by the Joint Inspection Group (JIG) Product Quality Committee whose contribution is also appreciated.

UPDATES

The bullet points below summarise the key updates found in the sixth edition of HM50 (compared to the previous fifth edition).

– All sections reviewed and updated where required.
– Cargo to be loaded added to the cleaning tables – Paraffinic diesel, clean condensate.
– Precargoes added to the tables – oxygenates, aromatics, clean condensate.
– Dirty condensate added to crude oil in the tables.
– Fuel oil grades updated to reflect latest sulfur limits.
– Grades removed from clean tables – wide cut jet fuel, JP4, Jet B, solvents, white spirity.
– Tables split up into three sections, aviation fuels, clean grades, dark/heavy grades, to improve readability and reduce number of precargoes.
– Table notes updated including guidance on loading aviation fuels after clean condensate and that mopping of tanks may replace freshwater washing if done effectively.
– Revised guidance on loading aviation kerosene after clean condensate.
– Section 2.11 revised and updated with new sections for paraffinic diesel, clean condensate, oxygenates, aromatics.
– Updated advice when loading after bio-origin cargoes, see 2.5.5.
– Expanded section 2.5.8, loading after base lubricating oils.
– Annex B added – information about biologically derived materials.

1 INTRODUCTION AND SCOPE

This publication has been compiled with the aim of sharing the experiences of oil companies and other bodies represented on the HMC-4 with other branches of the oil industry, by providing guidance with regard to preparation of tanks on board petroleum tank vessels, particularly when carrying refined products and changing from one product to another.

The guidelines are written principally for marine tank vessels; they are not considered appropriate for inland waterway barges.

This document addresses issues relating to most classes of refined product but does not cover chemicals or gases.

Guidelines for crude oil washing are contained in HM 40 *Guidelines for the crude oil washing of ships' tanks and the heating of crude oil being transported by sea*, published by the EI.

Instructions regarding tank preparation are normally issued by the charterers or vessel owners, either in the form of a specific instruction or a general tank cleaning guideline provided on board. This publication is intended to provide additional guidance to those involved with issuing such instructions and to other parties who may be involved in confirming that suitable procedures have been followed.

This publication has been prepared primarily with the aim of maintaining product quality using the minimum effective tank preparation procedures, reducing the use of marine bunkers and generation of wash water.

Further information relating to the handling and quality of aviation fuels can be found in EI/JIG Standard 1530 *Quality assurance requirements for the manufacture, storage and distribution of aviation fuel to airports*.

Safety and environmental issues are paramount in the operations described and for detailed guidance on these issues, the latest revisions of ISGOTT, ISGINTT, MARPOL and SOLAS regulations should be referred to and will take precedence over any recommendations made here.

Nothing in the guidance contained in these guidelines suggests or encourages deviation from the carriage and cleaning requirements required by MARPOL Annex II Noxious Liquid Substance (NLS) regulations. MARPOL Annex II details the carriage and cleaning standards for specific cargoes. The cleaning standards, carriage requirements and slop disposal provisions of MARPOL have been developed to protect the environment, not necessarily to prepare a tank for the next cargo. Products addressed in these guidelines to which Annex II NLS regulations may apply include, but are not limited to, biodiesels, lubricating oil additives, toluene, methanol, MTBE, all vegetable oils and many gasoline-blending components.

The guidance is based upon the prior three cargoes having been stowed to 80 pct or more of the tank capacity. Where the vessel's log of the last three cargoes shows that one or more of the tanks, designated to load, were less than 80pct laden, then due consideration shall be given to whether the tank-cleaning plan is sufficient for the intended cargo loading, and whether the requirements within this guide have been met.

EI standards are published as an aid to procurement of standardized equipment and materials and/or as good practice procedures. These standards are not intended to inhibit purchasers or producers from purchasing or producing products made to specifications other than those of the EI.

For the purpose of this document,

– ‘shall’ denotes a requirement;

– ‘should’ denotes a recommendation;

– ‘may’ denotes a course of action which is permissible , and

– ‘can’ denotes a possibility or capability.

2 TANK PREPARATION GUIDELINES

2.1 GENERAL INFORMATION

2.1.1 Introduction and cleanliness standards

Tank preparation is carried out to:

- Prepare tanks for the carriage of the next cargo.
- Prevent the build-up of oily residues.
- Facilitate gas-freeing and tank entry for repairs/tank mopping.
- Comply with charter party requirements.
- Comply with MARPOL regulations.
- In extreme circumstances, prepare tanks for the carriage of clean ballast.

Tank cleaning can be accomplished by means of portable or fixed tank washing machines, or sometimes a combination of both, using hot, cold, fresh or seawater and/or tank-cleaning chemicals singly or in combination.

In order to reduce unnecessary bunker consumption, impact on the environment and associated costs, vessels should only tank clean when necessary. Also, introducing water into the cargo system is not always the best action as it can increase contamination if tanks and lines are not properly stripped.

Cargo tanks should be prepared to the standard necessary to meet the requirements for the next cargo or, where applicable, for clean ballast or for tank entry and repairs. The tank preparation tables 1, 2 and 3 are to be used as a guide to the degree of cleaning necessary between cargoes.

Depending on the intended use of the product concerned, the standard of preparation required by some charterers/receivers may be different from that found within these guidelines. It is, therefore, extremely important to ensure that preparation recommendations are provided in writing. Any deviations from recommendations should be confirmed in writing.

2.1.2 Inert gas

The inert gas system, where fitted, should be operated appropriately during tank-washing, gas-freeing and tank-preparation operations. Additional safety precautions should be taken for vessels that do not have inert gas systems. Safety recommendations contained in ISGOTT should be followed at all times.

Inert gas systems and scrubbers which are not operated correctly or are poorly maintained can result in cargo contamination with water, soot, SO_2 or SO_3. This can impact many products and, for aviation jet fuel, this can lead to filtration issues and reduce the effectiveness of static dissipator additives.

2.1.3 Static electricity

Precautions to prevent static discharge during washing operations are detailed in ISGOTT and should be followed at all times.

Particularly hazardous conditions may exist when washing under non-inert conditions or when using hot water wash, which can increase the temperature of cargo residues closer to their flashpoint.

2.2 TANK BOTTOM AND LINE FLUSHING

2.2.1 General

It may be acceptable to flush the tank bottoms with the next grade to be loaded. This flushing medium is normally then discharged ashore or segregated on board. Discharges to shore can only take place after discussion with all parties involved. There will be costs associated with this procedure (in particular, contamination of the flushing medium), and all parties will need to agree to these costs and how they are to be met.

Flushing pumps and lines using water can only be considered when suitable reception facilities are available ashore or where washings can be pumped to a suitable slops tank. On completion, all lines and pumps should be well drained, but the practice of draining to the pump room bilge shall be avoided.

2.2.2 Fuel oil/VGO cargoes

When changing from a higher quality product to a lower quality product (for example low to high sulfur), it may be possible, under certain circumstances, to reduce the tank preparation procedures. In these cases, the amount remaining on board (ROB) should still be minimised.

Provided that any contamination would not adversely alter the quality of the cargo to be loaded, then load on top may be possible. However, this matter should always be clarified with, and agreed to by, all interested parties. Where uncertainty exists, the tank preparation guidelines should be followed.

When loading vacuum gas oil/waxy distillate or other feedstock products, it will be necessary to remove salt residues from any tank which has previously contained saltwater ballast or has been cleaned using salt water (see Table 3), typically using a freshwater rinse.

2.3 ELIMINATION OF WATER FOR WATER CRITICAL CARGOES

When it is necessary to mop tanks dry for critical cargoes such as aviation kerosene, lubricating oil or FAME, care should be taken to achieve a compatible standard of preparation throughout that portion of the cargo system allocated to the product. The following procedures should be followed:

– The cargo lines which are to load and discharge the critical product should be opened and well drained. This includes manifolds, drop lines, pump discharge lines and tank suction lines.

– Cargo pumps and their associated air vessels, strainers and bypasses should be opened and well drained. This is to include any vacuum breakers.

– Individual tank suction valves should be opened and remain open during the mopping process. Valve inspection covers should be opened as necessary if available.

