Amendments for Rules for the Classification of Steel Ships

(Part 5 Machinery Installation)

- Main Amendments -

(1) Effective date : 1 Jul. 2019 (Date of which contracts for construction are signed)

◉ The meaning of essential auxiliaries has been clarified by deleting 'facilities in relation to the purpose of ships'.

◉ Clarified that shaft protection coatings are subjected to type approval by the Society.

◉ The reduction requirement to replace a remote water level indicator with a high and low water level alarm device has been deleted.

◉ Allowable stress coefficient values of pressure vessel have been in line with New IGC code.

◉ The application part of the air pipe is revised to install the air pipe in the void space of the enclosed structure.

(2) Effective date : 1 Jul. 2019 (Date of which contracts for construction are signed or application for certification)

◉ The requirements of running test for individual turbochargers have been deleted.

◉ The requirements of the certification, torque test, bonding test for flexible couplings have been added.

Present	Amendment
CHAPTER 1 GENERAL	**CHAPTER 1 GENERAL**
Section 1 General	**Section 1 General**
101. <omitted>	**101. <same as the present>**
102. Definitions	**102. Definitions**
1. ~ 2. <omitted>	**1. ~ 2. <same as the present>**
3. Propeller shaft Kind 1 or Stern tube shaft Kind 1 is the shaft which is provided with effective measures against corrosion by sea water, or the shaft which is made of approved corrosion resistance material. The propeller shaft or stern tube shaft other than specified above is Kind 2.	**3. Propeller shaft Kind 1 or Stern tube shaft Kind 1** is the shaft which is provided with type approved measures against corrosion by sea water, or the shaft which is made of approved corrosion resistance material. The propeller shaft or stern tube shaft other than specified above is Kind 2. *(2019)*
4. <omitted>	**4. <same as the present>**
5. Essential auxiliaries are the auxiliary machinery for important use, and are those for propulsion of ships and for safety of lives and ships or those for facilities in relation to the purpose of ships. **【See Guidance】**	**5. Essential auxiliaries** are the auxiliary machinery for important use, and are those for propulsion of ships and for safety of lives and ships ~~or those for facilities in relation to the purpose of ships~~. *(2019)* **【See Guidance】**
(hereafter, omitted)	(hereafter, same as the present Rules)

Present	Amendment
CHAPTER 2 MAIN AND AUXILIARY ENGINES	**CHAPTER 2 MAIN AND AUXILIARY ENGINES**
Section 2 Internal Combustion Engines	**Section 2 Internal Combustion Engines**
201. ~ 210. <omitted>	**201. ~ 210. <same as the present>**
211. Tests and Inspections	**211. Tests and Inspections**
1. <omitted>	**1. <same as the present>**
2. Test of turbochargers (2017)	**2. Test of turbochargers (2017)**
(1) <omitted> (2) Individual turbochargers for category B and C are to be tested according to the followings. (A) ~ (E) <omitted> (F) Overspeed test of all compressor wheels for a duration of 3 minutes at either 20 % above alarm level speed at room temperature or 10 % above alarm level speed at 45°C inlet temperature when tested in the actual housing with the corresponding pressure ratio. The overspeed test may be waived for forged wheels that are individually controlled by an approved non-destructive method. (G) A mechanical running test of each turbocharger for the duration of 20 minutes at maximum speed and operation temperature is to be carried out. However, the duration of the running test may be reduced by the Society in consideration of the results of running test, etc. (H) For manufacturers who have facilities in their works for testing the turbochargers on an engine, for which the turbocharger is intended, the shop test prescribed in (G) above may be replaced by a test run of 20 minutes duration at 10 % over load of maximum continuous output of the engine. (3) <omitted>	(1) <same as the present> (2) Individual turbochargers for category B and C are to be tested according to the followings. *(2019)* (A) ~ (E) <same as the present> (F) Overspeed test of all compressor wheels for a duration of 3 minutes at either 20 % above alarm level speed at room temperature or 10 % above alarm level speed at 45°C inlet temperature when tested in the actual housing with the corresponding pressure ratio. The overspeed test may be waived for forged wheels that are individually controlled by an approved non-destructive method. ~~(G) A mechanical running test of each turbocharger for the duration of 20 minutes at maximum speed and operation temperature is to be carried out. However, the duration of the running test may be reduced by the Society in consideration of the results of running test, etc.~~ ~~(H) For manufacturers who have facilities in their works for testing the turbochargers on an engine, for which the turbocharger is intended, the shop test prescribed in (G) above may be replaced by a test run of 20 minutes duration at 10 % over load of maximum continuous output of the engine.~~ (3) <same as the present>
3. ~ 5. <omitted>	**3. ~ 5. <same as the present>**
(hereafter, omitted)	(hereafter, same as the present)

Present	Amendment
CHAPTER 3 PROPULSION SHAFTING AND POWER TRANSMISSION SYSTEMS	**CHAPTER 3 PROPULSION SHAFTING AND POWER TRANSMISSION SYSTEMS**
Section 2 Shaftings	**Section 2 Shaftings**
201. ~ 203. <omitted>	**201. ~ 203. <same as the present>**
204. Propeller shaft and stern tube shaft	**204. Propeller shaft and stern tube shaft**
1. ~ 2. <omitted>	**1. ~ 2. <same as the present>**
3. Sleeves	**3. Sleeves**
(1) ~ (3) <omitted> (4) Security of sleeves (A) Sleeves are to be shrunk or forced on the shaft by pressure and they are not to be secured by pins or bolts. (B) Sleeves are to be made in a single piece. if made of two or more lengths, the jointing of the separate pieces is to be done by an approved method of the Society.	(1) ~ (3) <same as the present> (4) Security of sleeves (A) Sleeves are to be shrunk or forced on the shaft by pressure and they are not to be secured by pins or bolts. (B) Sleeves are to be made in a single piece. if made of two or more lengths, the jointing of the separate pieces is to be done by an type approved method of the Society. *(2019)*
(hereafter, omitted)	(hereafter, same as the present Rules)

Present	Amendment
CHAPTER 3 PROPULSION SHAFTING AND POWER TRANSMISSION SYSTEMS	**CHAPTER 3 PROPULSION SHAFTING AND POWER TRANSMISSION SYSTEMS**
Section 4 Power Transmission Systems	**Section 4 Power Transmission Systems**
401. ~ 405. <omitted>	**401. ~ 405. <same as the present>**
406. Shaft couplings **1. Shaft couplings and coupling bolts** The dimensions of couplings and coupling bolts are applied to the related requirements in **207.** In case where they support heavy materials in cantilever style, they are to be designed so as to have sufficient strength to resist the weight. **2. Flexible couplings** The flexible couplings are to have sufficient strength against the torque to be transmitted to the shaft, and the constructions and materials are to be type approved by the Society.	**406. Shaft couplings** **1. Shaft couplings and coupling bolts** The dimensions of couplings and coupling bolts are applied to the related requirements in **207.** In case where they support heavy materials in cantilever style, they are to be designed so as to have sufficient strength to resist the weight. **2. Flexible couplings** The flexible couplings are to have sufficient strength against the torque to be transmitted to the shaft. ~~and the constructions and materials are to be type approved by the Society.~~ *(2019)* **【See Guidance】**

Present	Amendment
407. Tests and inspections	**407. Tests and inspections**
1. ~ 3. <omitted>	**1. ~ 3. <same as the present>**
4. <new>	**4. Flexible couplings *(2019)***

(1) The certification of flexible couplings is to be issued as required by **Table 5.3.8**.

Table 5.3.8 Certification of flexible couplings

Items	Certificate	Issued by	Remarks
Non-metallic type flexible couplings (rubber, silicon, etc.) ≥ 100 kW	Product	Society	
	Type approval	Society	
	Material	Manufacturer	Torque transmitting parts
	NDE	Manufacturer	Torque transmitting parts
Metallic type flexible coupling (spring type, etc.) ≥ 100 kW	Product	Society	
	Type approval	Society	For use of propulsion only
	Material	Manufacturer	Torque transmitting parts
	NDE	Manufacturer	Torque transmitting parts
NOTES: Issued by Society means KR Certificate Issued by Manufacturer means Work's certificate (refer to **Ch 1, 301. 2**)			

(2) For non-metallic type (rubber, silicone, etc.) flexible couplings are to be subjected to a torque test. The test is to be carried out by twisting the flexible coupling or by subjecting the elastomer to a load which is equivalent to the coupling twist. The test torque is to be not less than 1.5 times the permissible nominal torque T_{KN}. The deflection from test results is to be within the tolerance specified by manufacturer. Flexible couplings not used with internal combustion engines may adjust the scope of the torque test at the discretion of the Surveyor.

(3) For flexible couplings using bonding with rubber or silicone, etc. the bonding test is to be carried out under the load at least one direction 1.5 times the permissible nominal torque T_{KN}. At this load the elastomers are to be inspected for any signs of slippage in the bonding surface. ⚓

Present	Amendment
CHAPTER 5 BOILERS AND PRESSURE VESSELS	**CHAPTER 5 BOILERS AND PRESSURE VESSELS**
Section 1 Boilers	**Section 1 Boilers**
101. ~ 128. <omitted>	**101. ~ 128. <same as the present>**
129. Water level indicator	**129. Water level indicator**
1. Each boiler is to be provided with at least two water level indicators independently, one of which is to be a glass water level gauge and the other is to comply with either of the following requirements. And, water level indicators other than glass water level gauge are to be type approved by the Society. (1) Glass water level gauge located where the water level is easily read by the operator in his working area. (2) Remote water level indicator, but, for the boiler whose design pressure is 1 MPa or under, this may be replaced with a level alarm device. In this case, remote water level indicator or detector for high and low water level alarm device is to be independent of the detector for the low water level safety device required in **125.**	**1.** Each boiler is to be provided with at least two water level indicators independently, one of which is to be a glass water level gauge and the other is to comply with either of the following requirements. And, water level indicators other than glass water level gauge are to be type approved by the Society. (1) Glass water level gauge located where the water level is easily read by the operator in his working area. (2) Remote water level indicator. ~~but, for the boiler whose design pressure is 1 MPa or under, this may be replaced with a level alarm device. In this case, remote water level indicator or detector for high and low water level alarm device is to be independent of the detector for the low water level safety device required in **125.**~~
(hereafter, omitted)	(hereafter, same as the present)

Present	Amendment
Section 3 Pressure Vessels	**Section 3 Pressure Vessels**
301. ~ 306. <omitted>	**301. ~ 306. <same as the present>**
307. Allowable stress	**307. Allowable stress**
1. The allowable stress of the materials used at room temperature is to be determined by the following items.	**1.** The allowable stress of the materials used at room temperature is to be determined by the following items.
(1) The allowable stress of carbon steel (including carbon manganese steel) and low alloy steels excluding cast steels is not to be taken to be greater than obtained from the following formulae, whichever is the smaller. For pressure vessels used for liquefied gas, the values of denominator for f_1 and f_2 are to be 3.0 and 2.0, respectively.	(1) The allowable stress of carbon steel (including carbon manganese steel) and low alloy steels excluding cast steels is not to be taken to be greater than obtained from the following formulae, whichever is the smaller. For pressure vessels used for liquefied gas, the values of denominator for f_1 and f_2 are to be 3.0 and 1.5, respectively.
$f_1 = \frac{R_{20}}{2.7}, \quad f_2 = \frac{E_{20}}{1.6}$	$f_1 = \frac{R_{20}}{2.7}, \quad f_2 = \frac{E_{20}}{1.6}$
where : R_{20} = Specified minimum tensile strength at room temperature $(\mathrm{N/mm^2})$ E_{20} = Specified minimum yield stress or 0.2% proof stress $(\mathrm{N/mm^2})$	where : R_{20} = Specified minimum tensile strength at room temperature $(\mathrm{N/mm^2})$ E_{20} = Specified minimum yield stress or 0.2% proof stress $(\mathrm{N/mm^2})$
(2) ~ (4) <omitted>	(2) ~ (4) <same as the present>
(5) The allowable stress of austenitic stainless steel is to be taken to the following f_1 or f_2, whichever is the smaller.	(5) The allowable stress of austenitic stainless steel is to be taken to the following f_1 or f_2, whichever is the smaller.
$f_1 = \frac{R_{20}}{3.5}, \quad f_2 = \frac{E_{20}}{1.6}$	$f_1 = \frac{R_{20}}{3.5}, \quad f_2 = \frac{E_{20}}{1.5}$
where : R_{20}, E_{20} = As specified in (1)	where : R_{20}, E_{20} = As specified in (1)
(hereafter, omitted)	(hereafter, same as the present)

Present	Amendment
CHAPTER 6 AUXILIARIES AND PIPING ARRANGEMENT	**CHAPTER 6 AUXILIARIES AND PIPING ARRANGEMENT**
Section 2 Air Pipes, Overflow Pipes and Sounding Devices	**Section 2 Air Pipes, Overflow Pipes and Sounding Devices**
201. Air pipes	**201. Air pipes**
1. General	**1. General**
(1) Air pipes are to be fitted to all tanks, cofferdams and tunnels. **【See Guidance】**	(1) Air pipes are to be fitted to all tanks, cofferdams, tunnels and void space of the enclosed structure. **【See Guidance】**
(hereafter, omitted)	(hereafter, same as the present)

Amendments for Guidance Relating to the Rules for the Classification of Steel Ships

(Part 5 MACHINERY INSTALLATIONS)

- Main Amendments -

(1) Effective date : 1 Jul. 2019 (Date of which the contract for construction is signed)

◉ The requirements of Ch 1, 101. 3 for bow or side thrusters are to be moved to that of Ch 3, 102. 2 in accordance with the structure of the Rules and the sealing devices of bow and side thrusters are to be type approved by the Society.

