Amendment on 26 December 2024
Resolved by Technical Committee on 23 July 2024

IACS Unified Requirement for Gas-fuelled Engines

Object of Amendment

Rules for the Survey and Construction of Steel Ships Parts B, D, GF, and N
Rules for the Survey and Construction of Inland Waterway Ships
Guidance for the Survey and Construction of Steel Ships Parts GF and N
Guidance for Automatic and Remote Control Systems
Guidance for High Speed Craft
Guidance for the Survey and Construction of Inland Waterway Ships
Guidance for the Approval and Type Approval of Materials and Equipment for Marine Use

Reason for Amendment

In 2018, IACS adopted Unified Requirement (UR) M78, which stipulates requirements for trunk-piston engines supplied with low-pressure natural gas. The Society has already incorporated the UR's requirements into Parts GF and N of its Rules for the Survey and Construction of Steel Ships (hereinafter referred to as "Part GF of the Rules" and "Part N of the Rules", respectively).

For engines supplied with high-pressure gas fuel, IACS did adopt UR M59 in 1996, but it was deleted in 2019 because some of the requirements became inconsistent with the revised version of the IGC Code (MSC.370(93)) that entered into force in 2016. Since 2019, the Society has basically been conducting examinations for such engines based partially on UR M78 in addition to its own requirements for high-pressure gas-fuelled engines, which it established in 1995.

Subsequently, IACS reviewed UR M78 and discussed whether it could be revised to also apply to high-pressure gas-fuelled engines and crosshead engines. As a result of its review, IACS adopted UR M78(Rev.2) in January 2024.

Accordingly, relevant requirements are amended based on UR M78(Rev.2).

Outline of Amendment

The main contents of this amendment are as follows:

(1) Renames Annex 1.1.3-3, Part GF of the Rules and Annex 16.1.1-3, Part N of the Rules from "Low Pressure Gas-Fuelled Engines" to "Gas-Fuelled Engines" and added the requirements for 2-stroke engines and high pressure gas-fuelled engines to those annexes.
(2) Adds test requirements for pipes which transfer gas fuel and their associated fittings.
(3) Deletes Annex 1.1.3-2 "High Pressure Gas-Fuelled Engines" from Part GF of the Rules and Annex 16.1.1-2 "High Pressure Gas-Fuelled Engines" from Part N of the Rules.

Effective Date and Application

This amendment applies to engines that fall under the following:

(1) for which the application for approval is submitted to the Society on or after 1 January 2025.
(2) for which the application for renewal is submitted to the Society on or after 1 January 2025.

An asterisk (*) after the title of a requirement indicates that there is also relevant information in the corresponding Guidance.

ID: DD24-12

Amended-Original Requirements Comparison Table (IACS Unified Requirement for Gas-fuelled Engines)

Amended	Original	Remarks
RULES FOR THE SURVEY AND CONSTRUCTION OF STEEL SHIPS **Part B CLASS SURVEYS**	**RULES FOR THE SURVEY AND CONSTRUCTION OF STEEL SHIPS** **Part B CLASS SURVEYS**	
Chapter 2 CLASSIFICATION SURVEYS	**Chapter 2 CLASSIFICATION SURVEYS**	
2.3 Sea Trials and Stability Experiments	**2.3 Sea Trials and Stability Experiments**	
2.3.1 Sea Trials*	**2.3.1 Sea Trials***	
1 In the Classification Survey of all ships, sea trials specified in following **(1)** to **(13)** are to be carried out in full load condition, in the calmest possible sea and weather condition and in deep unrestricted water. However, where sea trials cannot be carried out in full load condition, sea trials may be carried out in an appropriate loaded condition. The noise measurements specified in **(11)** are to be carried out at either the full load condition or the ballast condition. (1) Speed test (Omitted) (2) Astern test (a) (Omitted) (b) (Omitted) (c) For gas-fuelled dual fuel engines, the confirmation specified in **(b)(1)** is to be carried out for all operating modes (i.e. the applicable gas mode, diesel mode, etc.).	**1** In the Classification Survey of all ships, sea trials specified in following **(1)** to **(13)** are to be carried out in full load condition, in the calmest possible sea and weather condition and in deep unrestricted water. However, where sea trials cannot be carried out in full load condition, sea trials may be carried out in an appropriate loaded condition. The noise measurements specified in **(11)** are to be carried out at either the full load condition or the ballast condition. (1) Speed test (Omitted) (2) Astern test (a) (Omitted) (b) (Omitted) (c) For low pressure (i.e. pressure less than 1 *MPa*) gas-fuelled dual fuel engines, the confirmation specified in **(b)(1)** is to be carried out for all operating modes (i.e. the applicable gas mode, diesel mode, etc.). This test is to be carried out at the maximum power available in gas mode (*See*	Requirements (c) and (d) were rearranged following the integration of the annexes.