– Where fitted, fixed eductor systems should be blown through with air, valves opened and lines left to drain into the tank prior to mopping.

– Fixed tank washing lines should be drained, and any water in the leg between the main line and the machine allowed to drain into the tank via the machine prior to mopping.

– After draining, the fixed tank cleaning machines should be positively isolated from the supply line by blanking or other secure means.

– Particular attention should be paid to the inert gas deck seal overboard line. It should be ascertained that this line is free from blockage and that there are no valves partially or fully closed. Any substantial increase in the deck seal water level will cause 'carry over' and introduce water back into the tank during re-inerting.

– Low point drains on inert gas lines should be cleared of water and other liquid contamination. Condensed liquids in the inert gas lines can be hazardous.

As a general rule when loading, the product should be directed initially into a single tank using as many lines as possible. This will ensure that any water trapped in the system will be flushed through to this single tank. The water is then much easier to deal with at the discharge port if necessary. This procedure should be verified with the charterers and cargo owners.

2.4 CARGO RESIDUES

Residues should be dealt with in compliance with current MARPOL regulations to reduce the quantity of residues on board. When shore reception facilities are available at the loading port, residues should be discharged to the facilities. If they are not available, residues should be retained on board and segregated from the cargo.

2.5 TANK WASHING

2.5.1 General

Appropriate stern trim and efficient use of washing equipment are important. Minimum tank washing patterns should be used. Any accumulations of scale should be removed frequently, and excessive coating breakdown leading to build-up of scale should be recorded.

2.5.2 After black oil cargoes

These cargoes range from gas oils to heavy fuel oils and the degree of cleaning will vary considerably with the grade to be loaded and the grades previously carried. Products within this group are persistent oils and residues and should be handled in accordance with 2.4.

If the ship is reloading at the discharge port, it may be possible to pump washings/residues from tank cleaning operations to a shore facility. Otherwise, the residues will be retained on board. Regardless of the medium used for washing (cargo or water), care should be taken to ensure that segregation is not compromised.

Heavy fuel oils may leave residues on tank bottoms and structures and these can cause serious contamination of lighter fuels and gas oils. Washing should be continued until the

required degree of cleanliness is achieved. The bottom portion of the tank, together with any internal structure, may require particular attention, especially after carrying heavy or waxy fuel oils. Where available, portable tank cleaning machines may be required to ensure adequate coverage.

Hot water should always be used when the nature of the cargo warrants it or when a special degree of cleaning is required. The temperature of the hot water should be at least 15 °C above the pour point of the previous cargo in order to achieve effective removal by tank washing.

Scale formation is not usually heavy in ships which are employed solely on black oil trading, but where present, it may be mixed with waxy deposits from fuel oils which make it difficult to clean to the standard for gas oils and light fuel oils, etc. If a build-up occurs, special arrangements may need to be made to remove or reduce these deposits.

The amount of washing required when changing from a black oil cargo to a white oil cargo cannot be defined precisely as it varies considerably and depends primarily on the length of time the vessel was in the black oil trade, the condition of the tank coating and the arrangement of the cleaning machines within the tanks. It is particularly important to ensure that blind areas under structures are adequately washed.

After the initial washing, the tank should be gas-freed and inspected to check on the effectiveness of the washing.

Inadequate washing may be caused by poor stripping or failure to remove water from the tank during the wash. This can be due to a number of factors, including insufficient trim, adverse list or the pumps not keeping up with the water being added to the tank. Vessels shall also confirm that washing machines are working effectively and in good working order.

Another common practice when switching a vessel from black oil to white oil service would be to load one or a number of buffer cargo(es) such as gas oil.

The effectiveness of a buffer product in improving the tank/line condition will depend on multiple factors including, but not limited to, the initial condition of the tanks, the solvent nature of the buffer product, and the stowage level and length of time that the buffer product is carried.

A good indicator of how efficient a buffer product has been would be to compare the quality of samples taken before and after carriage (colour, density etc.).

If the colour of a buffer product after carriage is above ASTM Colour 2.5, additional tank cleaning will likely be required.

2.5.3 After white oil/clean product cargoes

White oil cargoes range from very light volatile oils like naphtha, to gas oils and lubricating oils.

Cold water washing is generally adequate for cleaning after most white oil cargoes, except after the carriage of the heavier lubricating oils where hot water or chemical wash may be required. Also, the risk of contamination of certain grades may require the removal of all previous cargo (see Table 1).

Although it is often important to remove all traces of the last cargo, it is also important to avoid excess tank washing, particularly with hot water, as this may eventually lead to expensive renewal of tank coatings.

Providing that the coatings are in a good condition, adhesion of most types of clean oil is minimal and this reduces the amount of washing required.

With volatile cargoes, little residue is left on tank sides and structure other than liquid and gases trapped in scale and other loose materials. With gas oils and lubricating oils, an oily film may remain. With all cargoes, there is also a small amount of liquid left below the effective stripping level.

2.5.4 After crude oil cargoes

The statutory requirements for washing after crude oils are contained within MARPOL. Additional sources of information are the vessel's cargo operations manual and EI HM 40.

The following points should be assessed when considering the need for water washing of crude oil tanks:

- the build-up of sludge in the tanks;
- the wax content of the crude;
- the possibility of delaying the washing until the vessel is in warmer water;
- the use of portable machines;
- the next crude to be carried and its suitability for washing, and
- loading port restrictions where there are strict environmental concerns for release of vapours.

2.5.5 After vegetable oil, animal fats or oil of bio-origin cargoes (not including finished grade fuels such as FAME and HVO)

These cargoes can often be solid at ambient temperatures and will be carried at elevated temperatures. They also often leave significant residues in the tanks, pipelines and pumps. All traces of such cargoes should be removed before loading petroleum products, as they can affect not only the next cargo loaded but those following later. When assessing cleaning requirements, careful consideration should be made to the properties of the previous cargo, the tank construction and the grade to be loaded.

Washing tanks with warm or hot water immediately after completion of discharge of these cargoes may cause the formation of an oil film or 'varnish' on internal tank surfaces and so vegetable oils which are liquid at ambient temperatures will typically be cold water washed, then washed with warm water followed by washing with cleaning chemicals.

Oils with higher melting points may require hot water washing, followed by washing with cleaning chemicals and a solvent wash.

See also 2.5.6, 2.5.9 and 2.11.5 regarding the loading of aviation jet fuel after vegetable oils, animal fats and waste bio-origin oils. See also Annex B for more information on the types of bio-origin cargoes.

2.5.6 After fatty acid methyl ester (FAME) or blended biodiesel cargoes

Analysis has shown that FAMEs adhere to surfaces more readily than other oils. However, as they remain liquid at ambient temperatures, they can be cleaned using a water wash and a cleaning chemical (type to be recorded in the vessel cleaning log) as described in 2.5.5 for lighter vegetable oils.

Some FAME grades may have cloud points above ambient temperatures so any wash water should be heated to at least 15 °C above this.

Contamination of aviation kerosene with FAME is a serious concern. Intermediate cargoes and a strict washing regime are therefore recommended when following these cargoes with aviation kerosene (see 2.11.5) and special cleaning instructions should be obtained from the cargo owner. See also Annex B for more information.

Note: The recommendations relating to FAME also apply to other fatty acid ethyl esters (FAEE).

2.5.7 After gasoline cargoes containing oxygenates (e.g., ethanol, MTBE)

Some cargoes are very sensitive to contamination from oxygenates blended into some gasolines.

Tank washing to remove oxygenate traces will be required prior to loading naphtha, condensate (see 2.11.1) and aviation grades (see 2.11.2 and 2.11.5).

2.5.8 After base lubricating oils

Base lubricating oils can be fully refined oils or refinery feedstocks. They refer to lubricating oils prior to blending to meet the end-customer requirements and the addition of additive packages required for their application.

Base lubricating oils can vary significantly in their properties depending upon the refining technique and how they are 'finished/upgraded'.

For example, the least refined types (known as Group 1 base oils) are generally less than 90 % saturates and have a high sulfur content. Those produced using the Fischer-Tropsch process, gas-to-liquid (GTL) base oils, are high-quality, clean, low-odour base oils with virtually no sulfur, nitrogen or aromatics.

