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GUIDELINES FOR USE OF LOW SULPHUR DISTILLATE FUELS IN SHIPS

2018

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Contents

Foreword

New SO_x emission control criteria are developed or implemented in MARPOL Annex VI, EU directive and CARB regulations successively, requiring the use of fuel oils with a sulphur content not exceeding 0.10% m/m when ships operating within specified areas (such as the emission control areas specified in MARPOL Annex VI, EU ports, waters of 24 n miles from California coast and its ports). Moreover, new SO_x emission control criteria are implemented in Hong Kong Regulation and China Implementation Plan on Emission Control Areas successively, requiring the use of fuel oils with a sulphur content not exceeding 0.50% m/m when ships are operating within specified areas or berthing. For the requirements for the limit of the sulphur content of fuel oils used by ships, see Table 1.

Note 1: For users' easy reference, Table 1 only gives part of the requirements for the limit of sulphur content of fuel oils used by ships, the date of implementation and implementation areas as specified in MARPOL Annex VI, EU Low Sulphur Directive 2005/33/EC, Titles 13 and 17 of California Code of Regulations, Hong Kong Regulation and China Implementation Plan on Emission Control Areas. For detailed requirements are to be referred to the above-mentioned convention, directive/regulations.

Note 2: For ships engaged on domestic voyages, in addition to the SO_x emission requirements of the above China Implementation Plan on Emission Control Areas and Hong Kong Regulation, the relevant requirements of regulations applicable for ships engaged on domestic voyages are to be complied with.

List of Requirements for the Limit of Sulphur Content of Fuel Oils Table 1

Convention/Regulations	Sulphur content of fuel oils (% m/m)	Date of implementation	Implementation area
MARPOL Annex VI	3.50	1 January 2012	Outside SO_x emission control area
	0.50[1]	1 January 2020	
	1.00	1 July 2010	Inside SO_x emission control area[2]
	0.10	1 January 2015	
EU Directive	0.10	1 January 2010	EU ports[3]
CARB Regulations	1.50[4] 0.50[5]	1 July 2009	California waters[6]
	1.00[4] 0.50[5]	1 August 2012	
	0.10[4] 0.10[5]	1 January 2014	
Hong Kong Regulation	0.50	1 July 2015	Hong Kong ports[7]
China Implementation Plan on Emission Control Areas	0.50[8]	1 January 2016[9]	Domestic emission control areas[10]

Notes:

1. IMO Resolution MEPC. 280(70) decides that the standard for fuel oils with a sulphur content not exceeding 0.50% m/m will be implemented from 1 January 2020.
2. The emission control areas as specified in regulation 14 of MARPOL Annex VI include at present: Baltic Sea area, North Sea area, North American area and Caribbean Sea area (to be implemented on 1 January 2014).
3. Ships berthing at EU ports (including anchoring, mooring on buoy, alongside dock) for more than 2 hours are not allowed to use fuel oils with a sulphur content exceeding 0.10% m/m.
4. Marine gas oil, corresponding to DMA grade "Distillate Fuel" as specified in ISO 8217 standard.
5. Marine diesel oil, corresponding to DMB grade "Distillate Fuel" as specified in ISO 8217 standard.
6. 24 n miles from California coast and its ports.
7. During the berthing period (except for the first hour and the last hour) at Hong Kong ports, ships are not allowed to use fuel oils with a sulphur content exceeding 0.50%.
8. The implementation effect of the emission control measures as specified in China Implementation Plan on Emission Control Areas is to be evaluated by the Chinese Government before 31 December 2019, in order to decide whether:
   (1) to introduce the requirement of 0.10% m/m sulphur content when ships enter emission control areas;
   (2) to extend the geographical scope of emission control areas;
   (3) to introduce other control measures.
9. Emission control measures as specified in China Implementation Plan on Emission Control Areas are to be implemented as follows:

Implementation date①	Implementation description
2016.1.1	Berthing period② at ports where appropriate
2017.1.1	Berthing period② at core ports
2018.1.1	Berthing period② at all ports
2019.1.1	Ships entering emission control areas

Note: ① After the issuance of China Implementation Plan on Emission Control Areas, relevant provinces and cities have successively formulated and issued some corresponding supporting policies/implementation rules such as "work plans", "supervision measures" or "implementation opinions". For easy reference for users, Appendix 4 of the Guidelines summarizes the partial implementation requirements of the province/cities concerned and the detailed requirements are to be subject to the official documents issued by the relevant provinces/cities.

② The first hour after arrival and the last hour before departure are excluded.

10. Refers to three emission control areas in waters of the Pearl River Delta, the Yangtze River Delta and Bohai Rim (Beijing, Tianjin, Hebei) as specified in China Implementation Plan on Emission Control Areas. See China Implementation Plan on Emission Control Areas for the geographic scope of seas and inland waters and ports within the three emission control areas.

The following options are generally available for ships to meet SO_x emission requirements of conventions/regulations:

(1) Pretreatment of fuel oils: using special process to desulfurize fuel oils and the ship directly uses low sulphur fuel oil complying with the requirements;

(2) After-treatment of exhaust gas: removing the SO_x in the exhaust gas by installing exhaust treatment device so as to achieve emission reduction equivalent to that of using low sulphur fuel oil.

(3) Alternative fuels: ships use clean fuels such as natural gas. Due to low sulphur content of natural gas fuel, SO_x emission is very low after combustion.