◉ ‘relevance to specific service of ships' has been changed to 'for cargo handling' in order to avoid the interpretation as the essential auxiliaries because it is related to specific service of the ships.

◉ Clarify requirements for omission of 110% power run for propulsion engines.

◉ When detailed calculations such as dynamic fluid load analysis and finite element analysis are carried out on propeller blade thickness, the requirements to recognize this have been added.

◉ The specific requirements of strength for flexible coupling have been newly added.

◉ Improvement of the citation system of international standard
- Add international standards KS B ISO 5579 corresponding of KS D 0227.
- Add “other equivalent standards” to KS D 0213

◉ A fuel oil cooler has been added to heat exchangers that the hydraulic test is required even though it is classified as a Class 3 pressure vessel.

◉ A reference to the data sheet with general engine information in Table 1 has been added.

◉ Submission requirements for the calculation of stern tube bearing fitting pressure and length, and the requirements for stern tube bearing clearance have been deleted.

◉ The requirements related to exhaust gas emission abatement system have been deleted.(Annex 5-10,13,15 & 15-A)

◉ Minimum nominal pressure for ship-side valves and fittings has been established.(Ch 6, Sec 1)

◉ The requirements overlapping rules for requirements for sounding device has been eliminated.(Ch 6, Sec 2)

◉ Bilge piping requirements for the cabin under the freeboard deck have been amended.(Ch 6, Sec 4)

◉ The requirement related to drainage facilities for fish hold, etc have been revised.(Ch 6, Sec 4)

◉ Annex 5-13 Fuel oil Treatment System has been established to reflect the IACS REC.151.

(2) Effective date : 1 Jul. 2019 (Date of the application for type approval)

◉ IACS UR M78 (New July 2018) on internal combustion engines supplied with low pressure gas has been newly established and reflected.

Present	Amendment
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Present	Amendment
CHAPTER 1 GENERAL	**CHAPTER 1 GENERAL**
Section 1 General	**Section 1 General**
101. Application [See Rules]	**101. Application [See Rules]**
1. In application to **101. 1** of the Rules, where redundant propulsion systems and steering systems are installed, the requirements in Annex 5-11 may be applied additionally.	**1.** In application to **101. 1** of the Rules, where redundant propulsion systems and steering systems are installed, the requirements in **Annex 5-10** may be applied additionally.
2. <omitted>	**2. <same as the present>**
3. In application to **101. 3** of the Rules, the thrusters may be in accordance with the following; (1) Thrusters (A) Application These requirements apply to the thrusters and their control units (hereinafter called "**thrusters**"). (B) Plans and documents Before the work is commenced, the manufacturers are to submit the following plans and documents in triplicate to the Society for approval. (a) General arrangement of thruster (b) Sectional assembly (including materials of principal component) (c) Controlling diagrams (d) Shaft arrangement and sealing devices (e) ~ (i) <omitted> (C) ~ (E) <omitted>	**3.** ~~In application to **101. 3** of the Rules, the thrusters may be in accordance with the following;~~ ~~(1) Thrusters~~ ~~(A) Application~~ ~~These requirements apply to the thrusters and their control units (hereinafter called "**thrusters**").~~ ~~(B) Plans and documents~~ ~~Before the work is commenced, the manufacturers are to submit the following plans and documents in triplicate to the Society for approval.~~ ~~(a) General arrangement of thruster~~ ~~(b) Sectional assembly (including materials of principal component)~~ ~~(c) Controlling diagrams~~ ~~(d) Shaft arrangement and sealing devices~~ ~~(e) ~ (i) <omitted>~~ ~~(C) ~ (E) <omitted>~~
(hereafter, omitted)	(hereafter, same as the present)

Present	Amendment
CHAPTER 1 GENERAL	**CHAPTER 1 GENERAL**
Section 1 General	**Section 1 General**
101. <omitted>	**101. <omitted>**
102. Definitions	**102. Definitions**
1. The essential auxiliaries given in **102. 5** of the Rules are as follows; (1) Auxiliary machinery essential for main propulsion <omitted> (2) Auxiliary machinery for the safety of life and ship (A) ~ (E) <omitted> (F) Other auxiliary machineries as deemed essential by the Society (3) Auxiliary machinery having relevance to specific service of ships (A) Cargo handling machinery subject to **Pt 9, Ch 2** of the Rules Hydraulic pump for cargo handling machinery (B) Auxiliary machineries for oil tankers, ships carrying liquefied gases in bulk, ships carrying dangerous chemicals in bulk Cargo pumps, stripping pumps, tank cleaning pumps, gas compressors, pumps for gas cooling system, gas refrigerating compressors (C) Refrigerating machinery Compressors, liquid pump and condenser cooling pumps used for cargo refrigerating machinery (including items subject to **Pt 9, Ch 1** of the Rules) (D) Other auxiliary machineries as deemed essential by the Society	**1.** The essential auxiliaries given in **102. 5** of the Rules are as follows; (1) Auxiliary machinery essential for main propulsion <same as the present> (2) Auxiliary machinery for the safety of life and ship (A) ~ (E) <same as the present> (F) Auxiliary machinery for cargo handling *(2019)* (a) Cargo handling machinery subject to **Pt 9, Ch 2** of the Rules Hydraulic pump for cargo handling machinery (b) Auxiliary machineries for oil tankers, ships carrying liquefied gases in bulk, ships carrying dangerous chemicals in bulk Cargo pumps, stripping pumps, tank cleaning pumps, gas compressors, pumps for gas cooling system, gas refrigerating compressors (c) Refrigerating machinery Compressors, liquid pump and condenser cooling pumps used for cargo refrigerating machinery (including items subject to **Pt 9, Ch 1** of the Rules) (G) Other auxiliary machineries as deemed essential by the Society
(hereafter, omitted)	(hereafter, same as the present Rules)

Present	Amendment
CHAPTER 1 GENERAL	**CHAPTER 1 GENERAL**
Section 2 Plans and Documents	**Section 2 Plans and Documents**
202. Plans and documents to be submitted by the shipyard 【See Rules】	**202. Plans and documents to be submitted by the shipyard** 【See Rules】
1. Plans for approval	**1. Plans for approval**
[omitted]	[same as present]
2. In application to **202. 2** (5) of the Rules, where considered necessary by the Society and the requirements for shaft alignment are to comply with **Annex 5-14**. *(2017)*	**2.** In application to **202. 2** (5) of the Rules, where considered necessary by the Society and the requirements for shaft alignment are to comply with **Annex 5-12**. *(2017)*
203. Plans and documents to be submitted by the licensor and licensee of internal combustion engines ***(2018)*** 【See Rules】	**203. Plans and documents to be submitted by the licensor and licensee of internal combustion engines** ***(2018)*** 【See Rules】
1. In application to **203. Table 5.1.5** and **Table 5.1.6** of the Rules, the special sheet required by the Society is given in **Annex 5-12, Table 1**.	**1.** In application to **203. Table 5.1.5** and **Table 5.1.6** of the Rules, the special sheet required by the Society is given in **Annex 5-11, Table 1**.
[omitted]	[same as present]

<Present> Pt 5, Ch 2, 211. of the Guidance

Table 5.2.2 Programme for Shop Trials of Internal Combustion Engine

Test items \ Use of engines		Propulsion engines driving propeller or impeller only[1]	Engines driving generators for electric propulsion and main power supply[2]	Propulsion engines also driving power take off (PTO) generator[3]	Engines driving essential auxiliaries[1]
110 % power run		15 *minutes* at the speed of 1.032 times of the rated engine speed or after steady conditions have been reached, whichever is shorter	15 *minutes* at the rated engine speed	15 *minutes* at the rated engine speed	15 *minutes* at the rated engine speed
Approved intermittent overload (if applicable)		testing for duration as agreed with the manufacturer	-	testing for duration as agreed with the manufacturer	testing for duration as agreed with the manufacturer
Load tests	100 % power run[4]	60 *minutes* at the rated engine speed	60 *minutes* at the rated engine speed	60 *minutes* at the rated engine speed	30 *minutes* at the rated engine speed
	90 % or Normal continuous cruise power run[5]	20 *minutes* at engine speed in accordance with characteristics of propeller	-	20 *minutes* at engine speed in accordance with characteristics of propeller or the rated engine speed	-
	75 % power run		20 *minutes* at the rated engine speed		20 *minutes* at engine speed in accordance with the nominal power consumption curve
	50 % power run				
	25 % power run[5]				
Reverse maneuvering test[6]		○	-	-	-
Governor characteristics test		○	○	○	○
Performance test of alarm and safety devices		○	○	○	○
Overhaul inspection[7]		○	○	○	○

NOTES :

1. For electronically controlled diesel engines, integration tests are to be carried out in accordance with **211. 5** (4) of the Guidance.
2. (1) through (7) in this Table are subject to the following;
   (1) For 110 % power run of propulsion engines, only required once for each different engine/turbocharger configuration. After the trials, the fuel delivery system is to be blocked so as to limit the engines to run at not more than 100 % power, unless intermittent overload power is approved by the Society.
   (2) After running on the test bed, the fuel delivery system is to be adjusted so that full power plus a 10 % margin for transient regulation can be given in service after installation onboard. The transient overload capability is required so that the required transient governing characteristics are achieved also at 100 % loading of the engine, and also so that the protection system utilised in the electric distribution system can be activated before the engine stalls.
   (3) After running on the test bed, the fuel delivery system is to be adjusted so that full power plus a margin for transient regulation can be given in service after installation onboard. The transient overload capability is required so that the electrical protection of downstream system components is activated before the engine stalls. This margin may be 10 % of the engine power but at least 10 % of the PTO power.
   (4) The readings are to be taken twice at an interval of at least 30 *minutes*.
   (5) The test item may be dispensed with when deemed appropriate by the Society.
   (6) The test item applies only to direct reversible engines.
   (7) Random checks of components to be presented for inspection after works trials are left to the discretion of the attending Surveyor. *(2018)*

Table 5.2.2 Programme for Shop Trials of Internal Combustion Engine

Test items \ Use of engines		Propulsion engines driving propeller or impeller only(2)	Engines driving generators for electric propulsion and main power supply(3)	Propulsion engines also driving power take off (PTO) generator(4)	Engines driving essential auxiliaries(2)
110 % power run		15 *minutes* at the speed of 1.032 times of the rated engine speed or after steady conditions have been reached, whichever is shorter(1)	15 *minutes* at the rated engine speed	15 *minutes* at the rated engine speed	15 *minutes* at the rated engine speed
Approved intermittent overload (if applicable)		testing for duration as agreed with the manufacturer	-	testing for duration as agreed with the manufacturer	testing for duration as agreed with the manufacturer
Load tests	100 % power run(5)	60 *minutes* at the rated engine speed	60 *minutes* at the rated engine speed	60 *minutes* at the rated engine speed	30 *minutes* at the rated engine speed
	90 % or Normal continuous cruise power run(6)	20 *minutes* at engine speed in accordance with characteristics of propeller	-	20 *minutes* at engine speed in accordance with characteristics of propeller or the rated engine speed	-
	75 % power run		20 *minutes* at the rated engine speed		20 *minutes* at engine speed in accordance with the nominal power consumption curve
	50 % power run				
	25 % power run(6)				
Reverse maneuvering test(7)		○	-	-	-
Governor characteristics test		○	○	○	○
Performance test of alarm and safety devices		○	○	○	○
Overhaul inspection(8)		○	○	○	○

NOTES :

1. For electronically controlled diesel engines, integration tests are to be carried out in accordance with **211. 5** (4) of the Guidance.
2. (1) through (8) in this Table are subject to the following;
   (1) When the test report for identical engine and turbocharger configuration is presented proving the compatibility for overloaded operation, the 110 % power run may be waived. *(2019)*
   (2) After the trials, the fuel delivery system is to be blocked so as to limit the engines to run at not more than 100 % power, unless intermittent overload power is approved by the Society.
   (3) After running on the test bed, the fuel delivery system is to be adjusted so that full power plus a 10 % margin for transient regulation can be given in service after installation onboard. The transient overload capability is required so that the required transient governing characteristics are achieved also at 100 % loading of the engine, and also so that the protection system utilised in the electric distribution system can be activated before the engine stalls.
   (4) After running on the test bed, the fuel delivery system is to be adjusted so that full power plus a margin for transient regulation can be given in service after installation onboard. The transient overload capability is required so that the electrical protection of downstream system components is activated before the engine stalls. This margin may be 10 % of the engine power but at least 10 % of the PTO power.
   (5) The readings are to be taken twice at an interval of at least 30 *minutes.*
   (6) The test item may be dispensed with when deemed appropriate by the Society.
   (7) The test item applies only to direct reversible engines.
   (8) Random checks of components to be presented for inspection after works trials are left to the discretion of the attending Surveyor. *(2018)*