Viscosities of base lubricating oils can vary from as little as 3 mm^2/s @ 40 °C to over 500 mm^2/s @ 40 °C.

Tank preparations will need to consider the specific type of base oil previously carried. Previously carrying a high-viscosity, high-sulfur, Group 1 base lubricating oil is likely to require a more intensive tank preparation than previously carrying a GTL base oil.

2.5.9 Use of chemicals

Due to environmental considerations, tank-cleaning chemicals should no longer be used except where there is a requirement for stringent cleaning, in which case specific instructions should be issued for chemically assisted cleaning at the time of the cargo nomination. Where chemicals are used, details should be recorded in the vessel cleaning log and slops should be segregated to allow for easier disposal.

Note: The use of cleaning chemicals can cause haze in any hydrocarbon. Tank-cleaning chemicals containing surfactants should not be used to prepare tanks for aviation jet fuel or aviation gasoline cargoes, as residues can cause fixed haze in the fuel and harm aviation fuel

filters (see 2.11.5).

2.5.10 Cleaning of sampling equipment and stilling wells

The tight specifications for sensitive grades require extreme care during sampling, particularly closed or restricted sampling, to avoid contamination from previous cargoes or build-up of residues. Examples of this are FAME contamination of aviation fuels, and vegetable oils in gasolines. To reduce the possibility of drawing unrepresentative samples, the cleaning of sampling equipment, vapour locks, standpipes and stilling wells is recommended as part of the tank-cleaning regime.

2.6 TANK INSPECTIONS/ASSESSMENT

2.6.1 General

Responsibility for the cleanliness and overall suitability of tanks (including coating), lines and pumps to carry the nominated grades lies with the Master. Inspections are frequently carried out, however while such inspections may provide an opinion regarding those tanks which have been inspected, they do not relieve the Master of their responsibilities.

Tank inspection/assessment is a very important part of any cargo-loading operation and the method used on a particular operation will be dependent on a number of factors, including the last three cargoes, cleaning procedures and applicable local regulations.

The types of tank inspection/assessment should be clearly identified in the report. The types available are as follows:

– sounding/gauging from deck level;

– visual inspection from deck level;

– internal inspection, and

– internal inspection including wall wash.

Tank entry for inspections is potentially dangerous and shall be gas-free and safe for entry. All instances of tank entry shall only be done in accordance with a strict permit-to-enter/work system for enclosed spaces with due consideration given to the applicable regulations. Careful attention should be given to personnel safety; the ISGOTT guidelines covers this in detail.

Note: Additional information on the various inspection/assessment types and wall-wash procedures can be found within Energy Institute HM 51 and API MPMS Chapter 17.8.

2.6.2 Inerted tanks

Any requirement for cargo tank(s) to be gas-freed to allow internal inspection should be contained within the agreed charter party or voyage orders for the voyage about to be undertaken, as de-inerting/re-inerting is costly and time-consuming.

Reference should be made to ISGOTT recommendations regarding inerting and tank entry.

2.7 HEATING COILS

2.7.1 Testing

Heating coils should be pressure tested and, if necessary, blown through and repaired on each occasion prior to:

– Loading a cargo which requires heating.
– Carrying out tank repairs or tank entry (so that any coil leak will not introduce hydrocarbon gases or product into the tank).
– Gas-freeing for voyage repairs or dry-docking.

Similar action should be taken when changing from a low flashpoint to a high flashpoint cargo or from black oil products to white oil products.

2.7.2 Heating coils made from copper-containing alloys

Heating coils made from copper-containing alloys can reduce the thermal stability of aviation kerosene due to copper dissolving into the cargo from the alloy.

Concentrations of copper in aviation kerosene fuel above 10 parts per billion (ppb) start to affect thermal stability and 50 ppb invariably results in failure to meet specified requirements.

For this reason, aviation kerosene shall not be carried in ships fitted with heating coils made from copper-containing alloys.

2.8 TANK COATINGS

2.8.1 Temperature restrictions

In ships with coated tanks, the temperature and pressure of washing water should not normally exceed 66 °C and 10,5 kg/cm^2, respectively. However, these may be increased subject to the following criteria:

– Agreement from the coating manufacturer that excessive heat and/or pressure will not damage the coating.
– Agreement from the tank cleaning equipment manufacturer that excessive heat and/or pressure will not cause damage to the machines.
– The temperature of the washing water should always be at least 15 °C above the pour point of the previous cargo.

In coated tanks of white-oil carriers, washing with cold water is generally adequate, except where more stringent cleaning is required after the carriage of vegetable oils, lubricating oils and diesel fuel. Hot water (and/or cleaning chemicals) may be used occasionally to degrease

tank structures, expedite gas-freeing for entry or where a gas-free condition is required for a major change of grade. When hot water is used, this should be in accordance with these criteria.

2.8.2 Coating compatibility

Although not directly related to tank washing, it should be noted that tank coatings are not compatible with all products. Problems usually relate to chemicals rather than petroleum products, but manufacturers' resistance lists (usually kept on board) should be consulted if there are any doubts regarding coating compatibility.

Organic epoxy coatings can absorb some chemical cargoes, particularly chlorinated solvents. The contamination potential to subsequent cargoes (particularly aviation kerosene) may be considerable, as significant quantities can be absorbed and retained, depending on the chemical, exposure time, temperature, specific coating type, thickness, condition, etc. Contamination can persist after several subsequent cargoes and washings.

For aviation fuels, many oil companies have their own list of acceptable coatings. Cargo tanks with zinc silicate coatings or zinc silicate linings should not be used for transportation of jet fuel because of the potential adverse impact on fuel thermal stability. Where this is unavoidable, specialist advice should be sought regarding additional testing requirements, for example thermal stability testing at elevated temperatures prior to loading and discharge. The charterer should be consulted regarding coating acceptability for aviation fuel cargoes.

2.8.3 Stainless steel

Although stainless steel is compatible with most grades, it is subject to attack by chlorinated compounds. This is made worse by the presence of water. In addition, some stainless steel grades are subject to attack by seawater, so if a seawater wash is used in a stainless steel tank, this should be followed immediately by a freshwater rinse.

Note: Some shore-supplied 'fresh' water can contain sufficient chlorine to attack/discolour stainless steel.

2.8.4 Coating condition

Damaged, flaking or blistering paint can increase hold-up of residues from previous cargoes. As a result, tanks with damaged coating should be avoided, particularly for critical cargoes such as naphtha, light distillate feedstock and aviation kerosene.

2.9 CARGO LINES

2.9.1 General

Procedures for line washing should be documented in the vessel's cargo operations manual. An assessment of the actual pump room and above-deck piping configuration should be undertaken to identify any problem areas or 'dead ends' which may require special attention or additional cleaning.

MARPOL pumps and lines should be included in all draining, cleaning and washing operations. This should be recorded in accordance with current MARPOL regulations.

2.9.2 Cargo compatibility

When loading more than one grade of cargo, it should be determined whether the grades are compatible in both the liquid and vapour state.

Compatibility between cargoes is entirely dependent on their characteristics and the quality specification of each grade. Pipeline admixture should be kept to a minimum at all times, as each admixture will result in some change in the quality of the loaded cargo. Permissible admixture of one cargo by another is governed by the tolerance of quality characteristics such as flashpoint, colour, sulfur content, viscosity, etc.

In general, admixtures may only be permitted for those loadings where wash code 1 is shown in Tables 1, 2 and 3.

2.9.2.1 Liquid compatibility

If the grades are not compatible, each grade should be loaded through a separate system, with segregation provided by two valves or a blind.

Where different but compatible cargoes, such as two grades of crude, are loaded, single-valve segregation may be acceptable providing that the valves have been tested and proved tight.

If two or more cargoes are compatible, loading should be carried out in sequence, commencing with the most critical cargo first. Any admixing which may occur should not adversely affect the quality of the second cargo to be loaded. Lines should be drained and/or stripped between grades.

2.9.2.2 Vapour compatibility

Vapours from a volatile cargo such as gasoline can be taken up in diesel or gas oil cargoes which share the same vent systems or are under the same positive pressure of inert gas. If vapour mixing can occur, each cargo should be loaded on a separate cargo and vent system with vent system cross-over valves closed and tagged. If it is not possible to load using separate vent systems then, when the ship design allows without impacting the latest SOLAS regulations, individual tanks should be isolated from the system.