Amended-Original Requirements Comparison Table (IACS Unified Requirement for Gas-fuelled Engines)

Amended	Original	Remarks
	2.5.1-1(1), Annex 1.1.3-3, Part GF of the Rules or **2.5.1-1(1), Annex 16.1.1-3, Part N of the Rules**).	
(Deleted)	(d) To high pressure gas-fuelled dual fuel engines, the requirements for low pressure gas-fuelled dual fuel engines specified in **(c)** apply mutatis mutandis.	
(3) (Omitted)	(3) (Omitted)	
(4) Turning test	(4) Turning test	
The tests are to be carried out in accordance with **(a)** and **(b)** below. The turning test of an individual ship may be dispensed with, provided that sufficient data is available from the turning test of a sister ship and subject to special approval by the Society.	The tests are to be carried out in accordance with **i)** and **ii)** below. The turning test of an individual ship may be dispensed with, provided that sufficient data is available from the turning test of a sister ship and subject to special approval by the Society.	
(a) (Omitted)	i) (Omitted)	
(b) (Omitted)	ii) (Omitted)	
(5) Confirmation of no abnormality for the operating condition of machinery and behaviour of the ship during the trials	(5) Confirmation of no abnormality for the operating condition of machinery and behaviour of the ship during the trials	
The performance tests of machinery installations are to include the following **(a)** to **(i)** in order to verify that the machinery installations have sufficient normal functions and reliability and are free from detrimental vibration within the numbers of revolutions used. However, these tests may be dispensed with where such tests have been conducted while the ship was anchored or at dockside. The preparations specified in **2.6.1-2(1), Part D** are to be made before tests are carried out.	The performance tests of machinery installations are to include the following **(a)** to **(j)** in order to verify that the machinery installations have sufficient normal functions and reliability and are free from detrimental vibration within the numbers of revolutions used. However, these tests may be dispensed with where such tests have been conducted while the ship was anchored or at dockside. The preparations specified in **2.6.1-2(1), Part D** are to be made before tests are carried out.	
(a) (Omitted)	(a) (Omitted)	
(b) (Omitted)	(b) (Omitted)	
(c) Operating tests for starting devices	(c) Operating tests for starting devices	

Amended-Original Requirements Comparison Table (IACS Unified Requirement for Gas-fuelled Engines)

Amended	Original	Remarks
It is to be confirmed that the engines start continuously for the number required by **2.5.3-2** or **4.4.3-2, Part D**. For gas-fuelled dual fuel engines, this test is to be carried out for all operating modes (i.e. the applicable gas mode, diesel mode, etc.).	It is to be confirmed that the engines start continuously for the number required by **2.5.3-2** or **4.4.3-2, Part D**.	UR M78(Rev.2) 4.3
(d) (Omitted)	(d) (Omitted)	
(e) (Omitted)	(e) (Omitted)	
(f) (Omitted)	(f) (Omitted)	
(g) Gas-fuelled engines are to comply with **(a)** and **(f)**, and further comply with the following **i)** to **iii)**, in the case of gas-fuelled dual fuel engines.	(g) Low pressure (i.e. pressure less than 1 *MPa*) gas-fuelled engines are to comply with the requirements specified in **(a)** and **(g)**. For low pressure gas-fuelled dual fuel engines, the output tests and governor tests are to be carried out for all operating modes (i.e. the gas mode, diesel mode, etc.). This test is to be carried out at the maximum power available in gas mode (*See* **2.5.1-1(1), Annex 1.1.3-3, Part GF** or **2.5.1-1(1), Annex 16.1.1-3, Part N**). The 110% load test is not required for the gas mode.	Requirements (g) and (h) were rearranged following the integration of the annexes.
i) The output tests and governor tests are to be carried out for all operating modes (i.e. the applicable gas mode, diesel mode, etc.). The 110 % load test is not required for the gas mode provided that changeover to oil fuel mode is automatically performed in case of overload.		UR M78(Rev.2) 4.1.7.1
ii) During the output tests specified in **i)**, if a test load is performed in all applicable operation modes without interruption (direct changeover at same power and speed), the duration of 100 % power run required by **Table B2.2** may be considered as the total duration demonstrated in all fuel modes. However, demonstration at each mode is not to be less than 1 *hour*.		UR M78(Rev.2) 4.3
iii) Automatic switching over to oil fuel mode is to be tested. Further, manual changeover from diesel to gas mode and vice versa is to be tested.		