Present	Amendment
CHAPTER 3 PROPULSION SHAFTING AND POWER TRANSMISSION SYSTEMS	**CHAPTER 3 PROPULSION SHAFTING AND POWER TRANSMISSION SYSTEMS**
Section 1 General	**Section 1 General**
101. <omitted>	**101. <same as the present>**
102. Other propulsion and maneuvering machinery 【See Rules】	**102. Other propulsion and maneuvering machinery** 【See Rules】
In application to **102.** of the Rules, water-jet propulsion systems and azimuth or rotatable thrusters may be complied with the following ;	In application to **102.** of the Rules, water-jet propulsion systems and azimuth or rotatable thrusters may be complied with the following ;
1. Water-jet propulsion systems and azimuth or rotatable thrusters water-jet propulsion systems or azimuth or rotatable thrusters are to comply with the requirements given in **Annex 5-1.**	**1. Water-jet propulsion systems and azimuth or rotatable thrusters** water-jet propulsion systems or azimuth or rotatable thrusters are to comply with the requirements given in **Annex 5-1.**
2. <new>	**2.** Bow or side thrusters and their control units (hereinafter called "**thrusters**") are to comply with the followings. *(2019)* (1) Plans and documents Before the work is commenced, the manufacturers are to submit the following plans and documents in triplicate to the Society for approval. (A) General arrangement of thruster (B) Sectional assembly (including materials of principal component) (C) Controlling diagrams (D) Shaft arrangement and sealing devices(sealing devices to be type approved by the Society) (E) Propeller (F) Power transmission gear arrangement (G) Piping arrangement (H) Main particulars (kind of prime mover, output, number of revolution, capacity, etc. are to be stated) (I) Plans and documents considered necessary by the Society

Present	Amendment
	(2) Materials The materials used in the principal component, in principle, are to be complied with the requirements of **Pt 2, Ch 1** of the Rules. However, the Society may accept to be used of the materials which comply with *Korean Industrial Standard* or standard considered as equivalent thereto. (3) Shop tests (A) The test requirements of shafting, propellers and power transmission gears are to be applied appropriate modifications respectively such as follows; For shafting, **Ch 3, Sec 2** of the Rules; For propellers, **Ch 3, Sec 3** of the Rules; For power transmission gears **Ch 3, Sec 4** of the Rules. (B) The hydraulic tests for hydraulically pressurised parts of equipment and piping systems are to be in accordance with the requirements of **Ch 6** of the Rules. However, theses shop tests may be substituted for the tests carried out by the manufacturer. (C) The test requirements of piping system are to be applied appropriate modifications of **Ch 6** of the Rules. (D) The requirements of electrical installations are to be applied appropriate modifications of **Pt 6, Ch 1** of the Rules. (4) On board tests The performance test and the safety device test for thruster are to be carried out.
(hereafter, omitted)	(hereafter, same as the present)

Present	Amendment
CHAPTER 3 PROPULSION SHAFTING AND POWER TRANSMISSION SYSTEMS	**CHAPTER 3 PROPULSION SHAFTING AND POWER TRANSMISSION SYSTEMS**
Section 3 Propellers	**Section 3 Propellers**
301. Application [See Rules]	**301. Application [See Rules]**
1. For the propellers such as following, the Society may request the submission of calculation sheets for stress of blades. (1) Propellers having special type blade such as nozzle propeller, jacket propeller, etc. (2) Propellers for special purpose ships such as tug boat, stern trawler, pusher, etc. (3) Propellers having pitch ratio of more than 0.8 at the radius 0.25 *R*. (4) Specially designed propellers for improving propelling efficiency.	**1.** Where the detailed calculation of propeller blades is carried out, the thickness of the blades required by **303.** of the Rules may be reduced based on the detailed calculation submitted by the manufacturers. Detailed calculations shall include the followings. *(2019)* (1) Loading conditions and hydrodynamic loads applied to blades (2) Finite element model and boundary conditions (if requested by the Society, blades model data are to be provided.) (3) Yield and fatigue assessment (4) Proposed safety factor and its backgrounds for yield and fatigue (5) Other documents considered necessary by the Society **2.** For the propellers such as following, the Society may request the submission of calculation sheets for stress of blades. (1) Propellers having special type blade such as nozzle propeller, jacket propeller, etc. (2) Propellers for special purpose ships such as tug boat, stern trawler, pusher, etc. (3) Propellers having pitch ratio of more than 0.8 at the radius 0.25 *R*. (4) Specially designed propellers for improving propelling efficiency.
(hereafter, omitted)	(hereafter, same as the present)

Present	Amendment
CHAPTER 3 PROPULSION SHAFTING AND POWER TRANSMISSION SYSTEMS	**CHAPTER 3 PROPULSION SHAFTING AND POWER TRANSMISSION SYSTEMS**
Section 4 Power Transmission Systems	**Section 4 Power Transmission Systems**
406. Shaft couplings *(2017)*	**406. Shaft couplings** *(2017)*
1. In the application **406. 2** of the Rules, in case of the metallic coupling not used for main propulsion, the type approval may be dispensed.	~~**1.** In the application **406. 2** of the Rules, in case of the metallic coupling not used for main propulsion, the type approval may be dispensed.~~ **1.** In the application **406. 2** (1) of the Rules, the wording "to have sufficient strength against the torque" means complying with the following requirements. *(2019)* (1) The permissible nominal torque T_{KN} of the flexible coupling is to be complied with following formula. $T_{KN} \geq T_N \quad (\mathrm{kN \cdot m})$ where: T_N = Nominal torque (highest mean torque in continuous service) $T_N = \frac{9.55 \times P}{n} \quad (\mathrm{kN \cdot m})$ where: P = Maximum output in continuous service (kW) n = Number of revolution at maximum output in continuous service (rpm)

Present	Amendment
(hereafter, omitted)	(2) The actual working values of flexible coupling in environmental and service conditions over the design life such as maximum torque, maximum torque range, vibratory torque, number of revolution and power loss (heat dissipation) etc. are not to be exceeded the permissible values specified by manufacturer. (hereafter, same as the present)

Present	Amendment
CHAPTER 5 BOILERS AND PRESSURE VESSELS	**CHAPTER 5 BOILERS AND PRESSURE VESSELS**
Section 1 Boilers	**Section 1 Boilers**
101. <omitted>	**101. <same as the present>**
102. Materials	**102. Materials**
1. In application to **102. 1** (2) of the Rules, "where deemed appropriate by the Society" means the fittings having design pressure less than 3 MPa and nominal diameter less than 100 A. **【See Rules】**	**1.** In application to **102. 1** (2) of the Rules, "where deemed appropriate by the Society" means the fittings having design pressure less than 3 MPa and nominal diameter less than 100 A. **【See Rules】**
2. In application to **102. 2** of the Rules, the cast steels used for body of the boilers are to be ensured that the materials have not any harmful defect through radiographic examination and magnetic particle test. Test methods and judgement standards are to be in accordance with the following. **【See Rules】**	**2.** In application to **102. 2** of the Rules, the cast steels used for body of the boilers are to be ensured that the materials have not any harmful defect through radiographic examination and magnetic particle test. Test methods and judgement standards are to be in accordance with the following. **【See Rules】**
(1) The radiographic examination is to be carried out according to "*KS D* 0227 (method of radiographic examination for cast steels and classification of grade for radiograph film)", and if there is crack, the cast steel is to be rejected. The defects specified in *KS D* 0227 such as blow holes, sand spots, inclusions and concavity are to be accepted only defects of Grade 1.	(1) The radiographic examination is to be carried out according to KS D 0227 (method of radiographic examination for cast steels), (KS B) ISO 5579 or other equivalent standards and if there is crack, the cast steel is to be rejected. The defects such as blowholes, sand spots, inclusions and shrinkages are to be accepted only defects of Grade 1. *(2019)*
(2) The magnetic particle test is to be carried out according to "*KS D* 0213 (method of magnetic particle test for steels and classification of grade for defect shape of magnetic particle)", the defects specified in *KS D* 0213 are to be accepted only defects of Grade 1 or Grade 2.	(2) The magnetic particle test is to be carried out according to KS D 0213 (method of magnetic particle testing of ferromagnetic materials and classification of magnetic particle indication) or other equivalent standards. The acceptance criteria of defects may be in accordance with **Pt 2, Annex 2-2, 6** of the Guidance or other international standards recognized by the Society. *(2019)*
(hereafter, omitted)	(hereafter, same as the present)

Present	Amendment
Section 3 Pressure Vessels	**Section 3 Pressure Vessels**
302. <omitted>	**302. <same as the present>**
303. Materials [See Rules]	**303. Materials [See Rules]**
1. In application to **303. 2** of the Rules, body of pressure vessels used for noxious substances is not to be used special iron castings.	**1.** In application to **303. 2** of the Rules, body of pressure vessels used for noxious substances is not to be used special iron castings.
2. When the steel castings are used for the body of Class 1 or Class 2 pressure vessels, non-destructive test methods and judgement standards are to be in accordance with the following.	**2.** When the steel castings are used for the body of Class 1 or Class 2 pressure vessels, non-destructive test methods and judgement standards are to be in accordance with the following.
(1) The radiographic examination is to be carried out according to "*KS D* 0227 (method of radiographic examination for steel castings and classification of grade for radiograph film)" and if there is crack, to be rejected. The defects specified in *KS D* 0227 such as blowholes, sand spots, inclusions and concavity are to be accepted only defects of Grade 1. However, in the case of Class 2 pressure vessels, the defects specified in *KS D* 0227 such as blowholes, sand spots and inclusions found on test portions of thickness more than 25 mm may be accepted defects of Grade 1 and Grade 2.	(1) The radiographic examination is to be carried out according to KS D 0227 (method of radiographic examination for cast steels), (KS B) ISO 5579 or other equivalent standards and if there is crack, the cast steel is to be rejected. The defects such as blowholes, sand spots, inclusions and shrinkages are to be accepted only defects of Grade 1. However, in the case of Class 2 pressure vessels, the defects ~~specified in KS D 0227~~ such as blowholes, sand spots and inclusions found on test portions of thickness more than 25 mm may be accepted defects of Grade 1 and Grade 2. *(2019)*
(2) The magnetic particle test is to be carried out according to "*KS D* 0213 (method of magnetic particle test for steels and classification of grade for defect shape of magnetic particle)", the defects specified in *KS D* 0213 are to be accepted only defects of Grade 1 or Grade 2.	(2) The magnetic particle test is to be carried out according to KS D 0213 (method of magnetic particle testing of ferromagnetic materials and classification of magnetic particle indication) or other equivalent standards. The acceptance criteria of defects may be in accordance with **Pt 2, Annex 2-2, 6** of the Guidance or other international standards recognized by the Society. *(2019)*
(hereafter, omitted)	(hereafter, same as the present)

Present	Amendment
CHAPTER 5 BOILER AND PRESSURE VESSELS	**CHAPTER 5 BOILER AND PRESSURE VESSELS**
Section 3 Pressure Vessels	**Section 3 Pressure Vessels**
302. ~ 313. <omitted>	**302. ~ 313. <same as the present>**
319. Tests and inspections	**319. Tests and inspections**
1. In application to **319. 1 Table 5.5.17** of the Rules, the Class 3 pressure vessels which deemed necessary by the Society mean vessels satisfied with the following (1) or (2) are to be subjected to hydraulic test. (1) Design pressure (MPa) × Capacity (m^3) ≥ 1 (2) Heat exchangers (fresh water coolers, lubricating oil coolers, hydraulic oil coolers, lubricating oil heater, fuel oil heaters, condensors, feed water heaters, air coolers, etc.) and air tanks (control air tank, etc.) for operating the following; and other essential pressure vessels : (A) Main propulsion engines, essential auxiliary engines and propulsion shafting systems (B) Motors and electric power converters for electric propulsion unit (C) Boilers and thermal oil installations (main boilers, essential auxiliary boilers, boilers and thermal oil heaters for main propulsion engine fuel oil heating and for heating of cargo to be usually heated)	1. In application to **319. 1 Table 5.5.17** of the Rules, the Class 3 pressure vessels which deemed necessary by the Society mean vessels satisfied with the following (1) or (2) are to be subjected to hydraulic test. (1) Design pressure (MPa) × Capacity (m^3) ≥ 1 (2) Heat exchangers (heater/coolers for fresh water, lubricating oil, hydraulic oil and fuel oil, condensors, feed water heaters, air coolers, etc.) and air tanks (control air tank, etc.) for operating the following; and other essential pressure vessels : *(2019)* (A) Main propulsion engines, essential auxiliary engines and propulsion shafting systems (B) Motors and electric power converters for electric propulsion unit (C) Boilers and thermal oil installations (main boilers, essential auxiliary boilers, boilers and thermal oil heaters for main propulsion engine fuel oil heating and for heating of cargo to be usually heated)

Present	Amendment
CHAPTER 6 AUXILIARIES AND PIPING ARRANGEMENT	**CHAPTER 6 AUXILIARIES AND PIPING ARRANGEMENT**
Section 1 General	**Section 1 General**
[omitted]	[same as present]
103. Valves and fittings [See Rules]	**103. Valves and fittings [See Rules]**
[omitted]	[same as present]
5. Construction and standard of pipe fittings	**5. Construction and standard of pipe fittings**
[omitted]	[same as present]
(4) Newly added	(4) Nominal pressure for piping system related to ship-side is to be at least 5K. *(2019)*
[omitted]	[same as present]