Interconnecting inert gas block valves should be closed and tagged and, if vapour contamination from slops is possible, slops should be isolated from the main inert gas line. The oxygen content of isolated slop tanks should be monitored to ensure that it remains less than 8 % by volume.

Note: Before any tank is isolated from the main venting system, due consideration should be given to meeting the SOLAS requirements and a formal risk assessment should be conducted. The pressure in any tank segregated from the main venting system should be carefully monitored to ensure that individual tank venting arrangements are adequate to prevent formation of a vacuum or a build-up of pressure.

2.9.3 Testing of cargo lines and valves

On each occasion a tank is gas-freed and opened for entry, every effort should be made to

pressure test the associated internal pipelines and valves. A brief inspection of coatings and fittings should be undertaken at the same time. On no account should cargo be used to test pipelines and valves. Only clean water should be used for this purpose.

2.10 TANK PREPARATION

Tables 1, 2 and 3 provide guidelines for tank preparation.

The tables assume that tanks are coated and in good condition. Where this is not the case, additional cleaning may be required depending on the cargo involved; typically, the addition of gas-freeing, descaling and mopping where washing is specified.

Stripping and draining following discharge or washing is assumed to be thorough, such that any liquid ROB is confined to the pump well (if present). All associated lines (suction, deck lines and drop lines, etc.) are to be cleared and drained of all product or water.

Where washing is specified, this includes deck lines, loading drop lines and cross-over lines. For conventional pumping systems, pump room and bottom lines should also be washed.

By following these guidelines, it does not necessarily mean that the tank(s) will be acceptable for the next intended cargo. The Master is ultimately responsible for the cleanliness of the tank(s) and should ensure that the end result meets the owner's/charterer's/shipper's expectation.

Consideration may be given to substituting mopping by enhanced stripping and drying where such facilities are available.

Note: The internal tank structure shall be considered, as internal framing/steam coils/fixtures and fittings may affect the quantity of water or previous cargo ROB and may not allow the tank to be considered 'dry' even after additional stripping and drying.

2.11 COMMENTS ON INDIVIDUAL CARGOES (CARGO TYPES)

2.11.1 Naphtha and light distillate feedstocks (and/or – feedstocks, straight run benzene, pentane plus, natural gasoline, straight run gasoline)

Naphtha and light distillate feedstocks should not be contaminated by lead and should not be carried directly after cargoes that contained lead, such as aviation gasoline. Tank coating should be in good condition, as blistered or flaking tank coating can be a source of contamination from the previous cargo.

When loading after any cargo containing FAME, a hot water wash may be needed to remove residues.

Heavier feedstocks can tolerate minor admixing of aviation kerosene, kerosene, non-oxygenated solvents or lighter feedstocks.

Seawater washing should be followed by a freshwater rinse to remove chlorides. Some grades (such as chemical grade) are not tolerant of water contamination and tanks will require mopping prior to loading.

Chemical grade naphtha is very sensitive to contamination by oxygenates. Careful assessment is recommended and some contracts may specify that three oxygenate-free cargoes shall be carried before loading this cargo.

2.11.2 Aviation gasoline (and/or – avgas, aviation spirit)

Aviation gasoline products may have a high lead content and are often dyed.

Uncoated tanks should be hot water washed and have any loose bottom scale removed before loading.

Water cannot be tolerated, and extreme care should be taken to ensure that tanks and lines are drained before loading or discharging. Hand mopping is recommended. Products can also be sulfur critical.

Cleaning chemicals should not be used to prepare tanks for aviation gasoline cargoes as residues can cause fixed haze in the fuel and harm fuel filters/coalescers.

Contamination of aviation gasoline with oxygenates (ethanol, MTBE, etc.) could lead to specification issues. Thorough washing is required to ensure prevention of cross-contamination and the proposed tank cleaning/flushing plan should be discussed and agreed with the charterer.

2.11.3 Unleaded motor gasoline (and/or – unleaded motor spirit, regular unleaded, premium unleaded, super unleaded, toluene, methyl tertiary butyl ether (MTBE), reformate, alkylate, cracked spirit, ethanol, motor spirit/gasoline-blending components)

Thorough tank washing is required when following leaded products. Products are also sulfur critical.

Uncoated tanks should be hot water washed and have any loose bottom scale removed before loading.

2.11.4 Ultra-low sulfur gasolines

In addition to the comments in 2.11.3, these cargoes have a typical maximum sulfur content of 10 ppm (or possibly 50 ppm depending on location). If they are to be loaded into tanks or through lines that have previously contained cargoes that had a greater sulfur content, care should be taken to ensure that admixing is kept to a minimum.

When loading after gas oil, kerosene or Jet-A1, if the sulfur content of the pre-cargoes is less than 500 ppm, a thorough strip of all tanks, lines and pumps including drop lines may be sufficient instead of water washing. Attention is to be paid to the types of pumps used on the vessel, with deep-well pumps being more efficient at stripping than conventional pumps.

2.11.5 Aviation jet fuel (and/or – aviation kerosene, dual-purpose kerosene, Jet, Jet-A1, Avtur, ATK, JP5, JP8, synthetic jet fuel/sustainable aviation fuel (SAF), synthetic blending components (SBC))

These products are unleaded, fairly volatile and, depending upon their manufacturing process, may contain relatively high levels of sulfur (up to 3 000 ppm) which could affect the quality of a subsequent low sulfur cargo. Many refineries produce very low sulfur Jet A-1 (<10 ppm) and SBC tends to <5 ppm.

Loading aviation jet fuel cargoes on maiden voyages, or on first voyages after a dry dock where modifications to cargo handling systems (tanks, pumps and lines) have taken place, are not recommended given the increased risk of fuel contamination. However, such loadings can be acceptable when following guidance contained within EI/JIG 1530. For further guidance, please refer to the latest edition of EI/JIG 1530. Aviation jet fuel should not be carried after leaded products such as leaded aviation gasoline.

Jet fuel specifications preclude admixing by other cargo grades. See Table 1 for the exceptions (FAME-free undyed kerosene etc.).

Aviation jet fuels are particularly sensitive to water contamination. All reasonable efforts to eliminate water ingress to the cargo shall be taken, which includes ensuring that tanks and lines are drained/stripped effectively before loading. Mopping is recommended.

To avoid contamination from FAME it is recommended to have three intermediate FAME-free cargoes between FAME (B100), or any cargo with a FAME content greater than 15 % (B15), and an aviation jet fuel cargo.

In circumstances where one or more of the prior three consecutive cargoes carried contains a FAME content above 15 %, then the application of special cleaning procedures may render the tanks suitable for the carriage of aviation fuel, although the risk of FAME contamination remains high (additional testing for FAME contamination is recommended at load and discharge operations, first foots, spot cargo tanks and manifold/jetty etc.).

When following cargoes with a FAME content of 5 % or less (B5 or below), a hot water wash, including flushing of pumps and lines, followed by draining is recommended as a minimum.

When following cargoes with a FAME content of 15 % (B15) or less, but above B5, a hot water wash, including flushing of pumps and lines, followed by draining is again recommended as a minimum. However, tanks must be in good condition and washing needs to be particularly stringent. A single intermediate cargo with no FAME content is suggested as an alternative, followed by a hot water wash, including flushing of pumps and lines, and by draining.

Where the FAME content of a previous cargo is not known, it should be assumed to be 15 % or higher.

The very low specification limits for FAME contamination require extreme care during sampling. To reduce the possibility of drawing unrepresentative/contaminated samples, consideration should be given to cleaning of standpipes and stilling wells as part of the tank cleaning regime when tanks have previously held cargoes containing FAME. It is also recommended that sampling equipment (including restricted systems) is ensured to be clean and FAME free before use to eliminate chances of cross contamination if previously used for products containing FAME.

Note: The recommendations relating to FAME also apply to other fatty acid esters such as FAEE.

Other prior cargoes can have an adverse effect on aviation kerosene product quality and intermediate cargoes are recommended in these circumstances.

Cleaning chemicals shall not be used to prepare tanks for aviation jet fuel cargoes as residues can cause fixed water haze in the fuel and harm aviation fuel filters.