Amended-Original Requirements Comparison Table (IACS Unified Requirement for Gas-fuelled Engines)

Amended	Original	Remarks
(Deleted)	(h) To high pressure gas-fuelled engines, the requirements for low pressure gas-fuelled engines specified in **(i)** apply mutatis mutandis.	Deleted following the integration of the annexes.
(h) Function tests of the safety devices and alarms of boilers	(i) Function tests of the safety devices and alarms of boilers	
(i) Function tests of the safety devices and alarms of exhaust gas economizers	(j) Function tests of the safety devices and alarms of exhaust gas economizers	
(6) (Omitted)	(6) (Omitted)	
(7) (Omitted)	(7) (Omitted)	
(8) (Omitted)	(8) (Omitted)	
(9) Measurement of torsional vibration for the shafting systems The measurements of the torsional vibration for shafting systems are to be carried out in accordance with the following **(a)** and **(b)**.	(9) Measurement of torsional vibration for the shafting systems The measurements of the torsional vibration for shafting systems are to be carried out in accordance with the following **(a)** to **(c)**.	
(a) Measurements are to be carried out in accordance with the requirements of **8.1.3, Part D**. In cases where the confirmation of engine running conditions specified in **8.1.3-2, Part D** is performed at the estimated upper and lower borders by calculation, it is recommended that the fuel index around estimated borders also be confirmed with consideration given to possible differences between estimated borders and actual borders confirmed through measurements.	(a) Measurements are to be carried out in accordance with the requirements of **8.1.3, Part D**. In cases where the confirmation of engine running conditions specified in **8.1.3-2, Part D** is performed at the estimated upper and lower borders by calculation, it is recommended that the fuel index around estimated borders also be confirmed with consideration given to possible differences between estimated borders and actual borders confirmed through measurements.	
(b) Measurements in either diesel mode or in the gas mode (but not both modes) may be omitted where considered appropriate by the Society based upon relevant torsional vibration calculation sheets of diesel and gas mode.	(b) For low pressure (i.e. pressure less than 1 *MPa*) gas-fuelled dual fuel engines, the measurements specified in **(a)** are to be carried out for both the diesel and gas mode. However, measurements in either diesel mode or in the gas mode (but not both modes) may be omitted where considered appropriate by the Society based upon relevant torsional vibration calculation sheets of diesel	Requirements (b) and (c) were rearranged following the integration of the annexes.

Amended	Original	Remarks
(Deleted) (10) (Omitted) (11) (Omitted) (12) (Omitted) (13) (Omitted)	and gas mode. (c) For high pressure gas-fuelled dual fuel engines, the requirements for low pressure gas-fuelled dual fuel engines specified in **(b)** apply mutatis mutandis. (10) (Omitted) (11) (Omitted) (12) (Omitted) (13) (Omitted)	

Table B2.2 Sea Trials of Reciprocating Internal Combustion Engines

Test items		Use of engines		
		Main engines of ships in which reciprocating internal combustion engines are used as main propulsion machinery (excluding electric propulsion ships) (1)	Reciprocating internal combustion engines driving generators (including main engines of electric propulsion ships) (2)	Reciprocating internal combustion engines driving auxiliaries (excluding auxiliary machinery for specific use, etc.)
Load test	110 % power run	—	10 *minutes* at n_0 (n_0 is the rated engine speed.) (3)	—
	100 % power (rated power) run	4 *hours* at engine speed in accordance with propeller curve (4) (5) (6)	1 *hour* at n_0 (3)	30 *minutes* at n_0
Overspeed run		30 *minutes* at $1.032n_0$ or more (7) (8)	—	—
Minimum revolution test of main engine (9)		○(7)	—	—
Intermittent overload (10)		○		○

Amended-Original Requirements Comparison Table (IACS Unified Requirement for Gas-fuelled Engines)