Present	Amendment
CHAPTER 6 AUXILIARIES AND PIPING ARRANGEMENT	**CHAPTER 6 AUXILIARIES AND PIPING ARRANGEMENT**
Section 2 Air Pipes, Overflow Pipes and Sounding Devices	**Section 2 Air Pipes, Overflow Pipes and Sounding Devices**
201. Air pipes	**201. Air pipes**
[omitted]	[same as present]
202. Overflow pipes **【See Rules】**	**202. Overflow pipes** **【See Rules】**
[omitted]	[same as present]
203. Sounding devices	**203. Sounding devices**
1. In application to **203. 1** (1) of the Rules, sounding devices may be complied with following. **【See Rules】** (1) For a normally inaccessible small void compartment such as an echo sounder recess, sounding pipes may be omitted under the approval of the Society. For such arrangements, means for sampling such as plugs or cocks are to be provided to the manhole and a warning notice is to be located in a prominent position specifying the precautions for checking flooding of the compartment to be taken prior opening the manhole. (2) Special shaped voids, etc. which installation of sounding pipes or other sounding devices is impracticable as structural reason may be provided with a bilge alarm instead of sounding pipe under the approval of the Society.	**1.** In application to **203. 1** (1) of the Rules, sounding devices may be complied with following. **【See Rules】** (1) For a normally inaccessible small void compartment such as an echo sounder recess, sounding pipes may be omitted under the approval of the Society. For such arrangements, means for sampling such as plugs or cocks are to be provided to the manhole and a warning notice is to be located in a prominent position specifying the precautions for checking flooding of the compartment to be taken prior opening the manhole. (2) Special shaped voids, etc. which installation of sounding pipes or other sounding devices is impracticable as structural reason may be provided with a bilge alarm instead of sounding pipe under the approval of the Society.
2. Termination of sounding pipes In application to **203. 2 (1)** of the Rules, short sounding pipes with closing means at the upper end comply with the following may be led to the readily accessible positions below bulkhead deck. **【See Rules】** (1) Sounding pipes to fuel oil tank and other flammable oil storage tank are to be fitted with self-closing blanking devices and with a small-diameter self-closing control cock located below the blanking device. (2) Sounding pipes to other tanks mentioned in (1) and cofferdams are to be fitted with sluice valves, cocks or screw caps attached to the pipes by chains. (3) Sounding pipes to the tanks and cofferdams located in double bottom are to be fitted with self-closing blanking devices.	**2. Termination of sounding pipes** In application to **203. 2 (2)** of the Rules, Sounding pipes to the tanks and cofferdams located in double bottom are to be fitted with self-closing blanking devices. *(2019)* **【See Rules】** ~~(1) Sounding pipes to fuel oil tank and other flammable oil storage tank are to be fitted with self-closing blanking devices and with a small-diameter self-closing control cock located below the blanking device.~~ ~~(2) Sounding pipes to other tanks mentioned in (1) and cofferdams are to be fitted with sluice valves, cocks or screw caps attached to the pipes by chains.~~ ~~(3) Sounding pipes to the tanks and cofferdams located in double bottom are to be fitted with self-closing blanking devices.~~
[omitted]	[same as present]

Present	Amendment
CHAPTER 6 AUXILIARIES AND PIPING ARRANGEMENT	**CHAPTER 6 AUXILIARIES AND PIPING ARRANGEMENT**
Section 4 Bilge and Ballast System	**Section 4 Bilge and Ballast System**
401. General	**401. General** 【See Rules】
[omitted]	[same as present]
402. Drainage of compartment other than machinery spaces 【See Rules】	**402. Drainage of compartment other than machinery spaces** 【See Rules】
1. Omission of bilge suction pipes For small compartment such as echo sounder recess, the provision of bilge suction pipes may be omitted under the approval of the Society.	**1. Omission of bilge suction pipes** For small compartment such as echo sounder recess, the provision of bilge suction pipes may be omitted under the approval of the Society.
2. Bilge scuppers in special case In case where hold bilges are drained to the engine room or shaft tunnel adjacent thereto through the watertight construction as specified in **Fig 5.6.8** of the guidance, the bilge drainage piping is to be led to spaces readily accessible and self-closing valve or cock is to be provided. Where such bilge is led to the watertight bilge tanks, the above mentioned valve or cock may be omitted, but where the hold is located under the load line, non-return valve is to be provided. In case where hold bilges are led to the shaft tunnel, no sounding pipe may be provided, but the diameter of the drainage pipe is not to be less than the value specified for bilge suction pipe.	**2. Bilge scuppers in special case** In case where hold or cabin bilges are drained to the engine room or shaft tunnel adjacent thereto through the watertight construction as specified in **Fig 5.6.8** of the guidance, the bilge drainage piping is to be led to spaces readily accessible and self-closing valve or cock is to be provided. Where such bilge is led to the watertight bilge tanks, the above mentioned valve or cock may be omitted, but where the hold is located under the load line, non-return valve is to be provided. In case where hold bilges are led to the shaft tunnel, no sounding pipe may be provided, but the diameter of the drainage pipe is not to be less than the value specified for bilge suction pipe.
3. Bilge well high water level alarms For ships being within the application limits of regulation XII/4.2 of SOLAS, which have been constructed with an insufficient number of transverse watertight bulkheads to satisfy the regulation, it is provided with bilge well high water level alarms in all cargo holds, or in cargo conveyor tunnels, as appropriate, giving an audible and visual alarm on the navigation bridge.	**3. Bilge well high water level alarms** For ships being within the application limits of regulation XII/4.2 of SOLAS, which have been constructed with an insufficient number of transverse watertight bulkheads to satisfy the regulation, it is provided with bilge well high water level alarms in all cargo holds, or in cargo conveyor tunnels, as appropriate, giving an audible and visual alarm on the navigation bridge.
4. [Newly added]	**4. Bilge drainage system of fish hold & etc** Where drainage of bilge water is possible by means of water pipes or circulating water pipes installed in tanks or fish hold in which fish are caught with ice or water, the bilge pipes may be used instead of bilge pipes and they shall be deemed to comply with the bilge pipes. *(2019)*
[omitted]	[same as present]

Present	Amendment
CHAPTER 6 AUXILIARIES AND PIPING ARRANGEMENT	**CHAPTER 6 AUXILIARIES AND PIPING ARRANGEMENT**
Section 4 Bilge and Ballast System	**Section 4 Bilge and Ballast System**
[omitted]	[same as present]
403. [Newly added]	**403. Drainage of machinery spaces *(2019)*** **[See Rules]**
	1. Emergency bilge suction
	(1) In application to **403. 6 (3)** of the Rules, The emergency bilge suction may be led to the main cooling water pump or the main circulation water pump driven by the main engine.
[omitted]	[same as present]

Present

CHAPTER 6 AUXILIARIES AND PIPING ARRANGEMENT

Section 4 Bilge and Ballast System

[omitted]

404. Size of bilge suction pipes 【See Rules】

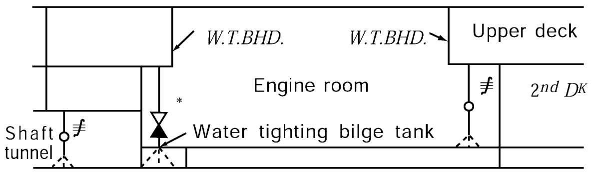
1. Main bilge pipes

[omitted]

diameter of such standard pipes is small of the calculated value by 13 mm or over.

2. Bilge suction branch pipes In application to **404. 2** of the Rules, the bilge suction branch pipes are to be complied with the following.

(1) For bilge suction piping of hold bilges, the main bilge suction system (Christmas tree system) is, in principle, not to be adopted. In case where such an arrangement is unavoidable, the ship is to be ensured satisfying the one-sub-division flooding condition. The internal diameter of bilge suction pipe in such a system is to be calculated according to the **Fig 5.6.9** of the Guidance.



⨎ Valve or cock with self-closing device

* Non-return valve (where the hold is located below the load line)

Fig 5.6.8 Example of Hold Bilge Drainage Line through the Watertight Construction

[omitted]

Amendment

CHAPTER 6 AUXILIARIES AND PIPING ARRANGEMENT

Section 4 Bilge and Ballast System

[same as present]

404. Size of bilge suction pipes 【See Rules】

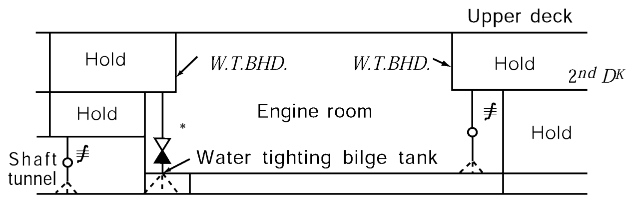
1. Main bilge pipes

[same as present]

diameter of such standard pipes is small of the calculated value by 13 mm or over.

2. Bilge suction branch pipes In application to **404. 2** of the Rules, the bilge suction branch pipes are to be complied with the following.

(1) For bilge suction piping of hold bilges, the main bilge suction system (Christmas tree system) is, in principle, not to be adopted. In case where such an arrangement is unavoidable, the ship is to be ensured satisfying the one-sub-division flooding condition. The internal diameter of bilge suction pipe in such a system is to be calculated according to the **Fig 5.6.9** of the Guidance.



⨎ Valve or cock with self-closing device

* Non-return valve (where the hold is located below the load line)

Fig 5.6.8 Example of Hold Bilge Drainage Line through the Watertight Construction

[same as present]

Present	Amendment
CHAPTER 6 AUXILIARIES AND PIPING ARRANGEMENT **Section 6 Steam and Exhaust Gas Piping** [omitted] **602. Exhaust gas piping** 【See Rules】 **1.** In application to **602. 1** of the Rules, the Selective Catalytic Reduction(SCR) system using ammonia solution or urea solution as the reductant agents is to comply with requirements in **Annex 5-10** in addition to those in this Chapter. **2.** In application to **602. 1** of the Rules, the ships provided the Exhaust Gas Recirculation(EGR) system are to comply with requirements in **Annex 5-13** in addition to those in this Chapter. **3.** In application to 6**02** of the Rules, the ships provided the Exhaust Gas Cleaning(EGC) system are to comply with requirements in Annex 5-15 in addition to those in this Chapter. *(2017)* [omitted]	**CHAPTER 6 AUXILIARIES AND PIPING ARRANGEMENT** **Section 6 Steam and Exhaust Gas Piping** [same as present] **602. Exhaust gas piping** 【See Rules】 **1.** In application to **602. 1** of the Rules, the Selective Catalytic Reduction(SCR) system using ammonia solution or urea solution as the reductant agents is to comply with requirements in **Sec 1** of **Guidance for exhaust gas emission abatement system** in addition to those in this Chapter. **2.** In application to **602. 1** of the Rules, the ships provided the Exhaust Gas Recirculation(EGR) system are to comply with requirements in **Sec 2** of **Guidance for exhaust gas emission abatement system** in addition to those in this Chapter. **3.** In application to **602.** of the Rules, the ships provided the Exhaust Gas Cleaning(EGC) system are to comply with requirements in **Sec 3** of **Guidance for exhaust gas emission abatement system** in addition to those in this Chapter. *(2017)* [same as present]

Present	Amendment
Annex 5-7-1 <New>	**Annex 5-7-1 Internal Combustion Engines Supplied with Low Pressure Gas *(2019)***

1. General

(1) Scope

(A) This Annex addresses the requirements for trunk piston internal combustion engines supplied with low pressure natural gas as fuel. This Annex is to be applied in association with other relevant requirements for internal combustion engine of **Pt 5** of the Rules, as far as found applicable to the specific natural gas burning engine design.

(B) The mandatory international codes of **Pt 7, Ch 5** of the Rules (IGC Code) and **Rules for Ships using Low-flash-point Fuels** (IGF Code) must also be considered, as applicable.

(C) Specific requirements of **Rules for Ships using Low-flash-point Fuels** as referenced in this Annex shall be applied to engine types covered by this Annex installed on any ship, regardless of type, size and trading area, as long as the **Pt 7, Ch 5** of the Rules is not referenced or explicitly specified otherwise. Engines can be either dual fuel engines (hereinafter referred to as DF engines) or gas fuel only engines (hereinafter referred to as GF engines).

(D) Gas can be introduced as follows:

(a) into the air inlet manifold, scavenge space, or cylinder air inlet channel port; or

(b) mixed with air before the turbo-charger ("pre-mixed engines").

(E) The gas / air mixture in the cylinder can be ignited by the combustion of a certain amount of fuel (pilot injection) or by extraneous ignition (sparking plug).

(F) The scope of this Annex is limited to natural gas fuelled engines.

(G) This Annex covers the following applications, but is not limited to:

(a) Mechanical propulsion

(b) Generating sets intended for main propulsion and auxiliary applications.

(c) Single engine or multi-engine installations

(2) Definitions

(A) **Certified safe type** means electrical equipment that is certified in accordance with the recommendation published by the International Electrotechnical Commission (IEC), in particular publication IEC 60092-502:1999, or with recognized standards at least equivalent. The certification of electrical equipment is to correspond to the category and group for methane gas.

(B) **Double block and bleed valves** means the set of valves referred to in:

(a) **Pt 7, Ch 5, 1604. 5** of the Rules

(b) **Ch 1, 102. 9** and **Ch 9, 401. 4** to **6** of **Rules for Ships using Low-flash-point Fuels**

(C) **Dual fuel engine ("DF engine")** means an engine that can burn natural gas as fuel simultaneously with liquid fuel, either as pilot oil or bigger amount of liquid fuel (gas mode), and also has the capability of running on liquid diesel fuel oil only (Diesel mode).