In all cases, salt contamination needs to be minimised after washing with seawater. Following any seawater washing, a freshwater rinse is recommended, although a thorough mopping of tanks, when carried out effectively, will suffice.

2.11.6 Premium and regular kerosene (and/or – kerosene feedstock, burning oil, stove oil)

Products may contain relatively high levels of sulfur which could affect the quality of a subsequent low sulfur cargo.

Flashpoint may be critical such that admixing with low flash point cargoes in tanks and lines should be avoided.

Admixing of dyed kerosene with undyed kerosene can result in the undyed cargo not meeting colour specifications. Tanks that have carried dyed products will require washing and mopping dry prior to loading undyed products. The type of dye used in the previous cargo is also relevant, liquid dye being easier to clean than powdered dye. Powdered dye may still be present in locations such as tank coamings, stilling wells or vapour locks, depending on how the dye was added to the cargo. It is recommended that the cleaning is checked accordingly.

Small amounts of gas oil may be tolerated (up to 0,1 % volume), subject to comments under 2.11.7.

2.11.7 Gas oil and automotive diesel fuel (and/or – automotive gas oil, automotive diesel oil, DERV, distillate marine diesel)

Some admixing with lighter distillate cargoes, such as kerosene, is acceptable, depending on minimum flashpoint requirements for the individual cargo. However, flash point requirements will preclude admixing with any naphtha, motor gasoline or other cargoes with low flash points.

Water contamination is a problem leading to ‘haze’ in the product. This can produce a water layer and subsequent corrosion in downstream storage.

The admixing of dyed gas oil with undyed gas oil can result in the undyed material not meeting the colour specification. Tanks that have carried dyed products will require washing prior to loading undyed products. The type of dye used in the previous cargo is also relevant, liquid dye being easier to clean than powdered dye. Powdered dye may still be present in locations such as tank coamings, stilling wells or vapour locks, depending on how the dye was added to the cargo. It is recommended that the cleaning is checked accordingly.

Cleaning chemicals can have a negative effect on gas oil or automotive diesel fuel quality and if these are used, hot water washing is recommended to remove any traces.

Increasingly, diesel fuels for road transport are blends of FAME* and conventional diesel fuel- blended biodiesel. These blends may simply be referred to as diesel fuel, but the grade name may indicate the percentage of FAME. Thus, a B7 diesel fuel contains 7 % FAME and a B15 diesel fuel, contains 15 % FAME. Cleaning procedures vary with the percentage of FAME in the blend, so it is important that shippers determine the FAME content of diesel fuel cargoes. Where the FAME content of a diesel fuel cargo is not known, it should be assumed to be 15 %.

Gas oil blends with paraffinic diesel are also becoming more common. Paraffinic diesel is similar chemically to gas oil therefore no additional precautions are needed when cleaning from these blends.

* These comments also apply to FAEE and other fatty acid esters.

Note 1: Some national specifications do not permit FAME in diesel that is not designated as biodiesel, even at contamination levels. In such cases, precautions similar to those used for aviation jet fuel should be followed.

Note 2: Some gas oils may contain up to 3 000 ppm sulfur. In Europe, a spec of 1 000 ppm is currently applied.

2.11.8 Ultra-low sulfur automotive diesel fuel (and/or – ULSD, ULS turbine gas oil)

In addition to the comments in 2.11.7, these cargoes typically have a maximum sulfur content of 10 ppm (possibly 50 ppm depending on location). If they are to be loaded into tanks or through lines that have previously contained cargoes that had a greater sulfur specification, care should be taken to ensure that admixing is kept to a minimum.

Gas oil and diesel cargoes, intended to be used as gas turbine fuels, are especially sensitive to contamination by metals, some of which are present in seawater, such as sodium, calcium and potassium.

It will be necessary to remove salt residues from any tank which has previously contained seawater ballast or has been cleaned using seawater, by rinsing with fresh water.

Flash point may be critical such that admixing with low flash point cargoes in tanks and lines should be avoided.

When loading after gasoil or Jet A1, if the sulfur content of the pre-cargoes is less than 500 ppm, a thorough strip of all tanks, lines and pumps, including drops, may be sufficient instead of water washing. Attention is to be paid to the types of pumps used on the vessel, with deep-well pumps being more efficient at stripping than conventional pumps.

2.11.9 Paraffinic diesel (HVO/GTL)

This is a diesel grade typically made from synthesis gas or hydrotreated bio-oils and fats. The diesel is primarily paraffinic and contains a mixture of N-paraffins, cyclo-paraffins and iso-paraffins. The ratio of these can affect the properties such as the cetane number and the cold properties. Due to this, the quality can vary though typically it will meet the requirements of standard specifications such as EN 15940. Often these are water white, have excellent cold properties and very low sulfur content, though a review of the quality certificate is recommended when reviewing cleaning plans. Depending on the processing involved, some grades will have higher cloud points so may require heating and possibly a hot wash.

When loading HVO, and reviewing cleaning, attention should paid to possible colour degradation and sulfur increase from previous cargo. The flashpoint is similar to those of the diesel specifications that are often mixed with paraffinic diesel in order to make finished grade diesel. Aromatics are also tightly controlled.

Gas-to-liquid (GTL) products are entering the market, typically naphtha, kerosene and diesel. Properties are as per similar non-GTL cargoes but all are low sulfur and low aromatic.

2.11.10 Crude oil and dirty condensate

The properties of crude oil cargoes vary considerably. General guidance, together with a list of physical properties of many grades along with washing and carriage recommendations, is given in EI HM 40 *Guidelines for the crude oil washing of ships' tanks and the heating of crude oil being transported by sea*.

Condensate which is dark in colour may be treated as crude oil. For the purposes of this guide, this applies to any condensate with an ASTM Colour of greater than 2,5. For any condensates at 2,5 or lower, see 2.11.11.

2.11.11 Clean condensate

For condensates that are 'clean', in other words those with an ASTM Colour less than 2,5, allow loading of clean products as detailed in Tables 1 and 2. Typically, ships in clean service will only load condensate if the colour is sufficiently light enough. To determine whether a condensate is clean, the quality certificate of the condensate shall be reviewed.

Clean condensate is often sent directly to cracking units so pre-cargoes should not contain any oxygenates or heavy metals as these could adversely affect the catalyst.

When loading of aviation fuel is being considered, the quality certificate of the condensate shall be reviewed. Attention shall also be given to the following parameters of the condensate:

Either
- ASTM D1500/IP196 should be less than 2,5.
- ASTM D86/IP123 distillation should be less than 10 % residue at 290 °C.
- Cloud point should not be greater than -10 °C.
- Viscosity at 20 °C should be less than 1,5 mm^2/s.

Or if some of the data above are not available on prior cargoes of condensate to determine that they were 'clean' for loading aviation jet fuel and components, an after-loading ship's MTC(s) should be tested (COA or RTC) to confirm compliance to specification. EI/JIG 1530 section 4.5.6 variability limits shall apply. Note 3 of EI/JIG 1530 Table 2 requires testing for incidental materials (i.e., FAME) where risk of contamination exists from (prior cargoes).

2.11.12 Base lubricating oils

The properties of base lubricating oils can vary considerably, depending on their intended application (see 2.5.8), and they can be sensitive to contamination from previous cargoes affecting the sulfur content, viscosity, flash point, colour, particulates and wax content.

All base lubricating oils are very sensitive to water contamination and it is important to ensure tanks are dry prior to loading.

Gas-to-liquid base oils are extremely sensitive to contamination by coloured cargoes and those containing sulfur and aromatics, while some specializsed application oils, such as those used to form transformer oils, are sensitive to dirt and rust.

2.11.13 Vacuum gas oil (and/or – cracker feed, waxy distillate)

These cargoes are sodium-critical and tanks which have been seawater washed will require freshwater washing to remove any salt traces. Vacuum gas oil may be loaded on top of some light crude oils and condensates without washing. However, as with fuel oils, the need to heat the product leads to a high flash point specification and precludes admixing with any volatile residues.

2.11.14 Medium and heavy fuel oils

The admixing of these cargoes with waxy residues can result in the material not meeting the maximum pour point specification limit. Tanks which have carried high pour point cargoes should be carefully drained and stripped prior to loading.