Currently, the fuel oil in the fuel market with the sulphur content in line with 0.1% m/m is mainly low sulphur distillate fuel (such as DMA, DMB, etc.). At the end of 2014, in order to meet the market demand of 0.1% m/m sulphur content, some fuel suppliers developed and introduced new low sulphur "blended fuel", which improved the viscosity, lubricity and other characteristics by blending a small amount of heavy fuel oil in low sulphur distillate fuel. The main advantages of this low sulphur "blended fuel" are: its viscosity, lubricity and other characteristics are similar to the traditional heavy fuel oil, and it needs to be heated when storing, purifying and using onboard ships, and in general, the fuel oil system and fuel oil combustion units can be used without modification. However, as every fuel supplier has designed its own unique formulation, the properties of "blended fuel" vary significantly, which means that each "blended fuel" has its own specifics in terms of storing, handling and using the fuel, the fuel supplier is to be consulted for recommendations for use on board when purchasing. In addition, in view of the limited experience in using this "blended fuel" and the fact that the various marine fuel oil specifications (DM and RM) stipulated in the current ISO 8217 standard are still difficult to cover this kind of fuel, when a ship purchases and uses this kind of fuel, it is also to seek guidance and suggestions from the manufacturers of diesel engines, boilers, oil separators and other equipment.

Note: the position paper "New 0.10% sulphur marine (ECA) fuels", published by International Council on Combustion Engines (CIMAC), describes the compatibility and stability, viscosity, density, ignition quality, pour point, cat fines and sediment of this low sulphur "blended fuel", and puts forward the technical points in the course of storage, treatment and use on board for the reference of ship owners/ship operators.

In order to meet the increased demand of fuel oil with 0.1% m/m sulphur content, marine distillate fuel blended with FAME (biodiesel) was also introduced in marine fuel oil supply market . The sixth revision of ISO 8217 standard adds three new types of distillate fuels (DFA, DFZ and DFB), specifying that the volume percentage of blended FAME is not to exceed 7%, and that the other specifications are same as those of DMA, DMZ and DMB respectively. Therefore, when this kind of distillate fuel blended with FAME is used on board, the requirements for storage, handling and use are basically the same as those for marine diesel oil (DMA, DMZ and DMB) specified in ISO 8217. However, given the potential properties of biodiesel such as oxidation, biodegradation, cleaning of deposits in fuel oil tanks and system, additional considerations are to be given when using such fuel on board such as storage periods, fuel condition monitoring, water content and microbial monitoring, filter condition monitoring, etc. If this fuel is intended for use on board, it is recommended that the ship owner/operator consult with the manufacturers of diesel engines, boilers and other equipment to confirm the compatibility of the fuel oil combustion units with the fuel. Regarding the use of this fuel, International Council on Combustion Engines (CIMAC) has developed the guideline for fuel management "Guideline for ship owners and operators on managing distillate fuels up to 7.0% v/v FAME (biodiesel)" for the reference of ship owners/ship operators.

The Guidelines mainly take into account the possible effects of changes in the properties of low sulphur distillate fuels on the safety of ship and machinery installations.

In order to produce such low sulphur distillate fuels, oil refineries often desulphurize fuel oils with special technologies and procedures, leading to significant changes to many characteristics of low sulphur distillate fuels. Since the fuel oil system and machinery installations of ships are normally designed for heavy fuel oil/marine diesel oil and there is less experience in the use of low sulphur distillate fuels, the changeover to low sulphur distillate fuels will possibly cause failure of the fuel oil system and equipment or even the risk of losing power for the ship.

During the design or conversion of a ship, changes to the characteristics of low sulphur distillate fuel are to be considered comprehensively and possible risks to the ship due to the use of low sulphur distillate fuel are to be identified systematically. Measures are to be taken from aspects of design, arrangement, monitoring and alarms, operating procedures on the basis of risk analysis results so as to keep the risks and associated hazards within an acceptable range.

The Guidelines have been developed on the basis of the study on effects of the use of low sulphur distillate fuels, giving special requirements for the design, arrangement, control and monitoring, operation and test of the systems and equipment related to the use of low sulphur distillate fuels as a supplement to ISC rules. The aim of the Guidelines is to provide guidance to the design/conversion, survey and test of ships and not to replace the provisions and operational requirements of any conventions, statutory regulations or directives.

It is not possible for the Guidelines to cover all equipment and systems using low sulphur distillate fuel. For each ship, the machinery installations are to be evaluated by the equipment manufacturer or a professional authorized by the manufacturer. The possible risks due to the changeover and use of different fuel oils are to be identified, and a suitable design or conversion plan and applicable procedures are to be developed. The detailed evaluation report will be provided.

Chapter 1 General

1.1 Application

1.1.1 The Guidelines apply to ships using low sulphur distillate fuels in order to comply with requirements of MARPOL Annex VI, regional or national directive/regulations①.

Note 1: The term low sulphur distillate fuel in the Guidelines refers specifically to the distillate fuels with a sulphur content not exceeding 0.10% m/m, see the definition of 1.3.1(2).

Note 2: Hong Kong Regulation and China Implementation Plan on Emission Control Areas require the fuel oils with a sulphur content not exceeding 0.50% m/m. If the ship intends to use the low sulphur distillate fuel as defined in 1.3.1(2) of the Guidelines to meet the SO_x emission requirements, the Guidelines also apply to the ship.

1.1.2 Unless otherwise specified, the requirements the Guidelines are only supplementary to the relevant ISC rules, not replacing the relevant provisions of any conventions, statutory regulations or directives.

1.2 Class notations

1.2.1 Ships intended to use low sulphur distillate fuel may be assigned the class notation of LSDF if they meet the requirements of the Guidelines upon satisfactory inspection.