Amended	Original	Remarks
Notes: (1) After testing has been completed, the fuel delivery system is to be blocked so as to limit the engines to run at not more than 100 % power, excluding propulsion engines for which intermittent overload is approved as well as propulsion engines also driving generators. (2) The tests are to be performed based on the rated electrical powers of the driven generators. (3) This may, if possible, be done during the electrical propulsion plant test, which is tested at 100 % propulsion power (i.e., total electric motor capacity for propulsion) by distributing the power on as few generators as possible. The duration of this test is to be sufficient to reach the stable operating temperatures of all rotating machines or for at least 4 *hours*. When some of the generator set(s) cannot be tested due to insufficient time during the propulsion system test mentioned above, those required tests are to be carried out separately. (4) In the case of controllable pitch propellers, the test is to be performed at rated engine speed n_0 at a propeller pitch leading to 100 % power, or to the maximum achievable power if 100 % power cannot be reached. (5) In the case of propulsion engines also driving generators, tests are to be also carried out for 2 *hours* at 100 % propeller branch power (unless already covered in the test at 100 % power) and 1 *hour* with 100 % power take off branch power at rated engine speed n_0 in addition to the test for 4 *hours* at 100 % power. (6) For ships in which the tests specified in **2.2.5-2(1), Rules for Automatic and Remote Control Systems** are performed for not less than 4 *hours* at 100 % power without interruption, the 100 % power test specified in this table may be omitted. For gas-fuelled engines, see also **2.3.1-1(5)(g)ii).** (7) Only for engines driving fixed pitch propellers. (8) The test may be omitted if a 100 % power test is performed at $1.032n_0$ or more. In cases where engine speed cannot reach the specified speed due to the planned propeller curve, etc., an overspeed test may be performed at maximum achievable continuous revolution (i.e., maximum engine speed within the range of torque limit, etc.). (9) The test is to be carried out to identify the minimum working revolution of the main engine when the ship is steered to the maximum rudder angle. (10) Only for engines for which intermittent overload is approved. The test is to be performed for the duration agreed upon with the manufacturer.		Clarified the relationship with M0 tests

Amended-Original Requirements Comparison Table (IACS Unified Requirement for Gas-fuelled Engines)

Amended	Original	Remarks
RULES FOR THE SURVEY AND CONSTRUCTION OF STEEL SHIPS **Part D MACHINERY INSTALLATIONS**	**RULES FOR THE SURVEY AND CONSTRUCTION OF STEEL SHIPS** **Part D MACHINERY INSTALLATIONS**	
Chapter 2 RECIPROCATING INTERNAL COMBUSTION ENGINES	**Chapter 2 RECIPROCATING INTERNAL COMBUSTION ENGINES**	
2.1 General	**2.1 General**	
2.1.1 General*	**2.1.1 General***	
6 Gas-fuelled engines to which **Chapter 16, Part N** applies are to be in accordance with **Annex 16.1.1-3, Part N** in addition to this chapter.	**6** Gas-fuelled engines to which **Chapter 16, Part N** applies are to be in accordance with **Annex 16.1.1-2** or **Annex 16.1.1-3** of **Part N** in addition to this chapter.	Amended following the integration of the annexes.
7 Gas-fuelled engines to which **Chapter 16, Part N** does not apply (**Part GF** applies instead) are to be in accordance with **Annex 1.1.3-3, Part GF** in addition to this chapter.	**7** Gas-fuelled engines to which **Chapter 16, Part N** does not apply (**Part GF** applies instead) are to be in accordance with **Annex 1.1.3-2** or **Annex 1.1.3-3** of **Part GF** in addition to this chapter.	Amended following the integration of the annexes.
2.1.2 Terminology*	**2.1.2 Terminology***	
4 For gas-fuelled engines, the terminology is in accordance with **1.4, Annex 1.1.3-3, Part GF**.	**4** For low pressure gas-fuelled engines, the terminology is in accordance with **1.4 of Annex 1.1.3-3, Part GF**.	
2.2 Materials, Construction and Strength	**2.2 Materials, Construction and Strength**	
2.2.2 Construction, Installation and General*	**2.2.2 Construction, Installation and General***	
6 Ventilation of crankcase, and any arrangement which could produce a flow of external air into the crankcase, is not	**6** Ventilation of crankcase, and any arrangement which could produce a flow of external air into the crankcase, is not	UR M10(Rev.4) M10.5