The need to heat the product leads to a high flashpoint specification and precludes admixing with any volatile residues. Washing will generally be required when loading these products after crude oil cargoes. Water itself can affect the quality of the grade to be loaded where water and sodium levels are tightly controlled, so wash water shall be thoroughly stripped.

2.11.15 Low sulfur fuel oil (and/or – low sulfur atmospheric residue (LSAR), low sulfur waxy residue (LSWR))

In addition to comments in 2.11.14, these products are frequently traded with sulfur content very close to the specified upper limit. Admixing with cargoes with higher sulfur content should therefore be kept to a minimum. Hot washing may be required when loading after crude oils or other fuel oils, depending on the characteristics of the cargo discharged.

Cargoes for refinery cracking will also be sodium-critical, and tanks which have been washed with salt water will require washing with fresh water to remove any salt traces.

2.11.16 FAME and blended biodiesel

FAMEs vary considerably in properties, depending on the original source of the oil/fat. However, all are prone to absorb water both from the atmosphere and from tank washing activities. Tanks which have been subject to water washing should therefore be mopped dry before loading any cargo of FAME or FAME/petroleum diesel blend.

2.11.17 Light cycle oil (LCO)

LCO can be a dark product or a clear, straw-coloured product.

With regard to products following LCO: dark LCO should be treated as a black oil cargo and clear LCO can be treated as a clean cargo.

Cleaning before loading LCO will depend on the end use of the product and, of course, the previous cargo. Advice should be requested from the cargo owner/charterer.

2.11.18 Oxygenates

Oxygenates are organic compounds containing oxygen that can be used as a fuel or fuel component. They are commonly blended into gasoline. Most common oxygenates are water soluble so are straightforward to clean from as a last cargo. They also have a low flash point, therefore tanks will need to be made gas-free or purged with inert gas to reduce hydrocarbon gas levels to acceptable limits. Common oxygenates seen in the energy industry are methanol, ethanol, MTBE, ETBE, IPA, n-butanol and n-propanol. Oxygenates also include ketones and aldehydes. Prior to cleaning, owners are to assess the properties of the product to ensure that a suitable cleaning regime is used.

2.11.19 Aromatics

Aromatics are solvents that primarily contain compounds with a benzene ring. There are many of these. For the purposes of this guide, the pre-cargoes refer to the compounds and mixtures commonly found in the energy industry. This doesn't include any inhibited cargoes such as styrene. A non-exhaustive list is below:

- xylenes (isomers or mixtures) toluene or mixed aromatics C7-C9;
- ethyl benzene;
- benzene;
- benzene heart cut;
- pyrolysis gasoline;
- platformate;
- reformate, and
- cumene.

Some aromatics have a higher melting point than ambient temperature so water should be heated (40-60 °C) when washing from these pre-cargoes.

Table 1: Tank preparation recommendations – Loading aviation/kerosene grades

This table to be used only with reference to the written recommendations of HM 50. See 2.11.

This table to be used only with reference to the written recommendations of HM 50 See:	Cargo to be loaded	Previous cargo: Aviation gasoline	Aviation jet fuel and components	Motor gasoline containing oxygenates (ethanol, MTBE, etc.)	Motor gasoline (unleaded)	Ultra-low sulfur motor gasoline (unleaded) †	Oxygenates	Aromatics †	Naphtha (lead-free)	Clean condensate	Natural gasoline (NGLs)†	Kerosene and gas oil (undyed)	Kerosene and gas oil (dyed)	Ultra-low sulfur gas oil/diesel	Paraffinic diesel (HVO/GTL)	Diesel blended with up to 15 % FAME (B15 or lower) (see notes 3 and 4)	FAME or diesel/gas oil blended >15 % FAME (B15 or higher) (see note 4)	Base lubricating oil – See 2.5.8	Vacuum gas oil, fuel oil, crude oil and dirty condensate (see note 2.5.4)
2.11.2	Aviation gasoline #	1	2M	2M	1	1	2M	1	2M	2M	2M	2M	2M	2M	2M	3M*	X*	X*	X*
2.11.5	Aviation jet fuel and components #	2M	1	2M	2M	2M	2M	2M	2M	2M	2M	1	2M	1	1	3M*	X*	X*	X*
2.11.6	Kerosene (undyed)	2P	1	2P	2P	2P	2P	2P	2P	2P	2P	1	2	1	1	1	2	3	X
2.11.6	Kerosene (dyed)	2P	1	2P	2P	2P	2P	2P	2P	2P	2P	1	1	1	1	1	2	3	X

Notes for Table 1: Tank preparation recommendations – Loading aviation/kerosene grades

Code	Cleaning recommendations
X	Not to be loaded without special cleaning instructions
X*	Not to be loaded without special cleaning instructions. Three clean and zero FAME or vegetable oils/animal fats or unrefined oil of bio-origin content in the intermediate cargoes recommended
1	Drain tanks, lines and pumps well. If previous cargo shows signs of instability or oxidation (dark colouring or broken down from sediment), then use code 2M
2	Wash with cold water and drain well
3	Wash with hot water and drain well
3M*	A stringent hot water wash, drain and mop may be sufficient if tanks are in good condition. As an alternative one clean product/zero biological content intermediate cargo is recommended, followed by hot water wash, drain and mop. Freshwater rinse required if seawater is used. Consideration may be given to substituting mopping by enhanced stripping and drying, see 2.10
P	Purge to below 2 % hydrocarbon by volume
M	Gas-free, lift scale and mop. Consideration may be given to substituting mopping by enhanced stripping and drying, see 2.10
#	A freshwater rinse is recommended following a seawater wash, although thorough mopping of tanks, when carried out effectively, will suffice

Notes:

1. Additional cleaning may be required for uncoated tanks, tanks with extensive coating breakdown or where specified by the charter party.
2. † Benzene may be present in any petroleum product but may be present in higher concentrations in those products marked. Refer to ISGOTT for .precautions in handling cargo suspected of having a benzene content and prior to entering a space which has contained such a cargo.
3. In cases where the FAME content in diesel is unknown, and in locations where reporting of FAME content is not required, it shall be assumed to be 15 %.
4. Comments regarding FAME also apply to FAEE and other fatty acid esters
5. A clean condensate is defined in 2.11.11. Some clean condensates can be treated like naphtha so careful cleaning may be required and any pre-cargoes with oxygenates or lead should be avoided.
6. When loading aviation fuels after clean condensate, if the recommended data listed in 2.11.11 is not available, as an alternative to intermediate cargoes, following cleaning (as directed by HM-50 guidance and ship's master), and after loading, a ship's MTC(s) may be tested (COA or RTC) to confirm compliance to specification. EI/JIG 1530 section 4.5.6 variability limits shall apply. Note 3 of EI/JIG 1530 Table 2 requires testing for incidental materials (i.e., FAME) where risk of contamination exists (prior cargoes).