1.3 Definitions and abbreviations

1.3.1 For the purpose of the Guidelines, the following definitions apply:

(1) Low sulphur fuel oil (LSFO) means the fuel oil with a sulphur content not exceeding 0.10% m/m which is used by the ship when operating in the SO_x emission control area, such as low sulphur distillate fuel and "blended fuel" with a sulphur content not exceeding 0.10% m/m.

(2) Low sulphur distillate fuel (LSDF) means the distillate fuel complying with all criteria of ISO 8217 standard, except that its sulphur content is not over 0.10% m/m.

Note: For users' easy reference, the requirements for distillate marine fuels as specified in ISO 8217 are tabulated in Appendix 2 of the Guidelines. For detailed requirements, the original standard is to prevail.

(3) Fuel oil (FO) means the fuel oils other than LSFO, which are normally supplied to main and auxiliary engines as well as boilers when the ship operates outside the SO_x emission control areas (such as HFO, MDO).

(4) Marine diesel oil (MDO) means the distillate fuels complying with all criteria of ISO 8217 standard, excluding LSDF.

(5) Heavy fuel oil (HFO) means the residual fuels complying with all criteria of ISO 8217standard.

① EU Directive (EU Low Sulphur Directive 2005/33/EC), CARB regulations (Titles 13 and 17 of California Code of Regulations), Hong Kong Regulation and China Implementation Plan on Emission Control Areas.

Note: For users' easy reference, the requirements for residual marine fuels as specified in ISO 8217 are tabulated in Appendix 3 of the Guidelines. For detailed requirements, the original standard is to prevail.

(6) SO_x emission control area (SECA) means a specific area① where, in pursuance of the convention, regional or national directive/regulations mentioned in 1.1.1 above, the sulphur content of fuel oils used by ships is not to exceed 0.10% m/m or 0.50% m/m.

1.3.2 For the purpose of the Guidelines, the following abbreviations are used:

(1) CARB: California Air Resources Board.

(2) EU: European Union.

1.4 Plans and documents

1.4.1 In addition to the plans and documents as required in ISC Rules for Classification of Sea-Going Steel Ships, the following plans and documents are to be submitted for approval:

(1) Details of viscosity/temperature control of LSDF, including chiller system, operating principle, control system and instructions for operation (according to 2.5.4);

(2) On-board test procedure (according to 1.6);

(3) Control, monitoring and safety systems of boilers (according to 3.3);

(4) List of alarm and indication points (according to 2.6.1).

1.4.2 In addition to 1.4.1, the following plans and documents are to be submitted for information:

(1) LSDF tanks capacity calculations (according to 2.2.2);

(2) Declarations and relevant information from manufacturers (according to 3.1);

(3) Calculations for changes of LSDF viscosity/temperature (according to 2.5.3);

(4) Operation manual (according to Chapter 4);

(5) Risk analysis report (according to 1.5).

1.5 Risk analysis

1.5.1 A recognized method for risk analysis/assessment (e.g., IEC/ISO 31010) is to be used to analyze and evaluate the safety issues in relation to the use and changeover of LSDF.

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① Emission control areas as specified in Regulation 14 of MARPOL Annex VI, ports as specified in EU directive, waters and ports as specified in CARB regulations, ports as specified in Hong Kong Regulation, waters and ports as specified in China Implementation Plan on Emission Control Areas.

1.5.2 Appendix 1 of the Guidelines may be taken as reference for factors to be considered, contents of report and analysis table during risk analysis.

1.6 On-board tests

1.6.1 On-board tests are to be carried out for ships using LSDF according to the relevant requirements of ISC Rules for Classification of Sea-Going Steel Ships to confirm that continuous operation of related systems and equipment on LSDF. The functions of control, alarm and safety protection systems relating to the use of LSDF are to be verified.

1.6.2 Fuel oil changeover is to be tested to verify that the changeover between FO and LSDF may be completed safely and reliably by the system and that relevant parameters are kept within the specified range. If the cylinder oil needs to be changed for engine operation in fuel oil changeover, the changeover of cylinder oil is also to be tested.

1.6.3 If the LSDF as specified in 1.1.1 is not available for the test, marine diesel oil may be substituted as an alternative. The marine diesel oil is to be heated during the test so as to decrease the viscosity close to that of LSDF. A report for the use of LSDF is to be submitted to ISC during the first periodical survey of the ship after using LSDF for the first time, and at least the following items are to be included:

– specifications of LSDF;

– duration of the changeover to LSDF and position of the ship;

– equipment operating with LSDF and operation loads;

– operating time of the equipment and key parameters (such as temperature/viscosity of fuel oil);

– control, monitoring and safety protection functions;

– assessment of the operation condition of equipment.

Chapter 2 Fuel Oil Systems

2.1 General requirements

2.1.1 The flash point of LSDF is to comply with the requirements of paragraph 1.2.9, Chapter 1, PART THREE of ISC Rules for Classification of Sea-Going Steel Ships.

2.1.2 Where two or more different types of fuels (e.g., FO, LSDF, etc.) are bunkered on board, it is recommended that the following measures be adopted to avoid or reduce the possible risks when using those fuels on board:

(1) Compatibility test kits, approved or recommended by the fuel oil manufacturer, are to be used to test and ensure the compatibility between those different fuel oils.

(2) Every attempt (e.g., purification, filtering, etc.) is to be made to reduce the catalyst fine to the lowest possible levels, and ensure that the maximum amount of catalyst fines reaching the engine does not exceed 10 ppm (Al+Si) or satisfy the requirements for machinery installations, and in some instances this might rise to 15 ppm.