Present	Amendment
	(D) **Engine room** is a machinery space or enclosure containing gas fuelled engine(s). (E) **Gas** means a fluid having a vapour pressure exceeding 2.8 bar absolute at a temperature of 37.8 ℃. (F) **Gas admission valve** is a valve or injector on the engine, which controls gas supply to the cylinder(s) according to the cylinder(s) actual gas demand. (G) **Gas engine** means either a DF engine or a GF engine. (H) **Gas fuel only engine ("GF engine")** means an engine capable of operating on gas fuel only and not able to switch over to oil fuel operation. (I) **Gas piping** means piping containing gas or air / gas mixtures, including venting pipes. (J) **Gas Valve Unit (GVU)** is a set of manual shutoff valves, actuated shut-off and venting valves, gas pressure sensors and transmitters, gas temperature sensors and transmitters, gas pressure control valve and gas filter used to control the gas supply to each gas consumer. It also includes a connection for inert gas purging. (K) **IGC Code** means the International Code for the Construction and Equipment of Ships Carrying Liquefied Gases in Bulk (as amended by IMO Resolution MSC.370(93)). (L) **IMO** means the International Maritime Organization. (M) **IGF Code** means the International Code of Safety for Ships Using Gases or other Low-Flash point Fuels (IMO Resolution MSC.391(95)). (N) **Low pressure** gas means gas with a pressure up to 10 bar. (O) **Lower Heating Value (LHV)** means the amount of heat produced from the complete combustion of a specific amount of fuel,excluding latent heat of vaporization of water. (P) **Methane Number** is a measure of resistance of a gas fuel to knock, which is assigned to a test fuel based upon operation in knock testing unit at the same standard knock intensity. Pure methane is used as the knock resistant reference fuel, that is, methane number of pure methane is 100, and pure hydrogen is used as the knock sensitive reference fuel, methane number of pure hydrogen is 0. (Q) **Pilot fuel** means the fuel oil that is injected into the cylinder to ignite the main gas-air mixture on DF engines. (R) **Pre-mixed engine** means an engine where gas is supplied in a mixture with air before the turbocharger. (S) **Recognized standards** means applicable international or national standards acceptable to the Society or standards laid down and maintained by an organization which complies with the standards adopted by IMO and which are recognized by the Society. (T) **Safety Concept** is a document describing the safety philosophy with regard to gas as fuel. It describes how risks associated with this type of fuel are controlled under reasonably foreseeable abnormal conditions as well as possible failure scenarios and their control measures. A detailed evaluation regarding the hazard potential of injury from a possible explosion is to be carried out and reflected in the safety concept of the engine.

Present	Amendment
	2. Documents and drawings to be submitted (1) Documents and drawings to be submitted for the approval of DF and GF engines. The following **Table 1** is to be submitted for the approval of DF and GF engines, in addition to those required in **Ch 1, 203. 1** of the Rules. (2) Where considered necessary, the Society may request further documents to be submitted.

Table 1 Additional documents and drawings for DF engine and GF engine

No.	A/R(1)	DF engine	GF engine	Documents and drawings
1	A	○	○	Schematic layout or other equivalent documents of gas system on the engine
2	A	○	○	Gas piping system (including double-walled arrangement where applicable)
3	A	○	○	Parts for gas admission system(4)
4	A	○	○	Arrangement of explosion relief valves (crankcase(2), charge air manifold, exhaust gas manifold) as applicable
5	A	○	○	List of certified safe equipment and evidence of relevant certification
6	R	○	○	Safety concept
7	R	○	○	Report of the risk analysis(3)
8	R	○	○	Gas specification
9	A	○		Schematic layout or other equivalent documents of fuel oil system (main and pilot fuel systems) on the engine
10	A	○		Shielding of high pressure fuel pipes for pilot fuel system, assembly
11	A	○		High pressure parts for pilot fuel oil injection system(4)
12	A		○	Ignition system

NOTES:
(1) A: for approval, R: for reference
(2) If required by **Ch 2, 203. 4** of the Rules
(3) See **3**.
(4) The documentation to contain specification of pressures, pipe dimensions and materials.

Present	Amendment
	3. Risk analysis (1) Scope of the risk analysis The risk analysis is to address the followings. With regard to the scope of the risk analysis it shall be noted that failures in systems external to the engine, such as fuel storage or fuel gas supply systems, may require action from the engine control and monitoring system in the event of an alarm or fault condition. Conversely failures in these external systems may, from the vessel perspective, require additional safety actions from those required by the engine limited risk analysis required by this Annex. (A) a failure or malfunction of any system or component involved in the gas operation of the engine (B) a gas leakage downstream of the gas valve unit (C) the safety of the engine in case of emergency shutdown or blackout, when running on gas (D) the inter-actions between the gas fuel system and the engine (2) Form of the risk analysis (A) The risk analysis is to be carried out in accordance with international standard ISO 31010:2009 Risk management-Risk assessment techniques, or other recognized standards. (B) The required analysis is to be based on the single failure concept, which means that only one failure needs to be considered at the same time. Both detectable and non-detectable failures are to be considered. Consequences failures, i.e. failures of any component directly caused by a single failure of another component, are also to be considered. (3) Procedure for the risk analysis The risk analysis is to be in accordance with the followings. The results of the risk analysis are to be documented. (A) Identify all the possible failures in the concerned equipment and systems which could lead: (a) to the presence of gas in components or locations not designed for such purpose, and/or (b) to ignition, fire or explosion. (B) Evaluate the consequences. (C) Where necessary, identify the failure detection method. (D) Where the risk cannot be eliminated, identify the corrective measures: (a) in the system design, such as: (i) redundancies (ii) safety devices, monitoring or alarm provisions which permit restricted operation of the system (b) in the system operation, such as: (i) initiation of the redundancy (ii) activation of an alternative mode of operation.

Present	Amendment
	(4) Equipment and systems to be analysed The risk analysis required for engines is to cover at least the following aspects. (A) failure of the gas-related systems or components, in particular, gas piping and its enclosure (where provided), or cylinder gas supply valves (failures of the gas supply components not located directly on the engine, such as block-and-bleed valves and other components of the Gas Valve Unit (GVU), are not to be considered in the analysis.) (B) failure of the ignition system (oil fuel pilot injection or sparking plugs) (C) failure of the air to fuel ratio control system (charge air by-pass, gas pressure control valve, etc.) (D) for engines where gas is injected upstream of the turbocharger compressor, failure of a component likely to result in a source of ignition (hot spots) (E) failure of the gas combustion or abnormal combustion (misfiring, knocking) (F) failure of the engine monitoring, control and safety systems (where engines incorporate electronic control systems, a failure mode and effects analysis (FMEA) is to be carried out in accordance with **Ch 1, 203. Table 5.1.5** Note (5) of the Rules.) (G) abnormal presence of gas in engine components (e.g. air inlet manifold and exhaust manifold of DF or GF engines) and in the external systems connected to the engines (e.g. exhaust duct). (H) changes of operating modes for DF engines (I) hazard potential for crankcase fuel gas accumulation, for engines where the space below the piston is in direct communication with the crankcase, refer to **Ch 10, 301. 2** of **Rules for Ships using Low-flash-point Fuels** **4. Design** (1) General principles (A) The manufacturer is to declare the allowable gas composition limits for the engine and the minimum and (if applicable) maximum methane number. (B) Components containing or likely to contain gas are to be designed to the followings. Also refer to **Ch 10, Sec 2** and **Ch 10, Sec 3** of **Rules for Ships using Low-flash-point Fuels**. (a) minimise the risk of fire and explosion so as to demonstrate an appropriate level of safety commensurate with that of an oil-fuelled engine; (b) mitigate the consequences of a possible explosion to a level providing a tolerable degree of residual risk, due to the strength of the component(s) or the fitting of suitable pressure relief devices. Discharge from pressure relief devices shall prevent the passage of flame to the machinery space and be arranged such that the discharge does not endanger personnel or damage other engine components or systems. Relief devices shall be fitted with a flame arrester.

Present	Amendment
	(2) Gas piping (A) The requirements of this section apply to engine-mounted gas piping. The piping shall be designed in accordance with the criteria for gas piping (design pressure, wall thickness, materials, piping fabrication and joining details etc.) as given in **Ch 7** of **Rules for Ships using Low-flash-point Fuels**. For gas carriers, **Pt 7, Ch 5, Sec 5** and **Sec 16** of the Rules. (B) Arrangement of the gas piping system on the engine Pipes and equipment containing fuel gas are defined as hazardous area Zone 0 (refer to **Ch 12, 402. 1** of **Rules for Ships using Low-flash-point Fuels**). The space between the gas fuel piping and the wall of the outer pipe or duct is defined as hazardous area Zone 1 (refer to **Ch 12, 402. 2** (6) of **Rules for Ships using Low-flash-point Fuels**). (a) Normal "double pipe or duct" arrangement (i) The gas piping system on the engine shall be arranged according to the principles and requirements of **Ch 9, Sec 6** of **Rules for Ships using Low-flash-point Fuels**. For gas carriers, **Pt 7, Ch 5, 1604. 3** of the Rules applies. (ii) The design criteria for the double pipe or duct are given in the **Ch 7, 401. 4** and **Ch 9, Sec 8** of **Rules for Ships using Low-flash-point Fuels**. (iii) In case of a ventilated double pipe or duct, the ventilation inlet is to be located in accordance with the provisions of **Ch 13, 801. 3** of **Rules for Ships using Low-flash-point Fuels**. For gas carriers, **Pt 7, Ch 5, 1604. 3** (2) of the Rules applies. (iv) The double pipe or duct is to be pressure tested in accordance with **Ch 6, 1404. 3** of the Rules to ensure gas tight integrity and to show that it can withstand the expected maximum pressure at gas pipe rupture. (b) Alternative arrangement (i) Single walled gas piping is only acceptable: - for engines installed in ESD protected machinery spaces, as defined in **Ch 5, 401. 2** of **Rules for Ships using Low-flash-point Fuels** and in compliance with other relevant parts of **Rules for Ships using Low-flash-point Fuels** (e.g. **Ch 5, Sec 6**); - in the case as per **Ch 9, 601. 2** of **Guidance for Ships using Low-flash-point Fuels**. (ii) For gas carriers, the **Pt 7, Ch 5** of the Rules applies. (iii) In case of gas leakage in an ESD-protected machinery space, which would result in the shut-down of the engine(s) in that space, a sufficient propulsion and maneuvering capability including essential and safety systems is to be maintained. (The sufficient propulsion and maneuvering is to refer to **Ch 1, 102. 25** of the Rules or to be assessed on a case-by-case basis from the operational characteristics of the ship.) (iv) Therefore the safety concept of the engine is to clearly indicate application of the "double wall" or "alternative" arrangement.

Present	Amendment
	(3) Charge air system on the engine (A) The charge air system on the engine is to be designed in accordance with (1) (B) above. In case of a single engine installation, the engine is to be capable of operating at sufficient load to maintain power to essential consumers after opening of the pressure relief devices caused by an explosion event. Sufficient power for propulsion capability is to be maintained. Load reduction is to be considered on a case by case basis, depending on engine configuration (single or multiple) and relief mechanism (self-closing valve or bursting disk). (4) Exhaust system on the engine (A) The exhaust gas system on the engine is to be designed in accordance with (1) (B) above. In case of a single engine installation, the engine is to be capable of operating at sufficient load to maintain power to essential consumers after opening of the pressure relief devices caused by an explosion event. Sufficient power for propulsion capability is to be maintained. Continuous relief of exhaust gas (through open rupture disc) into the engine room or other enclosed spaces is not acceptable. (5) Engine crankcase (A) Crankcase explosion relief valves Crankcase explosion relief valves are to be installed in accordance with **Ch 2, 203. 4** of the Rules. (B) Fuel gas accumulation in the crankcase Fuel gas accumulation in the crankcase is to be considered in the risk analysis (see 3) in accordance with **Ch 10, 301. 2** of **Guidance for Ships using Low-flash-point Fuels**. (C) Inerting For maintenance purposes, a connection, or other means, are to be provided for crankcase inerting and ventilating and gas concentration measuring. (6) Gas ignition in the cylinder (A) Requirements of **Ch 10, Sec 3** of **Rules for Ships using Low-flash-point Fuels** apply. For gas carriers, **Pt 7, Ch 5, 1607** of the Rules applies. (7) Control, monitoring, alarm and safety systems (A) The engine control system is to be independent and separate from the safety system. (B) The gas supply valves are to be controlled by the engine control system or by the engine gas demand. (C) Combustion is to be monitored on an individual cylinder basis. In the event that poor combustion is detected on an individual cylinder, gas operation may be allowed in the conditions specified in **Ch 10, 301. 6** of **Rules for Ships using Low-flash-point Fuels**. If monitoring of combustion for each individual cylinder is not practicable due to engine size and design, common combustion monitoring may be accepted. (D) Unless the risk analysis required by **3** of this Annex proves otherwise, the monitoring and safety system functions for DF or GF engines are to be provided in accordance with **Table 2** of this Annex in addition to the general monitoring and safety system functions given by the Societies. For DF engines, **Table 2** applies only to the gas mode.

Present	Amendment
	(8) Gas admission valves (A) Gas admission valves shall be certified safe as follows. (a) The inside of the valve contains gas and shall therefore be certified for Zone 0. (b) When the valve is located within a pipe or duct in accordance with (2) (B) (a), the outside of the valve shall be certified for Zone 1. (c) When the valve is arranged without enclosure in accordance with the “ESD-protected machinery space” (see (2) (B) (b)) concept, no certification is required for the outside of the valve, provided that the valve is de-energized upon gas detection in the space. (d) However, if they are not rated for the zone they are intended for, it shall be documented that they are suitable for that zone. Documentation and analysis is to be based on IEC 60079-10-1 or IEC 60092-502.