Table 2: Tank preparation recommendations – Loading clean grades

This table to be used only with reference to the written recommendations of HM 50. See 2.11.																					
		Previous cargo																			
This Table to be used only with reference to the written recommendations of HM 50 See:	Cargo to be loaded	Aviation gasoline	Aviation jet fuel and components – see note 9	Motor gasoline containing oxygenates (ethanol, MTBE, etc.) †	Motor gasoline (unleaded) †	Ultra-low sulfur motor gasoline (unleaded)	Oxygenates	Aromatics †	Naphtha (lead-free)	Clean condensate	Natural gasoline (NGLs)†	Kerosene and gas oil (undyed)	Kerosene (dyed)	Gas oil (dyed)	Ultra-low sulfur gas oil/diesel	Paraffinic diesel (HVO/GTL)	Diesel blended with up to 15 % FAME (B15 or lower) (see note 4)	FAME or diesel/gas oil blended >15 % FAME (B15 or higher) (see notes 3 and 4)	Base lubricating oil – See 2.5.8	Vacuum gas oil	Fuel oil, crude oil and dirty condensate (see note 2.5.2 and 2.5.4)
2.11.3	Motor gasoline (unleaded) containing oxygenates (ethanol, MTBE, etc.) †	2M	1	1	1	1	1	1	1	2M	1	1	1	2M	1	1	1	2M	3M	X	X
2.11.3	Motor gasoline (unleaded) †	2	1	1	1	1	1	1	1	2	1	1	1	2	1	1	1	2	3	X	X
2.11.4	Ultra-low sulfur motor gasoline (unleaded) †	2M	2M	2M	2M	1	1	1	2M	2M	2M	1, Note 5	2M	2M	1	1	1	2M	3	X	X
2.11.1	Naphtha (lead-free) †# See note 7	X	1	2, Note 6	1	1	X	1	1	2	1	1	2	2	1	1	2	3	3	X	X
2.11.11	Clean condensate # See note 8	X	1	2, Note 8	1	2	X	1	1	1	1	1	2	2	1	1	2	3	3	X	X
2.11.1	Natural gasoline (NGLs) †	X	1	1	1	1	X	1	1	1	1	1	2	2	1	1	1	2	3	3	X
2.11.7	Gas oil (undyed)	2P	1	2P	2P	2P	2P	2P	2P	2P	2P	1	2	2	1	1	1	2	3	3	X
2.11.7	Gas oil (dyed)	2P	1	2P	2P	2P	2P	2P	2P	2P	2P	1	1	1	1	1	1	2	3	3	X
2.11.8	Ultra-low sulfur gas oil/diesel	2M	2M	2M	2M	2M	2M	2M	2M	2M	2M	1, Note 5	2M	2M	1	1	1	2M	3M	X	X
2.11.9	Paraffinic diesel (HVO/GTL)	2M	2M	2M	2M	2M	2M	2M	2M	2M	2M	1, Note 5	2M	2M	1	1	1	2M	3M	X	X

Notes for Table 2: Tank preparation recommendations – Loading clean grades

Code	Cleaning recommendations
X	Not to be loaded without special cleaning instructions
1	Drain tanks, lines and pumps well. If previous cargo shows signs of instability or oxidation (dark colouring or broken down from sediment) then, use code 2M
2	Wash with cold water and drain well
3	Wash with hot water and drain well

P	Purge to below 2 % hydrocarbon by volume
M	Gas-free, lift scale and mop. Consideration may be given to substituting mopping by enhanced stripping and drying, see 2.10
#	Freshwater rinse after any seawater wash when loading these products

Notes:

1. Additional cleaning may be required for uncoated tanks, tanks with extensive coating breakdown or where specified by the charter party.
2. † Benzene may be present in any petroleum product but may be present in higher concentrations in those products marked. Refer to ISGOTT for precautions in handling cargo suspected of having a benzene content and prior to entering a space which has contained such a cargo.
3. In cases where the FAME content in diesel is unknown, and in locations where reporting of FAME content is not required, it shall be assumed to be 15 %.
4. Comments regarding FAME also apply to FAEE and other fatty acid esters.
5. Where high sulfur kerosene or gas oil has been discharged, Code 2M should be used.
6. Chemical grade naphtha is very sensitive to contamination by oxygenates and some contracts may require three oxygenate-free cargoes before loading chemical grade naphtha.
7. Seawater washing should be followed by a freshwater rinse to remove chlorides. Some grades are not tolerant of water contamination and tanks will require mopping prior to loading.
8. A clean condensate is a condensate with an ASTM Colour of 2,5 or lower. Refer to 2.11.11 for definition of clean condensate. Some clean condensates can be treated like naphtha so careful cleaning may be required and any pre-cargoes with oxygenates or lead should be avoided.
9. When loading ultra-low sulfur motor gasoline, gas oil/diesel or paraffinic diesel after aviation jet fuel with less than 500 mg/kg sulfur or components such as synthetic blending components, the vessel may be able to use Code 1 provided tanks, lines and pumps are stripped and well drained.

Table 3: Tank preparation recommendations – Loading heavy/dark grades

This table to be used only with reference to the written recommendations of HM 50. See 2.11.																			
		Previous cargo																	
This table to be used only with reference to the written recommendations of HM 50 See:	Cargo to be loaded	Aviation gasoline	Aviation jet fuel and components	Motor gasoline (may contain oxygenates; ethanol, MTBE, etc.)	Oxygenates	Aromatics †	Naphtha (lead-free)	Clean condensate	Natural gasoline (NGLs)†	Kerosene (dyed and undyed)	Gas oil (dyed and undyed)	Ultra-low sulfur gas oil/diesel	Paraffinic diesel (HVO/GTL)	Diesel blended with FAME (see note 3)	Base lubricating oil – See 2.5.8	Vacuum gas oil	Fuel oil (sulfur > 0.5 %)	Low sulfur fuel oil (sulfur < 0.5 %)	Crude oil and dirty condensate (see note 2.5.4)
2.11.12	Base lubricating oil	2M	2M	2M	2M	2M	2M	2M	2M	2M	2M	2M	2M	2M	LU	X	X	X	X
2.11.13	Vacuum gas oil #	2P	1	2P	2P	2P	2P	2P	2P	1	1	1	1	1	1	1	1	1	3P
2.11.14	Fuel oil (sulfur > 0.5 %)	2P	1	2P	2P	2P	2P	2P	2P	1	1	1	1	1	1	1	1	1	3P
2.11.15	Low sulfur fuel oil (sulfur < 0.5 %)	2P	1	2P	2P	2P	2P	2P	2P	1	1	1	1	1	1	1	3P	1	3P
2.11.10	Crude oil, dirty condensate †	2	1	1	2P	1	1	1	1	1	1	1	1	1	1	1	1	1	1

Notes for Table 3: Tank preparation recommendations – Loading heavy/dark grades

Code	Cleaning recommendations
X	Not to be loaded without special cleaning instructions
1	Drain tanks, lines and pumps well. If previous cargo shows signs of instability or oxidation (dark colouring or broken down from sediment), then use code 2M
2	Wash with cold water and drain well
3	Wash with hot water and drain well
P	Purge to below 2 % hydrocarbon by volume
M	Gas-free, lift scale and mop. Consideration may be given to substituting mopping by enhanced stripping and drying, see 2.10
#	Freshwater rinse after any seawater wash when loading these products
LU	Reduced cleaning may be permitted depending on lubricating oil specification. Otherwise apply code 3M

Notes:

1. Additional cleaning may be required for uncoated tanks, tanks with extensive coating breakdown or where specified by the charter party.
2. † Benzene may be present in any petroleum product but may be present in higher concentrations in those products marked. Refer to ISGOTT for precautions in handling cargo suspected of having a benzene content and prior to entering a space which has contained such a cargo.
3. Comments regarding FAME also apply to FAEE and other fatty acid esters.

ANNEX A
GLOSSARY OF TERMS

For the purposes of these EI guidelines, the terms used should be understood to have the following meanings:

admixture; transmix	Quantity of a different product (usually from a previous batch or cargo) which becomes mixed with the current batch or cargo.
aromatics	For the purposes of this guidance, aromatics means any conventional solvent containing a benzene ring, such as benzene, toluene, xylene (BTX) and ethyl benzene, as well as mixtures containing primarily aromatic compounds such as BTX, reformate and pygas.
ASTM colour	Colour scale for clean petroleum products as defined in ASTM D1500, latest version. Products are compared with coloured discs ranging in value from 0,5 to 8,0.
ATK	Aviation turbine kerosene.
aviation jet fuel (conventional)	Hydrocarbons for use in aviation turbine engines and derived from the following conventional sources: crude oil, natural gas, liquid condensate, heavy oil, shale oil and oil sands.
ballast	Water taken on board when a vessel is empty or partially loaded/discharged to increase draught so that the propeller is fully immersed, stability and trim are maintained, and stresses are minimised.
black oils	Petroleum products containing residual components which make them dark in colour.
blended biodiesel	Diesel fuel which is a blend of biologically derived components (e.g., FAME, FAEE or other fatty acid esters) and petroleum diesel. The percentage of biological component is often designated in the grade name, e.g., B15 indicates 15 % biological component.
BTL	biomass-to-liquid is a multi-step process of producing synthetic hydrocarbon fuels made from biomass via a thermochemical route.
clean ballast	Ballast contained in cargo tanks that have been crude oil washed (where appropriate) and thoroughly water washed. It may be discharged to sea and meets MARPOL requirements.
clingage	Material which adheres to the surfaces of tank walls and structures, both horizontal and vertical, within empty and part-empty tanks, other than bottom surfaces.
cloud point	Temperature at which a cloud of wax crystals first appears in a liquid when it is cooled under specified conditions. Also known as wax appearance temperature or wax appearance point.
COA	Certificate of Analysis, see EI/JIG 1530 for a full definition.