Note: Particle size has a significant influence on the capacity of the centrifugal separators to lower the level of catalyst fines in the fuel, with particles of 2 microns or less being particularly difficult to remove. The presence of particles of 2 microns size or lower may cause difficulties in achieving the 10 ppm limit. Engine manufacturer recommendations are also to be referred to for any further system specific recommendations.

(3) Dedicated continuous monitoring of the quantity of catfines between the pump and the service tank outlet is to be considered. If continuous monitoring of catfines is not implemented, then weekly sampling and analysing of catfine level at service tank outlet is recommended to ensure that catfine level doesn't exceed maximum level.

2.1.3 All elastomeric components in the fuel oil system (e.g. diaphragms) are to be made of fluoro-rubber or other material suitable for use with fuel oils.

2.1.4 If the fuel oil system is provided with sampling points, the sampling points are to meet the requirements of IMO Guidelines for on board sampling and verification of the sulphur content of the fuel oil used on board ships.

2.2 Storage of fuel oils

2.2.1 Dedicated LSDF storage tanks are to be provided on board, arranged not directly adjacent to heated tanks so as to prevent LSDF from being heated.

2.2.2 The LSDF storage capacity is to be sufficient for the consumption needed for ships operating in an intended emission control area or berthing and the consumption of LSDF is to be calculated taking into account various fuel oil consumption factors comprehensively.

2.3 Daily service tank and settling tank

2.3.1 Depending on different fuel oils used by main and auxiliary engines and boilers, the daily service tanks of LSDF may be provided as follows:

(1) For ships outside an emission control area with main and auxiliary engines and boilers operating with heavy fuel oil, where heavy fuel oil and marine diesel oil daily service tanks are provided in accordance with Section 2 of Chapter 4, PART THREE of ISC Rules for Classification of Sea-Going Steel Ships, the LSDF daily service tank may be provided as follows:

① an independent LSDF daily service tank with the capacity for at least 8 h operation of the ship; or

② a marine diesel oil daily service tank (or heavy fuel oil daily service tank) is substituted for a LSDF daily service tank with the capacity for at least 8 h operation of the ship, the arrangement and design of the system is to allow the heating means (if any) of the heavy fuel oil or marine diesel oil daily service tank to be reliably stopped, and there is to be sufficient time for such substitute daily service tank and the system being fully flushed to remove all the fuel oils with a sulphur content exceeding the limit for LSDF before the ship enters the emission control area.

(2) For ships outside an emission control area with main engines and boilers operating with heavy fuel oil and auxiliary engines operating with diesel oil, where heavy fuel oil and marine diesel daily service tanks being provided in accordance with Section 2 of Chapter 4, PART THREE of ISC Rules for Classification of Sea-Going Steel Ships, the LSDF daily service tank may be provided as follows:

① an independent LSDF daily service tank with the capacity for at least 8 h operation of the ship; or

② a marine diesel oil daily service tank (or heavy fuel oil daily service tank) is substituted for a LSDF daily service tank with the capacity for at least 8 h operation of the ship, the arrangement and design of the system is to allow the heating means (if any) of the heavy fuel oil or marine diesel oil daily service tank to be reliably stopped, and there is to be sufficient time for such substitute daily service tank and the system being fully flushed to remove all the fuel oils with a sulphur content exceeding the limit for LSDF before the ship enters the emission control area.

(3) For ships outside an emission control area and using LSDF as marine diesel oil, the provision of daily service tanks is to comply with the requirements of Section 2 of Chapter 4, PART THREE of ISC Rules for Classification of Sea-Going Steel Ships. However, all marine diesel oil daily service tanks are to be substituted by LSDF daily service tanks with the total capacity for at least 8 h operation of the ship.

2.3.2 For ships calling at EU ports only or operating less than 8 h within an SO_x emission control area (including the time for fuel oil changeover while entering or leaving the emission control area), the capacity of LSDF daily service tanks may be provided based on the actual consumption needed. However, the provision of other fuel oil daily service tanks is to comply with the requirements of Section 2 of Chapter 4, PART THREE of ISC Rules for Classification of Sea-Going Steel Ships.

2.3.3 For ships constructed before 1 July 1998, the capacity of LSDF daily service tanks may be provided based on the actual consumption needed.

2.3.4 Dedicated LSDF settling tanks are normally to be provided on board ships. If the quality of LSDF complies with the fuel specifications of the equipment manufacturer without settling, purifying or other treatment, or the LSDF in the storage tank may be transferred directly to the daily service tank after being purified by a separator, the dedicated LSDF settling tank is not required.

2.3.5 The LSDF daily service tank and settling tank are not to be directly adjacent to heated tanks so as to avoid LSDF from being heated.

2.4 Fuel oil transfer and treatment piping systems

2.4.1 Fuel oil pumps and purifiers are to be suitable for the LSDF used.

2.4.2 The LSDF transfer and treatment piping systems are to be separated from other fuel oil piping systems, or there is to be sufficient time for the piping systems being fully flushed so as to avoid contamination of fuel oils.

2.5 Fuel oil supply piping system

2.5.1 For ships intending to use heavy fuel oil or marine diesel oil outside emission control areas and LSDF in such areas, the arrangement of fuel oil pumps is to comply with the following requirements.

(1) Outside emission control areas:

Two fuel oil pumps are to be provided, as specified in 4.2.2.2 and 4.2.3.1 of Chapter 4, PART THREE of ISC Rules for Classification of Sea-going Steel Ships.