Amended-Original Requirements Comparison Table (IACS Unified Requirement for Gas-fuelled Engines)

Amended	Original	Remarks
permitted except in cases **(1)** to **(3)** below. (1) Ventilation pipes, where provided, are to be as small as practicable to minimise the inrush of air after a crankcase explosion. In addition, ventilation pipes for each engine are to be independent of any other engine. Ventilation pipes from the crankcase of main propulsion engine are to lead to a safe position on deck or to some other approved position. (2) If provision is made for the extraction of gases from the crankcase (e.g. for oil mist detection purposes), the vacuum in the crankcase is not to exceed 2.5×10^{-4} *MPa*. (3) In cases where gas-fuelled engines are provided with crankcase ventilation for preventing the accumulation of leaked gas.	permitted except in cases **(1)** to **(3)** below. (1) Ventilation pipes, where provided, are to be as small as practicable to minimize the inrush of air after a crankcase explosion. In addition, ventilation pipes for each engine are to be independent of any other engine. Ventilation pipes from the crankcase of main propulsion engine are to lead to a safe position on deck or to some other approved position. (2) If provision is made for the extraction of gases from the crankcase (*e.g.* for oil mist detection purposes), the vacuum in the crankcase is not to exceed 2.5×10^{-4} *MPa*. (3) In cases where trunk piston type dual fuel reciprocating internal combustion engines are provided with crankcase ventilation for preventing the accumulation of leaked gas.	
2.6 Tests	**2.6 Tests**	
2.6.1 Shop Tests*	**2.6.1 Shop Tests***	
3 For gas-fuelled engines (specified in **4.2.2, Annex 1.1.3-3, Part GF** or **5.2.2, Annex 16.1.1-3, Part N**), the following requirements are to be complied with. In addition, the scope of the tests may be expanded depending on the engine application, service experience, or other relevant reasons.	**3** For low pressure gas-fuelled engines (specified in **4.2.2 of Annex 1.1.3-3, Part GF** or **5.2.2 of Annex 16.1.1-3, Part N**), the following requirements are to be complied with.	UR M78(Rev.2) 4.2.1, 4.2.4
(1) The requirements specified in **-2(1)** to **(7)** apply subject to following **(2)** to **(5)** requirements. (2) For dual fuel engines, the tests specified in **Table D2.7** are to be carried out for both diesel and gas mode. However, for loads considered by the Society not to be designed to operate, the load test may be	(1) The requirements specified in **-2(1)** to **(7)** apply subject to following **(2)** to **(5)** requirements. (2) For dual fuel engines, the tests specified in **Table D2.7** are to be carried out for both diesel and gas mode.	UR M78(Rev.2) 4.2.1, 4.2.4

Amended-Original Requirements Comparison Table (IACS Unified Requirement for Gas-fuelled Engines)

Amended	Original	Remarks
omitted. For load tests for the gas mode, test loads are to be determined based on the maximum continuous power available in the gas mode (see **2.5.1-1(1), Annex 1.1.3-3, Part GF** or **2.5.1-1(1), Annex 16.1.1-3, Part N**). The 110 % load test is not required for the gas mode provided that changeover to oil fuel mode is automatically performed in case of overload.	Tests for the gas mode are to be carried out based on the maximum power available in the gas mode (see **2.5.1-1(1) of Annex 1.1.3-3, Part GF** or **2.5.1-1(1) of Annex 16.1.1-3, Part N**). The 110 % load test is not required for the gas mode.	
(3) In addition to the preparations specified in **-2(1)**, measures to verify that gas fuel piping for the engine is gas tight are to be carried out prior to the start-up of the engine.	(3) In addition to the preparations specified in **-2(1)**, measures to verify that gas fuel piping for the engine is gas tight are to be carried out prior to the start-up of the engine.	UR M78(Rev.2) 4.2.2
(4) In addition to **-2(2)** and **(3)**, the following engine data are to be recorded. (a) The item listed in **-2(2)(f)** is to be measured and recorded for both gas and diesel, as applicable (b) Gas pressure and temperature (c) Pilot fuel temperature and pressure (supply or common rail as appropriate)	(4) In addition to **-2(2)** and **(3)**, the following engine data are to be recorded. (a) The item listed in **-2(2)(f)** is to be measured and recorded for both gas and diesel, as applicable (b) Gas pressure and temperature (Newly added)	UR M78(Rev.2) 4.2.3
(5) The engines are to undergo integration tests to verify that the responses of the complete mechanical, hydraulic and electronic systems are as predicted for all intended operational modes. The scope of these tests is to be agreed to with the Society for selected cases based upon risk analysis by a procedure deemed appropriate by the Society and is to at least include the following incidents. The 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) (b) Failure of a cylinder gas supply valve (c) Failure of combustion (to be detected by e.g. misfiring, knocking, exhaust temperature	(5) The engines are to undergo integration tests to verify that the responses of the complete mechanical, hydraulic and electronic systems are as predicted for all intended operational modes. The scope of these tests is to be agreed to with the Society for selected cases based upon risk analysis by a procedure deemed appropriate by the Society and is to at least include the following incidents. The 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) (b) Failure of a cylinder gas supply valve (c) Failure of combustion (to be detected by e.g. misfiring, knocking, exhaust temperature	UR M78(Rev.2) 4.2.5