Present	Amendment

Table 2 Monitoring and safety system functions for DF or GF engines

Monitored parameters [H=High L=Low O=Abnormal status]		Alarm	Automatic activation of the double block-and-bleed valves	Automatic switching over to oil fuel mode(1)	Engine shutdown
Abnormal pressures in the gas fuel supply line	O	●	●	●	●(5)
Gas fuel supply systems - malfunction	O	●	●	●	●(5)
Pilot fuel injection or spark ignition systems - malfunction	O	●	●(2)	●	●(2)(5)
Exhaust gas temperature after each cylinder - high	H	●	●(2)	●	●(2)(5)
Exhaust gas temperature after each cylinder, deviation from average – low(3)	L	●	●(2)	●	●(2)(5)
Cylinder pressure or ignition - failure, including misfiring, knocking and unstable combustion	O	●	●(2)(4)	●(4)	●(2)(4)(5)
Oil mist concentration in crankcase or bearing temperature(6) - high	H	●	●		●
Pressure in the crankcase – high(4)	H	●	●	●	
Engine stops - any cause	O	●	●		
Failure of the control-actuating medium of the block and bleed valves	O	●	●	●	

NOTES: [● = apply]

(1) DF engine only, when running in gas mode

(2) For GF engines, the double block-and-bleed valves and the engine shutdown may not be activated in case of specific failures affecting only one cylinder, provided that the concerned cylinder can be individually shutoff and the safe operation of the engine in such conditions is demonstrated by the risk analysis.

(3) Required only if necessary for the detection of misfiring

(4) In the case where the failure can be corrected by an automatic mitigation action, only the alarm may be activated. If the failure persists after a given time, the safety actions are to be activated.

(5) GF engine only

(6) Where required by **Ch 2, 203. 10** of the Rules

Present	Amendment
	5. Specific design requirements (1) DF engines (A) General The maximum continuous power that a DF engine can develop in gas mode may be lower than the approved MCR of the engine (i.e. in oil fuel mode), depending in particular on the gas quality. This maximum power available in gas mode and the corresponding conditions shall be stated by the engine manufacturer and demonstrated during the type test. (B) Starting, changeover and stopping (a) DF engines are to be arranged to use either oil fuel or gas fuel for the main fuel charge and with pilot oil fuel for ignition. The engines are to be arranged for rapid changeover from gas use to fuel oil use. In the case of changeover to either fuel supply, the engines are to be capable of continuous operation using the alternative fuel supply without interruption to the power supply. (b) Changeover to gas fuel operation is to be only possible at a power level and under conditions where it can be done with acceptable reliability and safety as demonstrated through testing. (c) Changeover from gas fuel operation mode to oil fuel operation mode is to be possible at all situations and power levels. (d) The changeover process itself from and to gas operation is to be automatic but manual interruption is to be possible in all cases. (e) In case of shut-off of the gas supply, the engines are to be capable of continuous operation by oil fuel only. (C) Pilot injection Gas supply to the combustion chamber is not to be possible without operation of the pilot oil injection. Pilot injection is to be monitored for example by fuel oil pressure and combustion parameters. (2) GF engines (A) Spark ignition system In case of failure of the spark ignition, the engine is to be shut down except if this failure is limited to one cylinder, subject to immediate shut off of the cylinder gas supply and provided that the safe operation of the engine is substantiated by the risk analysis and by tests. (3) Pre-Mixed Engines (A) Charge air system (a) Inlet manifold, turbo-charger, charge air cooler, etc. are to be regarded as parts of the fuel gas supply system. Failures of those components likely to result in a gas leakage are to be considered in the risk analysis (see **3**). (b) Flame arresters are to be installed before each cylinder head, unless otherwise justified in the risk analysis, considering design parameters of the engine such as the gas concentration in the charge air system, the path length of the gas-air mixture in the charge air system, etc.

Present	Amendment
	6. Type testing (1) General Type approval of DF and GF engines is to be carried out in accordance with **Ch 3, Sec 8** of the **Guidance for Approval of Manufacturing Process and Type Approval, Etc.**, taking into account the additional requirements below. (2) Type of engine In addition to the criteria given in **Ch 3, 801. 4** of the **Guidance for Approval of Manufacturing Process and Type Approval, Etc.**, the engine that differ in one of the followings, in principle, is treated as engines of the different type. (A) gas admission method (direct cylinder injection, charge air space or pre-mixed) (B) gas supply valve operation (mechanical or electronically controlled) (C) ignition system (pilot injection, spark ignition, glow plug or gas self-ignition) (D) ignition system (mechanical or electronically controlled) (3) Safety precautions In addition to the safety precautions mentioned in **Ch 3, 803. 2** of the **Guidance for Approval of Manufacturing Process and Type Approval, Etc.**, measures to verify that gas fuel piping on engine is gas tight are to be carried out prior to start-up of the engine. (4) Test programme (A) The type testing of the engine is to be carried out in accordance with **Ch 3, 803.** of the **Guidance for Approval of Manufacturing Process and Type Approval, Etc.**. (B) For DF engines, the load tests referred to in **Ch 3, 803.** of the **Guidance for Approval of Manufacturing Process and Type Approval, Etc.** are to be carried out in gas mode at the different percentages of the maximum power available in gas mode (see **5** (1) (A)). The 110% load tests are not required in the gas mode. (C) The influence of the methane number and LHV of the fuel gas is not required to be verified during the Stage B type tests. It shall however be justified by the engine designer through internal tests or calculations and documented in the type approval test report. (5) Measurements and records In addition to the measurements and records required in **Ch 3, 803. 7** of the **Guidance for Approval of Manufacturing Process and Type Approval, Etc.**, the following engine data are to be measured and recorded. Additional measurements may be required in connection with the design assessment. (A) Each fuel index for gas and diesel as applicable (or equivalent reading) (B) Gas pressure and temperature at the inlet of the gas manifold (C) Gas concentration in the crankcase

Present	Amendment
	(6) Stage A (internal tests) In addition to tests required in stage A (internal tests) of **Ch 3, 803. 8 Table 3.8.1** of the **Guidance for Approval of Manufacturing Process and Type Approval, Etc.**, the following conditions are to be tested. (A) DF engines are to run the load points defined in stage A (internal tests) of **Ch 3, 803. 8 Table 3.8.1** of the **Guidance for Approval of Manufacturing Process and Type Approval, Etc.** in both gas and diesel modes (with and without pilot injection in service) as found applicable for the engine type. (B) For DF engines with variable liquid/gas ratio, the load tests are to be carried out at different ratios between the minimum and the maximum allowable values. (C) For DF engines, switch over between gas and diesel modes are to be tested at different loads. (7) Stage B (approval tests) (A) General Gas engines are to undergo the different tests required in stage B (approval tests) of **Ch 3, 803. 8 Table 3.8.1** of the **Guidance for Approval of Manufacturing Process and Type Approval, Etc.**. In case of DF engine, all load points must be run in both gas and diesel modes that apply for the engine type as defined by the engine designer (see (4)). This also applies to the overspeed test. In case of DF engines with variable liquid / gas ratio, the load tests are to be carried out at different ratios between the minimum and the maximum allowable values. (B) Functional tests (a) In addition to the functional tests required in (3), (4), (5) of stage B (approval tests) of **Ch 3, 803. 8 Table 3.8.1** of the **Guidance for Approval of Manufacturing Process and Type Approval, Etc.**, the following tests are to be carried out. (i) For DF engines, the lowest specified speed is to be verified in diesel mode and gas mode. (ii) For DF engines, switch over between gas and diesel modes are to be tested at different loads. (iii) The efficiency of the ventilation arrangement of the double walled gas piping system is to be verified. (iv) Simulation of a gas leakage in way of a cylinder gas supply valve. (b) Engines intended to produce electrical power are to be tested as follows. (i) Capability to take sudden load and loss of load in accordance with the provisions of **Pt 6, Ch 1, 302. 2** of the Rules. (ii) For GF and premixed engines, the influences of LHV, methane number and ambient conditions on the dynamic load response test results are to be theoretically determined and specified in the test report. Referring to the limitations as specified in **4** (1) (A), the margin for satisfying dynamic load response is to be determined. For DF engines, switchover to oil fuel during the test is acceptable. Application of electrical load in more than 2 load steps can be permitted in the conditions stated in **Pt 6, Ch 1, 302. 2** of the Rules.

Present	Amendment
	(C) Integration tests GF and DF engines are to undergo integration tests to verify that the response of the complete mechanical, hydraulic and electronic engine system is as predicted for all intended operational modes. The scope of these tests is to be agreed with the Society for selected cases based on the risk analysis required in **3** of this Annex, and shallat least include the following incidents. (a) Failure of ignition (spark ignition or pilot injection systems), both for one cylinder unit and common system failure (b) Failure of a cylinder gas supply valve (c) Failure of the combustion (to be detected by e.g. misfiring, knocking, exhaust temperature deviation, etc.) (d) Abnormal gas pressure (e) Abnormal gas temperature (This test may be carried out using a simulation signal of the temperature.) (8) Stage C (component inspection) Component inspection is to be carried out in accordance with the provisions of stage C (component inspection) of **Ch 3, 803. 8 Table 3.8.1** of the **Guidance for Approval of Manufacturing Process and Type Approval, Etc.**. The components to be inspected after the test run are to include also the followings. (A) gas supply valve including pre-chamber as found applicable (B) spark igniter (for GF engines) (C) pilot fuel injection valve (for DF engines) **7. Shop trials** (1) General Shop trials of DF and GF engines are to be carried out in accordance with **Ch 2, 211. 4** of the Rules, taking into account the additional requirements below. For DF engines, the load tests referred to in **Ch 2, 211. 5** of the Guidance are to be carried out in gas mode at the different percentages of the maximum power available in gas mode (see **5** (1) (A)). The 110 % load test is not required in the gas mode. (2) Safety precautions In addition to the safety precautions mentioned in **Ch 2, 211. 4** of the Guidance, measures to verify that gas fuel piping on engine is gas tight are to be carried out prior to start-up of the engine. (3) Records In addition to the records required in **Ch 2, 211. 5** (2) of the Guidance, the following engine data are to be recorded. (A) Fuel index, both gas and diesel as applicable (or equivalent reading) (B) Gas pressure and temperature

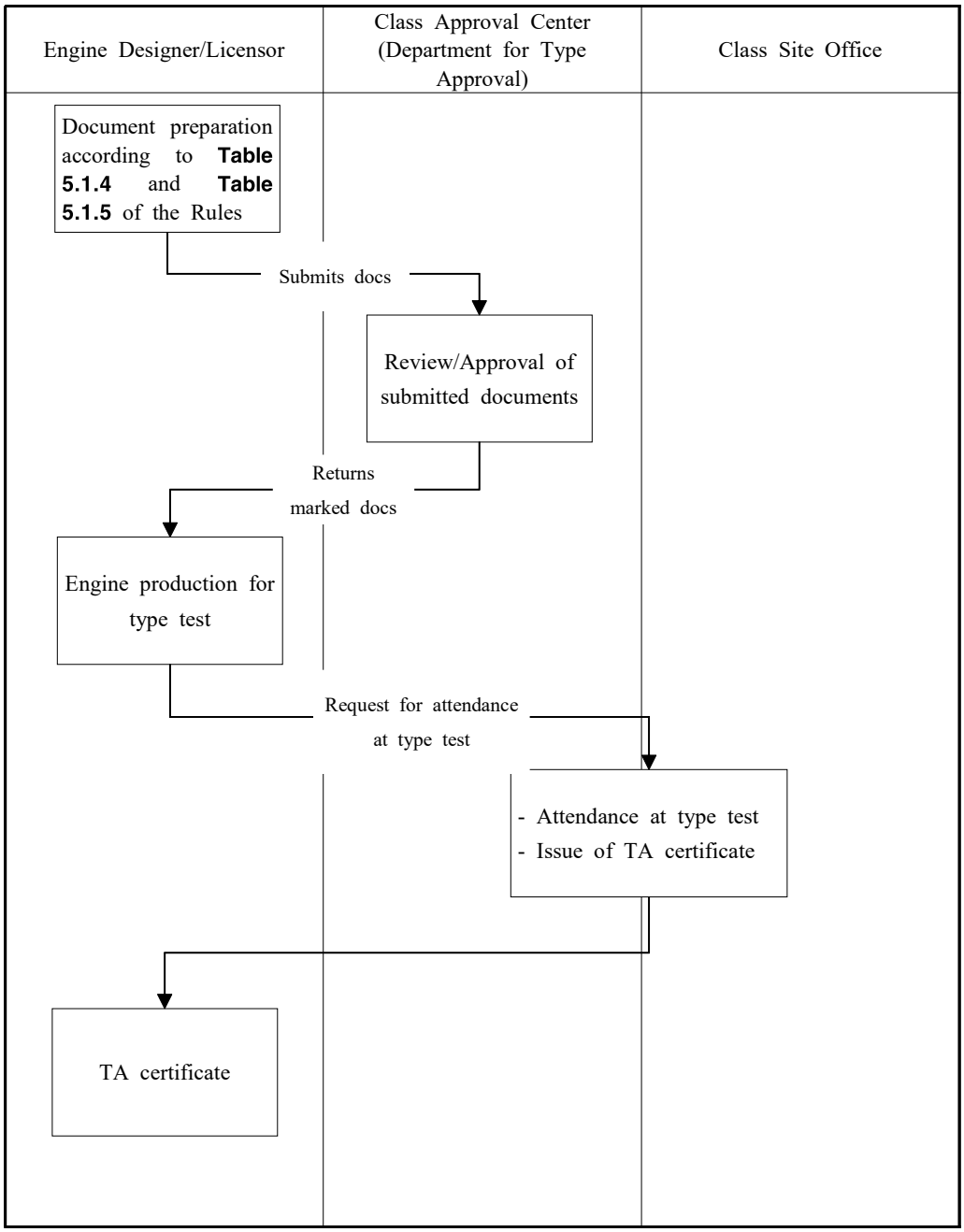
Present	Amendment
	(4) Test loads Test loads for various engine applications are given in **Ch 2, 211. 5 Table 5.2.2** of the Guidance. DF engines are to be tested in both diesel and gas mode as found applicable. In addition the scope of the trials may be expanded depending on the engine application, service experience, or other relevant reasons. (5) Integration tests GF and DF engines are to undergo integration tests to verify that the response of the complete mechanical, hydraulic and electronic system is as predicted for all intended operational modes. The scope of these tests is to be agreed with the Society for selected cases based on the risk analysis required in **3** of this Annex and shall at least include the following incidents. The above tests may be carried out using simulation or other alternative methods, subject to special consideration by the Society. (A) Failure of ignition (spark ignition or pilot injection systems), for one cylinder unit (B) Failure of a cylinder gas supply valve (C) Failure of the combustion (to be detected by e.g. misfiring, knocking, exhaust temperature deviation, etc.) (D) Abnormal gas pressure (E) Abnormal gas temperature **8. On-board tests** (1) Shipboard trials are to be carried out in accordance with the provisions of **Ch 2, 211. 5** of the Rules. (2) For DF engines, the test loads required in **Ch 2, 211. 6 Table 5.2.3** of the Guidance are to be carried out in all operating modes (gas mode, diesel mode, etc.).