(2) Within emission control areas one of the following configurations:

① two fuel oil pumps as in (1) instead of separate LSDF pumps, provided these are both suitable for LSDF and each is capable of delivering fuel oil at the required capacity for normal operation of the ship;

② when both of the two fuel oil pumps in (1) are suitable for LSDF but one pump alone is not capable of delivering fuel oils at the required capacity, then both pumps may operate in parallel to achieve the required capacity for normal operation of the ship. In this case, one separate fuel oil pump is to be provided in addition to the two fuel oil pumps as specified in (1). The additional pump is, when operating in parallel with one of the pumps in (1), to be suitable for and capable of delivering LSDF at the required capacity for normal operation of the ship;

③ when the two fuel oil pumps as in (1) are not suitable for LSDF, two separate LSDF pumps are to be provided additionally, each capable of supplying fuel oil at the required capacity for normal operation of the ship.

Note 1: The requirement for alarm at automatic start of standby pumps applies to separate LSDF pumps for ships holding the class notation for unattended machinery space.

Note 2: Where electrical power is required for the operation of propulsion machinery, the requirements are also applicable for machinery for power generation when such machinery is supplied by common fuel supply pumps.

Note 3: The required capacity for normal operation of the ship means the capacity required for the operation of equipment at rated load.

2.5.2 During the changeover to LSDF, a mixing tank is normally to be provided for mixing of fuel oils having different temperatures so as to avoid thermal shock to machinery installations and fuel oil systems due to drastic fuel oil temperature changes.

2.5.3 In order to ensure that the viscosity of LSDF under various conditions complies with the requirements for machinery installations, the temperature/viscosity of LSDF at the inlet of machinery installations is to be calculated. Factors such as working loads, fuel oil changeover, ambient temperature and possible thermal transfer and thermal accumulation during normal operation of the ship are to be considered for the calculation.

2.5.4 A dedicated fuel oil cooling system (such as seawater cooling or cooling through a refrigerating system) is to be provided if the viscosity of LSDF does not comply with the requirements for machinery installations upon calculation according to 2.5.3. The cooling system is to comply with the following requirements in addition to the relevant requirements of PART THREE of ISC Rules for Classification of Sea-Going Steel Ships.

(1) The fuel oil cooling system is to be designed taking into account the refrigerating capacity needed for the operation of machinery installations using fuel oil, e.g. main and auxiliary engines, boilers at various loads, ensuring that the temperature and temperature changes of fuel oil are maintained within the specified range.

(2) The fuel oil cooling system is to have automatic temperature control. Means for manual operation are to be provided.

(3) The surface temperature of coolers is to be maintained above the pour point of fuel oil.

(4) Where the fuel oil pressure exceeds the cooling medium pressure, means for detection of leakage are to be provided.

2.5.5 An independent piping system is to be provided for LSDF. However, a piping system common to LSDF and to other fuel oils may be provided if:

(1) all heaters may be reliably stopped or bypassed and indication of the status of the heating system is provided;

(2) the system is capable of being fully flushed before the ship enters an emission control area so as to ensure that the sulphur content of fuel oils used by equipment complies with the requirements of relevant conventions, regional or national directives/regulations.

2.5.6 Return oil pipes/re-circulating pipes are to be so designed and arranged as to prevent the contamination of LSDF tanks from high sulphur fuel oils.

2.5.7 Means are to be provided to prevent excessive heating of LSDF when a machinery installation is in standby mode.

2.5.8 Means are to be provided to prevent damage to the fuel pump caused by LSDF being pressurized repeatedly during recirculation.

2.6 Controls, alarms and indications

2.6.1 In addition to the relevant requirements of ISC Rules for Classification of Sea-Going Steel Ships, the following alarms or indications are to be considered for the controls, alarms and indications of LSDF system:

– alarm for high temperature or low viscosity;

– alarm for low temperature (if applicable);

– alarm for low water level in fuel oil cooling system expansion tank (if provided);

– indication of status of the fuel oil heating/cooling system (in operation or not), if common to fuel oil systems.

For ships applying for class notation of automation, the above alarms related to LSDF are also to meet the relevant requirements of Chapters 3 and 4, PART SEVEN of ISC Rules for Classification of Sea-Going Steel Ships.

2.6.2 Where any difference exists in the setting of alarms of different fuel oils, means are to be provided to prevent any false alarm or improper action being activated in fuel oil changeover.

Chapter 3 Machinery Installations

3.1 General requirements

3.1.1 The manufacturers of machinery installations (diesel engines, boilers, separators, fuel oil pumps, etc.) are to declare that their products are capable of continuous operation on LSDF. Such declarations are to include details on the use of LSDF such as operational capability, possible conditions and limitations, control and safety systems.

3.1.2 Conditions or limitations for the use of or the changeover to LSDF are not to impair the normal operation of machinery installations.

3.2 Diesel engines

3.2.1 The quality of the cylinder oil (alkalinity) and the arrangement of its system are to be suitable for the engine operation with fuel oils having different sulphur contents.

3.2.2 Where different cylinder oils are required to be used for the engine operation with fuel oils having different sulphur contents, the cylinder oil tank and system are to be so designed and arranged as to be suitable for the storage and use of various cylinder oils.

3.2.3 Where a diesel engine operates with fuel oils having different sulphur contents, the engine is to be operated and checked according to the requirements of the manufacturer, giving particular attention to the adjustment of cylinder oil feed rate and the cylinder oil changeover .

3.2.4 If the modifications of engines for operation with LSDF affect their NO_x emissions, the engines are to be re-inspected and re-certified according to the Guidelines for Testing and Survey of Emission of Nitrogen Oxides from Marine Diesel Engines.

3.3 Boilers

3.3.1 Necessary means are to be provided to prevent excessive heating of LSDF when the boiler and burner are in standby mode.