crude oil washing (COW)	The use of a high pressure stream of the crude oil cargo to dislodge or dissolve clingage and sediments from the bulkheads, bottom and internal tank structures of a vessel during the discharge operation.
DERV	Diesel Engine Road Vehicle is a fuel that is used to power road vehicles
enhanced stripping	Some deepwell cargo pumps have 'stripping cones' fitted to the pump impellers to enable enhanced stripping. These may be provided at time of construction, or they may be retrospectively fitted. A separate vacuum drain line may also have been incorporated.
fatty acid ethyl ester (FAEE)	Sometimes referred to as biodiesel or B100 (not yet widely used but properties similar to FAME).
fatty acid methyl ester (FAME)	Sometimes referred to as biodiesel or B100.
flashpoint	Lowest temperature of the test portion, corrected to a barometric pressure of 101,3 kPa, at which the application of an ignition source causes the vapour of the test portion to ignite and the flame to propagate across the surface of the liquid under the specified conditions of test.
gas-free	A tank, compartment or container is gas-free when sufficient fresh air has been introduced into it to lower the level of any flammable, toxic or inert gas to that required for a specific purpose, e.g., hot work, entry, etc.
GTL	Gas to liquid is a refinery process to convert natural gas or other gaseous hydrocarbons into longer-chain hydrocarbons, such as gasoline or diesel fuel.
HVO	Hydrotreated vegetable oil. This is produced from vegetable oils and other bio-origin feedstocks such as used cooking oil. See 2.11.9.
IMO	International Maritime Organization.
inert gas (IG)	A gas or gas mixture used to render the vapour space in the cargo tank non-flammable.
ISGINTT	*International Safety Guide for Inland Navigation Tank-barges and Terminals.*
ISGOTT	*International Safety Guide for Oil Tankers and Terminals.*
ISO	International Organization for Standardization.
MARPOL	Latest version of the Protocol of 1978 relating to the International Convention for the Prevention of Pollution from Ships, 1973.
MTC	Multiple tank composite, see EI/JIG 1530 for a full definition.

NGL	Natural gasoline
NLS	Noxious Liquid Substances.
oxygenate	An oxygen-containing organic compound such as an alcohol (e.g., ethanol) or ether (e.g., MTBE, ETBE) that can be used as a gasoline component.
persistent oil	The International Oil Pollution Compensation (IOPC) Fund guidelines consider an oil as non-persistent if, at time of shipment, at least 50 % of the hydrocarbon fractions, by volume, distil at a temperature of 340 °C and at least 95 % of the hydrocarbon fractions, by volume, distil at a temperature of 370 °C when tested in accordance with ASTM D86. A persistent oil is one which does not meet these criteria.
pour point	The lowest temperature at which a sample of petroleum product will continue to flow when it is cooled under specified standard conditions (see IP 15/ASTM D 97).
ppb	Parts per billion.
ppm	Parts per million or mg/kg.
purging	The introduction of inert gas into a tank already in an inert condition with the object of further reducing the existing oxygen content and/or the existing gas content to a level below which combustion can be supported if air is subsequently introduced into a tank.
remaining on board (ROB)	Sum of measured liquid volume, including free water, and measured non-liquid volume but excluding vapours, in cargo tanks on completion of discharge.
RTC	Recertification Certificate, see EI/JIG 1530 for a full definition.
SAF	sustainable aviation fuel
slop tank(s)	For the purposes of these guidelines, tank(s) utilised as a reservoir for COW medium and receipt of tank washings.
SOLAS	International Convention for the Safety of Life at Sea.
stripping	The removal of the final contents of a cargo tank, possibly using equipment additional to the main cargo pumps.
synthetic blending component (SBC)	A synthesised hydrocarbon that meets the requirements of one of the annexes of ASTM D7566, which may then be used as a component in the manufacture of semi-synthetic jet fuel.
trim	The difference between the fore and aft draught of the vessel. When the aft draught is greater than the forward draught, the vessel is said to be trimmed 'by the stern'. When the draught is less than the forward draught, the vessel is said to be trimmed 'by the head'.
ULSD	Ultra low sulfur diesel – automotive diesel.

viscosity	A measurement of a fluid's resistance to flow at a prescribed temperature. In this document the unit mm2/s for kinematic viscosity has been used. This is equivalent to Centistoke (cSt).
wax	A mixture of long chain hydrocarbons that crystallise at different temperatures as the overall fluid temperature falls.
white oils	Clean, refined petroleum products which are not dark in colour such as motor spirit, kerosene, gas oil, diesel fuel and blending components.

ANNEX B
BIOLOGICALLY DERIVED MATERIALS

A biologically derived material is any material that is produced over a short time span and originates from living organisms (such as plants and animals); this is in contrast to the very slow natural processes involved in the formation of fossil fuels. Biologically derived materials can be from agricultural, domestic or industrial sources.

Biologically derived material can be extremely varied in quality, but can be broadly divided into three groups to help determine the risk to conventional fuels and products:

Oils, fats and extracts, e.g. used cooking oil palm oils, and cashew nut shell liquid

This represents an extremely varied group of products or by-products (wastes), originating from food production, agricultural, forestry and industrial processes. They can contain compounds such as triglycerides, fatty acids, phospholipids, sterols, organic acids, phenols, aldehydes, ketones, carbohydrates etc. which are not typically seen in conventional fuels and products.

Significant amounts of contaminants such as water, nitrogen, sulfur, oxygen and halogens, and acidity levels, can significantly impact the quality of conventional fuel cargoes and, as a result, specialised cleaning is likely to be required to prevent contamination to the next cargo to be loaded.

Sustainable fuels and fuel components, e.g. FAME, FAEE, ethanol and methanol

These are products, derived from biological materials, that are specifically designed as a fuel or as a fuel component. Their composition is often controlled by a specification such that they can be used neat as a fuel or in blends with conventional fuels.

While they are intended to be used as fuels, they still contain compounds which may be prohibited in some products e.g. oxygen, esters and alcohols. As a result, cleaning will be required to prevent contamination to those sensitive next cargoes. For other products, contamination can be tolerated.

Biologically derived materials which have undergone additional refinery techniques, e.g. HVO, BTL, SBC

Referred to as hydroprocessed or synthetic fuels, these products are ultimately derived from biological materials, however refining techniques, such as hydroprocessing, mean that the compounds they contain resemble some of those found in conventional fossil fuels rather than those in biological materials. These refining techniques result in a non-polar hydrocarbon fuel with very low levels of contaminants.

For tank-cleaning purposes, these products can often be treated much like their conventional fossil equivalents.

ANNEX C
REFERENCES

The following standards and papers have been used in the preparation of this publication:

Central Commission for Navigation on the Rhine (CCNR) – https://www.eda.admin.ch/smno/en/home/zentralkommission-fuer-die-rheinschifffahrt.html

Energy Institute (EI) – https://www.energyinst.org

EI/JIG 1530 *Quality assurance requirements for the manufacture, storage and distribution of aviation fuel to airports*

EI 1533 *Quality assurance requirements for semi-synthetic jet fuel and synthetic blending components (SBC)*

HM 40 *Guidelines for the crude oil washing of ships' tanks and the heating of crude oil being transported by sea*

International Maritime Organization (IMO) – https://www.imo.org

Crude oil washing systems, revised 1983

International Convention for the Safety of Life at Sea (SOLAS), 1974, including amendments, Chapters 11 and 12

Regulations for the prevention of pollution by oil, Annex I and Annex II of MARPOL 73/78 including amendments

Oil Companies International Marine Forum (OCIMF) – https://www.ocimf.org

International safety guide for inland navigation tank-barges and terminals

Witherbys – http://www.witherbys.com

International safety guide for oil tankers and terminals (ISGOTT), 6th edition

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