Present	Amendment
Annex 5-10 Selective Catalytic Reduction System Using Ammonia Solutions or Urea Solutions as the Reductant Agents	**~~Annex 5-10 Selective Catalytic Reduction System Using Ammonia Solutions or Urea Solutions as the Reductant Agents~~**
[omitted]	[Deleted]
Annex 5-11 Redundant Propulsion and Steering System *(2017)*	**Annex 5-10 Redundant Propulsion and Steering System *(2017)***
[omitted]	[same as present]
Annex 5-12 Documents for the Approval of Diesel Engines	**Annex 5-11 Documents for the Approval of Diesel Engines**
[omitted]	[omitted]
Annex 5-13 Exhaust Gas Recirculation system	**~~Annex 5-13 Exhaust Gas Recirculation system~~**
[omitted]	[Deleted]
Annex 5-14 Shaft Alignment *(2017)*	**Annex 5-12 Shaft Alignment *(2017)***
[omitted]	[omitted]
Annex 5-15 Exhaust Gas Cleaning system *(2017)*	**~~Annex 5-15 Exhaust Gas Cleaning system *(2017)*~~**
[omitted]	[Deleted]
Annex 5-15-A Exhaust Gas Cleaning system(EGC) Ready ships *(2018)*	**~~Annex 5-15-A Exhaust Gas Cleaning system(EGC) Ready ships *(2018)*~~**
[omitted]	[Deleted]

Present	Amendment
Annex 5-12 Documents for the Approval of Diesel Engines	**Annex 5-11 Documents for the Approval of Diesel Engines**
1. <omitted>	**1. <same as the present>**
2. Document flow for obtaining a type approval certificate	**2. Document flow for obtaining a type approval certificate**
(1) For the initial engine type, the engine designer prepares the documentation in accordance with **Table 5.1.4** and **Table 5.1.5** of the Rules and forwards to the Society according to the agreed procedure for review and approval. (2) Upon review and approval of the submitted documentation (evidence of approval), it is returned to the engine licenser. (3) The engine designer arranges for a Surveyor to attend an engine type test and upon satisfactory testing the Society issues a type approval certificate. (4) A representative document flow process for obtaining a type approval certificate is shown in **Fig 1**. (5) After the Society has approved the engine type for the first time, which have undergone substantive changes, such as strength, safety and performance will have to be resubmitted for consideration by the Society. (6) The assignment of documents to **Table 5.1.5** of the Rules for information does not preclude possible comments by the individual Society. (7) Where considered necessary, the Society may request further documents to be submitted.	(1) For the initial engine type, the engine designer prepares the documentation in accordance with **Table 5.1.4** and **Table 5.1.5** of the Rules including data sheet with general engine information in **Table 1** and forwards to the Society according to the agreed procedure for review and approval. *(2019)* (2) Upon review and approval of the submitted documentation (evidence of approval), it is returned to the engine licenser. (3) The engine designer arranges for a Surveyor to attend an engine type test and upon satisfactory testing the Society issues a type approval certificate. (4) A representative document flow process for obtaining a type approval certificate is shown in **Fig 1**. (5) After the Society has approved the engine type for the first time, which have undergone substantive changes, such as strength, safety and performance will have to be resubmitted for consideration by the Society. (6) The assignment of documents to **Table 5.1.5** of the Rules for information does not preclude possible comments by the individual Society. (7) Where considered necessary, the Society may request further documents to be submitted.
(hereafter, omitted)	(hereafter, same as the present)

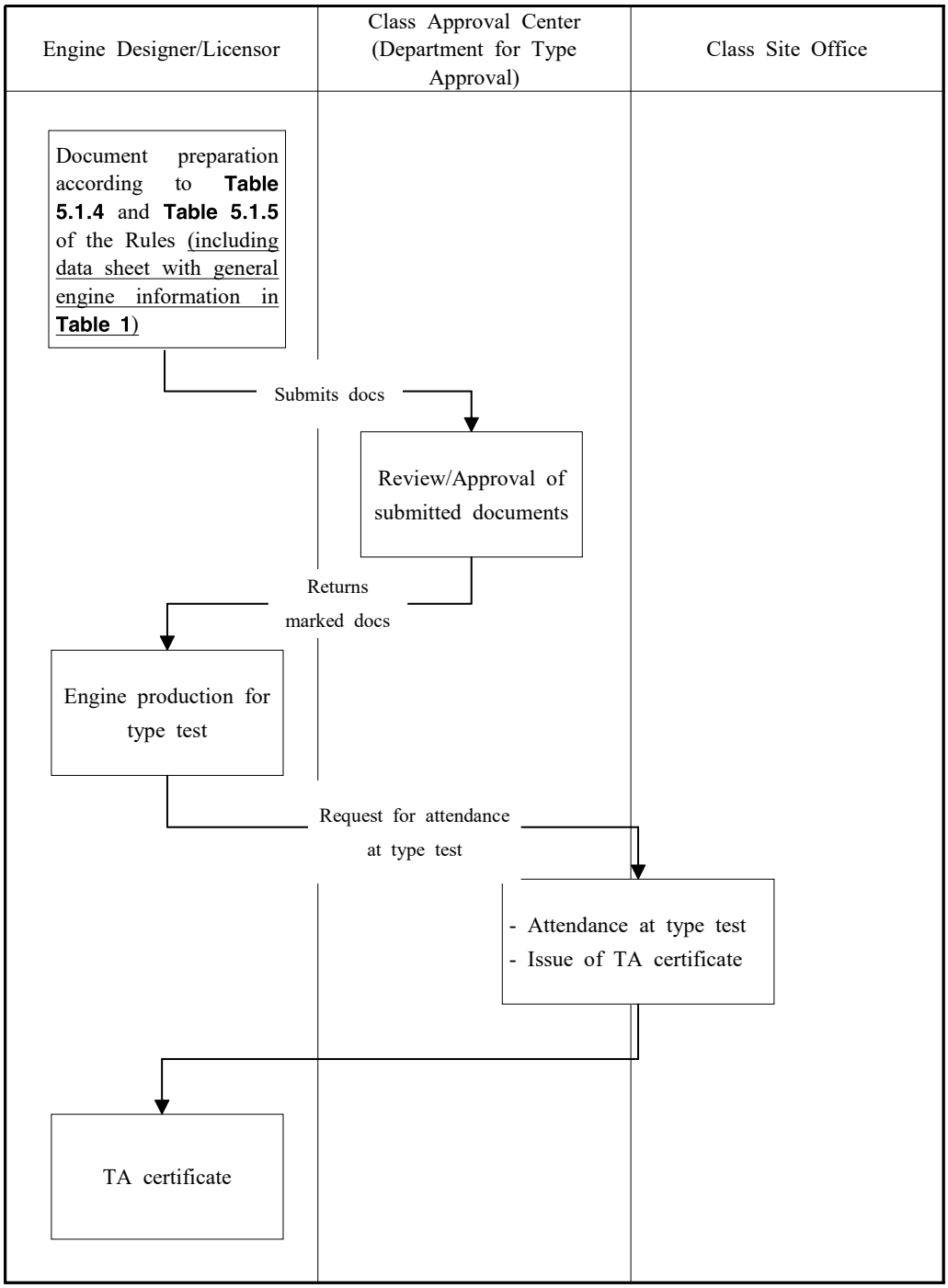
<Present>

Fig 1 Type Approval document flow



<Amendment>

Fig 1 Type Approval document flow



Present	Amendment
Annex 5-14 Shaft Alignment *(2017)*	**Annex 5-12 Shaft Alignment *(2017)***
1. <omitted>	**1. <same as the present>**
2. Shaft alignment calculations	**2. Shaft alignment calculations**
The shaft alignment calculations are to include bearing reactions, shear forces and bending moments along the shafting and are to be performed for the maximum allowable alignment tolerances.	The shaft alignment calculations are to include bearing reactions, shear forces and bending moments along the shafting and are to be performed for the maximum allowable alignment tolerances.
(1) ~ (2) <omitted>	(1) ~ (2) <same as the present>
(3) The shaft alignment calculations are to show the following.	(3) The shaft alignment calculations are to show the following. *(2019)*
(A) ~ (E) <omitted>	(A) ~ (E) <same as the present>
(F) Where stern tube bearing is force-fitted, based on the actual interference fit tolerances, the stern tube bearing fitting calculation, including fitting pressure and push-in distance, is to be submitted for review.	~~(F) Where stern tube bearing is force-fitted, based on the actual interference fit tolerances, the stern tube bearing fitting calculation, including fitting pressure and push-in distance, is to be submitted for review.~~
(G) Where the clearance calculation on aft and forward stern tube bearing is carried out, alignment model showing only the propeller shaft on two stern tube bearings, is to be included in the shaft alignment calculations and submitted to the Society for review.	~~(G) Where the clearance calculation on aft and forward stern tube bearing is carried out, alignment model showing only the propeller shaft on two stern tube bearings, is to be included in the shaft alignment calculations and submitted to the Society for review.~~
(H) The shaft alignment calculations are to identify the following corresponding to the condition in which they will be measured.	(F) The shaft alignment calculations are to identify the following corresponding to the condition in which they will be measured.
(a) Gap and sag data, temporary support location, jack down location and force	(a) Gap and sag data, temporary support location, jack down location and force
(b) Jack up location, jack up correction factor	(b) Jack up location, jack up correction factor
3. Stern tube bearing slope boring	**3. Stern tube bearing slope boring *(2019)***
(1) ~ (3) <omitted>	(1) ~ (3) <same as the present>
(4) The slope boring verification procedure is to be submitted for review.	~~(4) The slope boring verification procedure is to be submitted for review.~~

Present	Amendment
4. Shaft Alignment Procedure The shaft alignment procedure is to be submitted for review and is to be based on the submitted shaft alignment calculations. As a minimum, the shaft alignment procedure is to include the following. (1) <omitted> (2) Stern tube bearing fitting pressure verification : The stern tube bearing fitting pressure should be verified to comply with calculated values. (3) Stern tube bearing clearance measurement : The clearance measurements should be verified after the propeller shaft is fitted (before shaft unrestrained on the forward flange). (4) Gap and sag : The gap and sag procedure is to be verified against the respective analysis (e.g. based on dry dock or light ship draft condition). Acceptable tolerances are ±0.1 mm. (5) Bearing load measurements : Identification of the bearings at which the measurements are to be taken, the jack up locations, the data to be recorded and the procedures to be followed should be reported in the submittal. (6) Stern tube bearing run-in procedure : For alignment sensitive installation (e.g. tankers, bulkers and twin screw vessels), it is recommended to conduct a run-in procedure before the stern tube bearings are exposed to higher service speeds and rudder angles.	**4. Shaft Alignment Procedure *(2019)*** The shaft alignment procedure is to be submitted for review and is to be based on the submitted shaft alignment calculations. As a minimum, the shaft alignment procedure is to include the following. (1) <same as the present> (2) Stern tube bearing fitting pressure ~~verification~~ : The stern tube bearing fitting pressure should be verified to comply with planned values. ~~(3) Stern tube bearing clearance measurement : The clearance measurements should be verified after the propeller shaft is fitted (before shaft unrestrained on the forward flange).~~ (3) Gap and sag : The gap and sag procedure is to be verified against the respective analysis (e.g. based on dry dock or light ship draft condition). Acceptable tolerances are ±0.1 mm. (4) Bearing load measurements : Identification of the bearings at which the measurements are to be taken, the jack up locations, the data to be recorded and the procedures to be followed should be reported in the submittal. (5) Stern tube bearing run-in procedure : For alignment sensitive installation (e.g. tankers, bulkers and twin screw vessels), it is recommended to conduct a run-in procedure before the stern tube bearings are exposed to higher service speeds and rudder angles.