3.3.2 The burner and its nozzles are to be so designed, arranged and installed as to be suitable for the properties of fuel oils used, giving particular attention to the difference in the calorific value, viscosity and density of LSDF.

3.3.3 Means are to be provided to prevent LSDF from the risks of vaporization, coke deposit or self-ignition due to heating before being sprayed.

3.3.4 After the operation of a boiler with LSDF, its furnace is to be fully scavenged so as to reduce the risk of explosion as far as possible.

3.3.5 The flame detection device of boilers is to be suitable for the different combustion characteristics of various fuel oils.

3.3.6 The boiler control system is to be designed to ensure safe and reliable operation of the boiler, taking into account different properties of various fuel oils.

3.3.7 The need for scavenging under various conditions is to be considered for the boiler control system, such as fully scavenging the furnace before ignition, after the extinction of flame or normal stop of the boiler.

3.4 Fuel oil pumps

3.4.1 For the fuel oil pumps used for transfer, treatment and supply of HFO, where low sulphur distillate fuel is intended to be used when operating in the emission control area, the suitability of HFO pumps to low sulphur distillate fuel is to be determined in accordance with this Section. These fuel oil pumps include:

(1) primary essential services fuel oil pumps（main and stand-by） that need to be maintained in continuous operation，e.g. separator fuel oil supply pumps, booster pumps, feeder pumps, fuel valve cooling pumps(in system which use fuel oil for this service)；

(2) fuel pumps that are not required to be in continuous operation, e.g. fuel oil transfer pumps.

3.4.2 Each type of fuel oil pump intended for use in a fuel oil system on board a ship is to be subjected to type testing in accordance with the requirements of ISC rules. Tests carried out for a particular type of fuel oil pump will be accepted for all pumps of the same type built by both Licensors and Licensees.

3.4.3 In addition to the type test specified in the ISC rules, the running test is to be carried out for the fuel oil pump to verify the adaptability of LSDF. The test requirements are as follows:

(1) LSDF (or other similar products) is to be used as the test medium. The viscosity of LSDF is to be the minimum viscosity specified in ISO 8217 or lower; recommended low sulphur distillate fuel viscosity value for the test is to be 2,0 cSt at the fuel pump inlet.

(2) The lubricity of low sulphur distillate fuel for running test is to be less than 520 μm.

Note: The lubricity of fuel oil is to be determined by the test method according to ISO 12156-1.

(3) The running test is to be conducted for a minimum of 250 hours at a discharge pressure not less than the nominal pump pressure rating.

(4) During the running test the main performance parameters of the fuel oil pump are to be verified in accordance with applicable standards;

(5) During the running test, the pump is to be checked and assessed for smooth running and bearing temperature based on ISC rules or international standards. This may be based on the pump manufacturer’s in-house testing procedures in agreement with ISC.

Note: If the fuel oil pump installed on ships engaged on domestic voyages uses the general diesel fuel specified in GB 252 in order to meet the requirements of regulations for ships engaged on domestic voyages, the general diesel fuel specified in GB 252 is to be used as the test medium, and the viscosity is to be the lower viscosity limit specified in GB 252.

3.4.4 The following certificates/reports of tests and surveys are to be provided and kept on board:

(1) The running test certificates/reports containing:

① Manufacturer details;

② The test stand location and accreditation approval details;

③ Pump type and serial number;

④ Duration of test;

⑤ Viscosity of used medium;

⑥ Parameters as mentioned in 3.4.3;

⑦ Minimum operating temperature;

⑧ Result of running test,

(2) Hydraulic test certificates/reports.

(3) Materials certificates/reports.

3.4.5 The following plans and documents relevant to fuel oil pumps are to be kept on board:

(1) Fuel oil pump performance specification and installation information;

(2) List of components with characteristics of materials critical for reliable operation of pump;

(3) Sealing arrangements;

(4) Reliability and life cycle data;

(5) Operational manual with performance and life cycle guidance;

(6) Test programme of the pump for survey;

(7) Test evidence (including running test and performance test).

Chapter 4 Operation Manual

4.1 General requirements

4.1.1 Operation manuals are to be provided on board the ship.

4.1.2 The operation manual is to include at least the following:

(1) Procedures for the use and changeover of LSDF (see 4.2);

(2) Conditions and limitations relating to the use and changeover of LSDF;

(3) Operation and check;

(4) Maintenance;

(5) Emergency procedures (see 4.3).

4.2 Fuel oil changeover

4.2.1 Operational details, parameters to be monitored, time needed for changeover, control of changeover conditions (e.g. fuel oil temperatures, temperature gradient, loads), emergency measures relating to fuel oil changeover are to be specified in the changeover procedures.

4.2.2 The time needed for fuel oil changeover is to be calculated through the method specified by the equipment manufacturer, taking into account such factors as the amount of residual oil in daily service tanks, loads of equipment, temperature differences of fuel oils and temperature change gradient.

4.2.3 Where a different lubricating oil is required for operation of the engine after fuel oil changeover, an appropriate procedure for lubricating oil changeover is to be developed.

4.2.4 In order to avoid any failure due to human error during fuel oil changeover as far as possible, an automatic changeover system is recommended for fuel oil changeover. The automatic changeover system (if provided) is to be approved by ISC and is to be capable of manually operated to complete fuel oil changeover according to the specified procedures.

4.3 Emergency procedures

4.3.1 Appropriate emergency procedures are to be developed for possible failures during the LSDF changeover or operation with LSDF, such as incompatibility of fuel oils during mixing, excessive vaporization due to improper fuel oil changeover, failure of the automatic fuel oil changeover system, starting failure of diesel engines operating with LSDF, ignition or flame failure of boilers operating with LSDF, so as to reduce the harms caused by failures during the use of LSDF as far as possible.