Amended-Original Requirements Comparison Table (IACS Unified Requirement for Gas-fuelled Engines)

Amended	Original	Remarks
deviation, etc.) (d) Abnormal gas pressure (e) Abnormal gas temperature	deviation, etc.) (d) Abnormal gas pressure (e) Abnormal gas temperature	
(Deleted)	**4** To shop trials of the high pressure gas-fuelled engines specified in **4.2.2 of Annex 1.1.3-2, Part GF** or **5.2.2 of Annex 16.1.1-2, Part N**, the requirements for the shop trials of low pressure gas-fuelled engines specified in **-3** apply mutatis mutandis.	Deleted following the integration of the annexes.
4 (Omitted)	**5** (Omitted)	
5 (Omitted)	**6** (Omitted)	
6 (Omitted)	**7** (Omitted)	

Amended-Original Requirements Comparison Table (IACS Unified Requirement for Gas-fuelled Engines)

Amended	Original	Remarks
RULES FOR THE SURVEY AND CONSTRUCTION OF STEEL SHIPS **Part GF SHIPS USING LOW-FLASHPOINT FUELS**	**RULES FOR THE SURVEY AND CONSTRUCTION OF STEEL SHIPS** **Part GF SHIPS USING LOW-FLASHPOINT FUELS**	
Chapter 1 GENERAL	**Chapter 1 GENERAL**	
1.1 General (*IGF Code* 2.1)	**1.1 General (*IGF Code* 2.1)**	
1.1.3 Approval of Systems and Equipment, etc.*	**1.1.3 Approval of Systems and Equipment, etc.***	
2 (Deleted)	**2** In addition to the requirements specified in **-1**, reciprocating engines designed to directly inject natural gas pre-compressed to a high pressure into cylinders and ignite with appropriate sources of ignition for due combustion at the termination of compression strokes (hereinafter referred to as "high pressure gas-fuelled engines"), and to gas fuel supply systems are to be in accordance with **Annex 1.1.3-2**.	Deleted following the integration of the annexes. Left as "2 (Deleted)"
3 In addition to the requirements specified in **-1**, reciprocating internal combustion engines supplied with natural gas as fuel (hereinafter referred to as "gas-fuelled engines"), and gas fuel supply systems are to be in accordance with **Annex 1.1.3-3**.	**3** In addition to the requirements specified in **-1**, trunk piston reciprocating engines supplied with low pressure natural gas as fuel (hereinafter referred to as "low pressure gas-fuelled engines"), and gas fuel supply systems are to be in accordance with **Annex 1.1.3-3**.	Amended following the integration of the annexes.

Amended-Original Requirements Comparison Table (IACS Unified Requirement for Gas-fuelled Engines)