Present	Amendment
5. Tests and inspections The shaft alignment for all vessels is to be carried out in the presence of a Surveyor. The alignment is to be verified in the afloat condition with superstructure in place and major welding work completed and is to be to the satisfaction of the attending Surveyor. In addition, the vessels which are subjected to submission of shaft alignment calculations and procedures in **Par 1** are to comply with the following. (1) The alignment verification is to be carried out in accordance with the procedures. The alignment calculated data is to be verified and recorded, in the presence of the Surveyor for the following. (A) Stern tube sighting and slope boring (as applicable) before shaft fitting (B) Stern tube bearing fitting pressure and push-in distance as required in **Par 4** (2) (C) Stern tube bearing clearance as required in **Par 4** (3) (D) Gap and sag (E) Bearing reaction (2) Stern tube run-in procedure as required in **Par 4** (6) is recommended to be conducted, in the presence of the Surveyor. (3) <omitted> (4) Gap and sag verification (A) The gap and sag is to be measured at the drydock or after launching condition, unless agreed to otherwise by the Society. (B) With assistance of the temporary supports the gap and sag needs to be simultaneously verified at all open flanges until gap and sag values are brought within acceptable tolerances of ±0.1 mm from the corresponding calculated values. (hereafter, omitted)	**5. Tests and inspections** *(2019)* The shaft alignment for all vessels is to be carried out in the presence of a Surveyor. The alignment is to be verified in the afloat condition with superstructure in place and major welding work completed and is to be to the satisfaction of the attending Surveyor. In addition, the vessels which are subjected to submission of shaft alignment calculations and procedures in **Par 1** are to comply with the following. (1) The alignment verification is to be carried out in accordance with the procedures. The alignment calculated data is to be verified and recorded, in the presence of the Surveyor for the following. (A) Stern tube sighting and slope boring (as applicable) before shaft fitting (B) Stern tube bearing fitting pressure ~~and push-in distance~~ as required in **Par 4** (2) ~~(C) Stern tube bearing clearance as required in **Par 4** (3)~~ (C) Gap and sag (D) Bearing reaction (2) Stern tube run-in procedure as required in **Par 4** (5) is recommended to be conducted, in the presence of the Surveyor. (3) <same as the present> (4) Gap and sag verification (A) The gap and sag is to be measured at the drydock or after launching condition, unless agreed to otherwise by the Society. (B) With assistance of the temporary supports the gap and sag needs to be ~~simultaneously~~ verified at all open flanges until gap and sag values are brought within acceptable tolerances of ±0.1 mm from the corresponding calculated values. (hereafter, same as the present)

[Newly added]

Annex 5-13 Fuel oil treatment system *(2019)*

1. General

(1) Application

(A) The aim of these Annex is to improve the operational safety of the vessel by improving reliability of the oil fuelled machinery.

(B) These Annex cover the complete fuel oil treatment system, from the fuel bunker connection through to the interface with the oil fuelled machinery.

(C) For items not specified in this Annex, the relevant requirements specified in **Pt 5** and **Pt 8** of the Rules apply.

(D) Where Fuel oil treatment system is designed, constructed and tested in accordance with this Annex, the **FTS** notation may be assigned.

(2) Definition

The definitions of terms are to be followed to the Rules, unless otherwise specially specified sbelow.

(A) **Fuel oil treatment system** means a system intended for cleaning of the fuel oil by removal of water, catalyst fines, water bound ash constituents (e.g. sodium) and particulate matter, conditioning of the fuel oil to ensure efficient combustion.

(B) **Fuel oil** means petroleum fuels for use in marine diesel engines.

(C) **Oil fuelled machinery** means all machinery combusting fuel oil, including main and auxiliary engines, boilers, gas turbines.

(D) **A service tank** is a fuel oil tank which contains only fuel of a quality ready for use, i.e. fuel of a grade and quality that meet the specification required by the equipment manufacturer.

(3) Approval of plan and documents

(A) The Society, where considered necessary, may require further plans and documents other than specified in this Annex.

(a) Fuel oil storage/supply system diagram

(b) Fuel oil purifying system diagram

(c) The operation plan for fuel oil treatment etc. suitable for the fuel oil treatment system including elevant requirements specified in **2. System requirement** of the this annex.

(B) Guidelines for uel oil usage are to be provided on measures and procedures to minimize mixing of newly bunkered fuel with fuel already on-board or incompatible fuel during bunkering or fuel oil change-over.

2. System requirement

(1) General

(A) The capacity and arrangements of the fuel oil treatment system are to be suitable for ensuring availability of treated fuel oil for the Maximum Continuous Rating (MCR) of the propulsion plant and normal operating load at sea of the generator plant.

(B) The capacity and arrangements of the fuel oil treatment system are to be determined on the basis of the requirements of the oil fuelled machinery manufacturer and the types of fuel: Residual Marine Fuel (RMF), Distillate Marine Fuel (DMF) to be bunkered to the ship.

(C) Main bunker tanks are to be arranged to limit the need to mix newly bunkered fuel with fuel already on-board. When mixing of fuel oil is necessary, a compatibility test is to be performed prior to transfer.

(D) The maximum amount of water reaching the engine is to be 0.3 % v/v or according to engine maker's recommendations.

(E) The maximum amount of catalyst fines reaching the engine is to be 10 ppm Al+Si and in some instances this might rise to 15 ppm however every attempt must be made to reduce the catalyst to the lowest possible levels.

(F) Bunkered fuels are to be meet the requirements of ISO 8217 (latest revision) or an oilfuelled machinery consumer manufacturers' specification.

3. Sampling

(1) Sampling point

(A) The fuel oil treatment system is to be provided with sampling points.

(B) The sampling points are to be meet the requirements of MEPC.1/Circ.864 'Guidelines for on board sampling and verification of the sulphur content of the fuel oil used on board ships' and are to be located as follows:

(a) After the transfer pump discharge

(b) Before and after the fuel cleaning equipment

(c) After the fuel oil service tank, before any fuel change over valve

(d) Before fuel enters the oil fuelled machinery
(e) Fuel oil bunker manifold

(2) Sampling points are to be provided at locations within the fuel oil system that enable samples of fuel oil to be taken in a safe manner.

(3) The position of a sampling point is to be such that the sample of the fuel oil is representative of the fuel oil quality passing that location within the system.

(4) The sampling points are to be located in positions as far removed as possible from any heated surface or electrical equipment so as to preclude impingement of fuel oil onto such surfaces on equipment under all operating conditions.

4. System design

(1) Fuel oil tanks

(A) Settling and service tanks for fuel oil are to be designed and constructed in such a way as to direct water and sludge towards a drainage outlet.

(B) If settling tanks are not provided, the fuel oil bunker (storage) and daily service tanks are to be designed and constructed in such a way as to direct water and sludge towards a drainage outlet.

(C) A self-closing type cock or valve is to be installed under the fuel oil tank and the drain cock can not be considered as a sampling point.

(D) Fuel suction points are to be located at an appropriate distance above the tank drain point to prevent accumulated water and sludge being drawn into the fuel oil treatment system (e.g. a minimum 5% of the tank volume is below the suction of the high suction pipe).

(E) It is recommended that at least one low suction point and one high suction point be provided on the settling and service tank.

(F) The materials and/or their surface treatment used for the storage and distribution of fuel oil are to be selected such that they do not introduce contamination or modify the properties of the fuel.

(G) A temperature controller of PID type is to be fitted to ensure that the fuel is maintained at the temperature required for optimum system performance.

(H) The fuel oil storage tank is to be equipped with a monitoring device for the temperature and liquid level inside the tank.

(C) Pump suitability

(a) All elastomeric components in the fuel oil system (e.g. diaphragms) is to be made of fluoro-rubber or other material suitable for use with marine fuels according to MSC.1/Circ.1321.

(b) Displacement pumps are to be fitted with relief valves. The discharge from the relief valve is normally to be led back to suction side of the pump.

(c) The maximum amount of catalyst fines reaching the engine is to be 10 ppm Al+Si and in some instances this might rise to 15 ppm however every attempt must be made to reduce the catalyst to the lowest possible levels.

(d) 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, and the fuel type used is RMF, then weekly sampling and analysing of catfine level at service tank outlet is recommended to ensure that catfine level doesn't exceed maximum level.

(e) Compatibility test kits, approved or recommended by the fuel oil manufacturer, are to be used when bunkering two or more different fuel types, e.g. a high sulphur and low 0,10 % m/m sulphur fuel.

(f) An automated fuel oil changeover valve/system or manual valve/system that can provide for timed changeover of fuel oil from one type to another is to be provided and done in accordance with the engine manufacturers' recommendation.

(g) Each vessel or installation is to have established procedures for fuel oil changeover and posted on-board.

(D) Verification requirements for pump design and test documentation

(a) All types of fuel oil pumps used for operation with low-sulphur fuel oil installed onboard is to be tested and the evidence of test is to be kept on-board.

(b) The scope of design documentation supplied by the pump manufacturer and kept on board is to include:

(i) Pump(s) arrangement drawing, pump installation diagram with position and characteristics of sensors/monitoring system details
(ii) List of components with characteristics of materials critical for reliable operation of pump
(iii) Sealing arrangements
(iv) Reliability and life cycle data
(v) Operational manual with performance and life cycle guidance
(vi) Test programme of the pump(s) for class survey

(c) A certificate of the running test containing the following information is to be attached to the pump documentation.

(i) Manufacturer details
(ii) The test stand location and accreditation – approval details

(iii) Pump type and serial number
(iv) Pump type and serial number
(v) Viscosity of used medium
(vi) Parameters as mentioned in running test
(vii) Minimum operating temperature
(viii) Result of running test

(2) Fuel oil temperature management equipment and viscosity controller
(A) Where heating or cooling of the fuel oil is required for the efficient functioning of the fuel oil treatment system, a minimum of two heating or cooling units are to be provided. Each heating or cooling unit should be of sufficient capacity to maintain the required temperature of the fuel oil for the required delivery flow rate.
(B) Heaters and coolers are to be located to avoid oil spray or oil leakages onto hot surfaces or other sources of ignition, or onto rotating machinery parts. Where necessary, shielding is to be provided.
(C) Heaters and coolers are to be located to allow easy access for routine maintenance.
(D) Depending on the type of fuel oil to be used, a viscosity control device is to be provided to maintain the desired viscosity or a viscosity maintenance control means (eg, additive) is to be provided.

(3) Fuel oil pump
(A) Fuel pump capacity is to ensure that fuel flow rate through the fuel system is sufficient to maintain the installed oil-fuelled machinery's fuel consumption during normal operation, according to **SOLAS Regulation II-1/26.3**.
(B) Pumps are to be located to allow easy access for routine inspection and maintenance.

(4) Tests procedures to confirm the ability of RMF fuel oil pumps operation with marine fuels with low viscosity
(A) General
(a) Primary essential services fuel oil pumps (main and stand-by) used in all services that need to be maintained in continuous operation. These include: separator fuel oil supply pumps; booster pumps, feeder pumps, fuel valve cooling pumps, (in systems which use fuel oil for this service).
(b) Primary essential services fuel oil pumps (main and stand-by) used in all services that need to be maintained in continuous operation. These include: separator fuel oil supply pumps; booster pumps, feeder pumps, fuel valve cooling pumps, (in systems which use fuel oil for this service).
(c) The arrangement of the fuel oil pump is to be satisfied with UI SC255.
(B) Running test
(a) A running test is to be carried out with a minimum or lower viscosity fuel oil with a sulphur content of 0.10 % m/m or less specified in ISO 8217 (latest edition) Specifications for Marine Fuels; recommended fuel oil viscosity value for the test should be 2,0 cSt at the fuel pump.
(b) The lubricity of fuel oil for running test is to be less than 520 μm as determined by a high-frequency reciprocating rig test according to ISO 12156-1.
(c) The running test is to be conducted for a minimum of 250 hours for pumps for both continuous and non-continuous operation and at a discharge pressure equal to the nominal pump pressure rating.
(d) During the running test the following data is to be verified.
(i) volume rate of flow Q [m3/h]
(ii) delivery head H [m]
(iii) pump power input P [kW]
(iv) speed of rotation n [min-1]
(e) During the running test, the pump is to be checked for smooth running (for example VDI Regulation 2056 "Criteria for the assessment vibration in machines" could be used as a basis for acceptance) and bearing temperature. The assessment is to be based on international standard or a Classification Society's requirements. This may be based on the pump manufacturer's in-house testing procedures in agreement with the Society.

(5) Filters
(A) Filters are to be located to avoid oil spray or oil leakages onto hot surfaces or other sources of ignition, or onto rotating machinery parts. Where necessary, shielding is to be provided.
(B) Filters are to be located to allow easy access for routine maintenance.
(C) The arrangements of filters are to be such that any unit can be cleaned without interrupting the supply of filtered oil to the combustion system.
(D) Filters are to be fitted in the fuel oil supply lines to each oil engine and gas turbine to ensure that only suitably filtered oil is fed to the combustion system.
(E) The filters installed at the inlet of oil fuelled machinery are to be selected considering the maximum amount of fuel oil catalyst particles reaching the oil fulled machinery.

(5) Centrifugal separators
(A) Centrifugal separators are to be located to avoid oil spray or oil leakages onto hot surfaces or

other sources of ignition, oronto rotating machinery parts. Where necessary, shielding is to be provided.

(B) Centrifugal separators are to be located to allow easy access for routine maintenance.

5. Test and Inspection

(1) Shop tests

(A) Sampling equipment and fuel oil pumps used in low viscosity fuel oil are to be inspected by the Society.

(B) Centrifugal separators are to be certified for a flow rating in accordance with a recognised standard, e.g. CEN Workshop Agreement (CWA) 15375 (latest revision).

(C) Centrifugal separators are to meet the safety requirements of a recognised standard, e.g. EN 12547, Centrifuges.

(2) Onboard tests

(A) The main components of the fuel oil treatment system and their accessories are to be inspected for compliance with the approved drawings.

(B) Piping systems are to be examined and tested in accordance with Pt 5, Ch 6, Sec. 14 of the Rules.

(C) Electrical equipments are to be examined and tested in accordance with Pt 6, Ch 1 of the Rules.

(D) Instrumentation is to be tested to confirm proper operation as per its predetermined set points.

(E) Pressure relief and safety valves installed on the unit are to be tested. ⚓