The emergency procedures are to be completely included in the operation manual described in 4.1.

Appendix 1 Risk Analysis

1 Dangers caused by the change of properties of LSDF are to be considered comprehensively, in particular the possible effects on fuel oil system and machinery installations due to the different sulphur content, calorific value, viscosity, density, flash point and lubricity.

2 Systems and equipment related to the use and changeover of LSDF are to be considered as far as possible.

3 In general, the following are to be included in a risk analysis report:

(1) Standards and methods used for the analysis;

(2) Assumptions and preconditions made for the analysis;

(3) Analysis objects, such as systems, equipment, operations, etc.;

(4) Possible risks;

(5) Causes of the risks;

(6) Possible effects of the risks;

(7) Measures taken to prevent or reduce the harms of risks and implementation.

4 A generic work sheet for risk analysis is given in Table 1 for guidance.

Risk Analysis Sheet (Example) **Table 1**

Analysis item	Risk	Cause	Potential effects	Safety protection	Improvement measures

Appendix 2 Distillate Marine Fuels (excerpted from ISO 8217)

Characteristics		Unit	Limit	Category ISO-F							Test method reference
				DMX	DMA	DFA	DMZ	DFZ	DMB	DFB	
Kinematic viscosity at (40℃)		mm^2/s[a]	max.	5.500	6.000		6.000		11.00		ISO 3104
			min.	1.400	2.000		3.000		2.000		
Density at (15℃)		kg/m^3	max.	—	890.0		890.0		900.0		see 6.1, ISO 3675 or ISO 12185
Cetane index		—	min.	45	40		40		35		ISO 4264
Sulphur[b]		% (m/m)	max.	1.00	1.00		1.00		1.50		see 6.3, ISO 8754, ISO 14596, ASTM D4294
Flash point		℃	min.	43.0	60.0		60.0		60.0		see 6.4, ISO 2719
Hydrogen sulfide		mg/kg	max.	2.00	2.00		2.00		2.00		see 6.5, IP 570
Acid number (on KOH content basis)		mg KOH/g	max.	0.5	0.5		0.5		0.5		see 6.6, ASTM D664
Total sediment by hot filtration		% (m/m)	max.	—	—		—		0.10[c]		see 6.8, ISO 10307-1
Oxidation stability		g/m^3	max.	25	25		25		25[d]		ISO 12205
Fatty acid methyl ester (FAME)[e]		volume %	max.	—	—	7.0	—	7.0	—	7.0	see 6.10, ASTM D7963 or IP 579
Carbon residue: the 10 % volume distillation residue		% (m/m)	max.	0.30	0.30		0.30		—		ISO 10370
Carbon residue		% (m/m)	max.	—	—		—		0.30		ISO 10370
Cloud point[f]	winter quality	℃	max.	−16	report		report		—		see 6.11, ISO 3015
	summer quality	℃	max.	−16	—		—		—		
Cold filter plugging point[f]	winter quality	℃	max.	—	report		report		—		see 6.11, IP 309 or IP 612
	summer quality	℃	max.	—	—		—		—		
Pour point[f]	winter quality	℃	max.	—	−6		−6		0		See 6.11, ISO 3016
	summer quality	℃	max	—	0		0		6		
Appearance		—	—	Clear and bright[g]					[c]		see 6.12
Water		% (V/V)	max.	—	—		—		0.30[c]		ISO 3733
Ash		% (m/m)	max.	0.010	0.010		0.010		0.010		ISO 6245
Lubricity, corrected wear scar diameter(wsd 1, 4) at (60℃)[h]		μm	max.	520	520		520		520[d]		ISO 12156-1

Characteristics	Unit	Limit	Category ISO-F							Test method reference
			DMX	DMA	DFA	DMZ	DFZ	DMB	DFB	

a 1 mm^2/s = 1 cSt.
b Notwithstanding the limits given, the purchaser shall define the maximum sulphur content in accordance with relevant statutory limitations. See Foreword.
c If the sample is not clear and bright, the total sediment by hot filtration and water tests shall be required, see 6.8 and 6.12.
d If the sample is not clear and bright, the test cannot be undertaken and hence the oxidation stability limit shall not apply.
e See 5.1 and Annex A.
f Pour point cannot guarantee operability for all ship in all climates. The purchaser should confirm that the cold flow characteristics are suitable for the ship's design and intended voyage. See 6.11.
g If the sample is dyed and not transparent, then the water limit and test method as given in 6.12 shall apply.
h This requirement is applicable to fuels with a sulphur content below 500 mg/kg (0.050 mass %).

Appendix 3 Residual Marine Fuels (excerpted from ISO 8217)

Characteristic		Unit	Limit	Category ISO-F-											Test method reference
				RMA	RMB	RMD	RME	RMG				RMK			
				10.00	30.00	80.00	180.0	180.0	380.0	500.0	700.0	380.0	500.0	700.0	
Kinematic viscosity at (50℃)		mm^2/s[a]	max.	10.00	30.00	80.00	180.0	180.0	380.0	500.0	700.0	380.0	500.0	700.0	ISO 3104
Density at (15℃)		kg/m^3	max.	920.0	960.0	975.0	991.0	991.0				1010.0			see 6.1, ISO 3675 or ISO 12185
CCAI		—	max.	850	860	860	860	870				870			see 6.2
Sulphur[b]		% (m/m)	max.	Statutory requirements											see 6.3, ISO 8754, ISO 14596 or ASTM D4294
Flash point		℃	min.	60.0	60.0	60.0	60.0	60.0				60.0			see 6.4, ISO 2719
Hydrogen sulfide		mg/kg	max.	2.00	2.00	2.00	2.00	2.00				2.00			see 6.5, IP 570
Acid number (on KOH content basis)[c]		mg KOH/g	max.	2.5	2.5	2.5	2.5	2.5				2.5			See 6.6, ASTM D664
Total sediment aged		% (m/m)	max.	0.10	0.10	0.10	0.10	0.10				0.10			see 6.9, ISO 10307-2
Carbon residue		% (m/m)	max.	2.50	10.00	14.00	15.00	18.00				20.00			ISO 10370
Pour point[d]	winter	℃	max.	0	0	30	30	30				30			ISO 3016
	summer	℃	max.	6	6	30	30	30				30			ISO 3016
Water		% (V/V)	max.	0.30	0.50	0.50	0.50	0.50				0.50			ISO 3733
Ash		% (m/m)	max.	0.040	0.070	0.070	0.070	0.100				0.150			ISO 6245
Vanadium		mg/kg	max.	50	150	150	150	350				450			see 6.14, IP 501, IP 470 or ISO 14597
Sodium		mg/kg	max.	50	100	100	50	100				100			see 6.15, IP 501, IP 470
Aluminium plus silicon		mg/kg	max.	25	40	40	50	60				60			see 6.16, IP 501, IP 470 or ISO 10478
Used lubricating oils (ULO): calcium and zinc; or calcium and phosphorus		mg/kg	—	calcium > 30 and zinc > 15; or calcium > 30 and phosphorus > 15											see 6.17, IP 501 or IP 470, IP 500

a 1 mm^2/s = 1cSt.
b The purchaser shall define the maximum sulphur content in accordance with relevant statutory limitations. See Foreword.
c See Annex E.
d The purchaser should confirm that this pour point is suitable for the ship's intended area of operation.

Appendix 4 Summary of Implementation Requirements of Relevant Provinces/Cities in Domestic Emission Control Areas (for reference only)

Provinces/Cities	Document Name	Issuer	Fuel Oil Sulphur Content (%m/m)	Implementation Date	Implementation Description
Guangdong Province	Notification on Issuance of Implementation Opinions on Domestic Emission Control Areas in Waters of the Pearl River Delta in Guangdong Province	Communications Department of Guangdong Province	General diesel fuels specified in GB 252	January 1, 2017	Inland and river-sea ships in emission control areas
			0.5	January 1, 2017	Berthing period at core ports
				January 1, 2018	Berthing period at all ports
				January 1, 2019	Ships entering emission control areas
Shenzhen	Announcement on Use of Low Sulphur Fuel Oil during the Berthing Period of Ship at Shenzhen Port	Shenzhen Human Environment Committee Shenzhen Maritime Safety Administration Shenzhen Transportation Committee	0.5	October 1, 2016	Berthing period at Shenzhen Port
Shanghai	Announcement on Implementation of Domestic Emission Control Areas in Waters of Shanghai Port Notification on Strengthening Supervision and Management of Domestic Emission Control Areas	Shanghai Municipal Transport Commission Shanghai Maritime Safety Administration	General diesel fuels specified in GB 252	In accordance with GB 252①	Inland and river-sea ships
			0.5	April 1, 2016	Berthing period at Shanghai Port
Zhejiang Province	Notification on Issuance of Implementation Plan on Domestic Emission Control Areas in Zhejiang Province	General Office of the People's Government of Zhejiang Province	0.5	April 1, 2016	Berthing period at Beilun, Chuanshan, Daxie, Zhenhai, Meishan, Shengsi, Liuheng, Dinghai, Qushan, Jintang port areas of Ningbo Zhoushan Port

Provinces/Cities	Document Name	Issuer	Fuel Oil Sulphur Content（%m/m）	Implementation Date	Implementation Description
Jiangsu Province	Notification on Issuance of Implementation Plan on Domestic Emission Control Areas in Waters of the Yangtze River Delta in Jiangsu Province	General Office of the People's Government of Jiangsu Province	0.5	April 1, 2016	Berthing period at core ports
				January 1, 2018	Berthing period at all ports
				January 1, 2019	Ships entering emission control areas
Tianjin	Announcement on Implementation of Supervision Measures in Domestic Emission Control Areas in Waters of Tianjin Port	Tianjin Maritime Safety Administration	0.5	January 1, 2017	Berthing period at Tianjin Port
Hebei Province	Notification on Issuance of Implementation Plan on Domestic Emission Control Areas in Hebei Province	Communications Department of Hebei Province Hebei Maritime Safety Administration	0.5	January 1, 2017	Berthing period at core ports
				January 1, 2018	Berthing period at all ports
				January 1, 2019	Ships entering emission control areas
Liaoning Province	Notification on Issuance of Implementation Plan on Domestic Emission Control Areas in Liaoning Province	Communications Department of Liaoning Province	0.5	January 1, 2018	Berthing period at Dalian, Yingkou, Panjin, Jinzhou and Huludao ports
				January 1, 2019	Ships entering emission control areas

Note ①: Since January 1, 2017, the sulphur content of diesel used by public service ships, tourist ship along Huangpu Rivers, passenger ferries, harbor boats, sanitation ships and ships navigating, berthing and operating in the Huangpu River core section (waters from Nanpu Bridge over Huangpu River to 100 meters lower reaches from the mouth of Chuanyang River), is not to be higher than that of National Standard IV automotive diesel (0.005% m/m).