Amended	Original	Remarks
Annex 1.1.3-2 (Deleted)	**Annex 1.1.3-2 HIGH PRESSURE GAS-FUELLED ENGINES**	Left as "Annex 1.1.3-2 (Deleted)"
Annex 1.1.3-3 GAS-FUELLED ENGINES	**Annex 1.1.3-3 LOW PRESSURE GAS-FUELLED ENGINES**	
Chapter 1 GENERAL	**Chapter 1 GENERAL**	
1.1 Scope	**1.1 Scope**	
1 This annex applies to trunk piston reciprocating engines supplied with natural gas (including similar fuels with main component methane such as bio-methane or synthetic methane) as fuel, and gas fuel supply systems in accordance with the requirements of **1.1.3-3, Part GF of the Rules**.	**1** This annex applies to trunk piston reciprocating engines supplied with low pressure natural gas as fuel (hereinafter referred to as "low pressure gas-fuelled engines"), and gas fuel supply systems in accordance with the requirements of **1.1.3-3, Part GF of the Rules**.	UR M78(Rev.2) 1.1.1
2 It is to be ensured by the gas supply system that the gas supplied to the engine is always in gaseous state. This Annex does not cover requirements for liquid or cryogenic gas.	(Newly added)	UR M78(Rev.2) 1.1.1
3 Dual fuel engines and gas fuel only engines may not be permitted for emergency applications.	(Newly added)	UR M78(Rev.2) 1.1.1
4 Gas-fuelled engines and gas fuel supply systems are to be in accordance with requirements related to reciprocating internal combustion engines and gas supply systems specified in **Part D** and **Part GF of the Rules**, in addition to the requirements of this annex.	**2** Low pressure gas-fuelled engines and gas fuel supply systems are to be in accordance with requirements related to reciprocating internal combustion engines and gas supply systems specified in **Part D** and **Part GF of the Rules**, in addition to the requirements of this annex.	
4 The following requirements specified in **Part GF of the Rules** as well as other requirements specified separately by the Society apply to gas-fuelled engines regardless of ship type, ship size and ship service area. However, **1.1.1-2, Part**	**3** The following requirements specified in **Part GF of the Rules** as well as other requirements specified separately by the Society apply to low pressure gas-fuelled engines regardless of ship type, ship size and ship service area.	

Amended-Original Requirements Comparison Table (IACS Unified Requirement for Gas-fuelled Engines)

Amended	Original	Remarks
GF of the Rules does not apply except where explicitly specified otherwise. (1) **2.1-4(3)** (2) **2.2.3-1** (3) **2.2.4** (4) **2.4.2-5(1)** (5) **2.4.2-5(5)** (6) **2.4.2-5(6)(a)** to **(c)** (7) **2.4.2-5(4)(a)** (8) **3.1-6**	However, **1.1.1-2, Part GF of the Rules** does not apply except where explicitly specified otherwise. (1) **2.1-5(3)** (2) **2.2.3-1** (3) **2.2.4** (4) **2.4.4-5(1)** (5) **2.4.4-5(2)** (6) **2.4.4-5(3)(a)** to **(c)** (7) **2.4.4-5(4)(a)** (8) **3.1-6**	
1.2 Equivalency	**1.2 Equivalency**	
(Omitted)	(Omitted)	
1.3 Submission of Plans and Documents	**1.3 Submission of Plans and Documents**	
The plans and documents to be submitted are as follows. (1) Plans and documents for approval (a) Drawings and data specified in **2.1.3-1(1), Part D of the Rules** (b) Drawings and data specified in **18.1.3(1)(a)**, **(b)** and **(e), Part D of the Rules** (c) Gas admission valves and associated actuating systems (d) Gas fuel injection pipes and associated protective shielding (e) Arrangements of gas detectors (f) Combustion monitoring devices (g) Governors (h) Engine control system diagrams (including monitor, safety and alarm systems) for gas fuel combustion operations	The plans and documents to be submitted are as follows. (1) Plans and documents for approval (a) Drawings and data specified in **2.1.3-1(1), Part D of the Rules** (b) Drawings and data specified in **18.1.3(1)(a)**, **(b)** and **(e), Part D of the Rules** (c) Gas fuel injection valves and associated actuating systems (d) Gas fuel injection pipes and associated protective shielding (e) Arrangements of gas detectors (f) Combustion monitoring devices (g) Governors (h) Engine control system diagrams (including monitor, safety and alarm systems) for gas fuel combustion operations	UR M78(Rev.2) 1.3

Amended-Original Requirements Comparison Table (IACS Unified Requirement for Gas-fuelled Engines)

Amended	Original	Remarks
(i) Gas leak protection systems at connections between engines and gas fuel supply piping systems	(i) Gas leak protection systems at connections between engines and gas fuel supply piping systems	
(j) Gas fuel supply piping systems (including details of valves and pipe fittings) and protective devices for gas leaks from such systems	(j) Gas fuel supply piping systems (including details of valves and pipe fittings) and protective devices for gas leaks from such systems	
(k) Pilot oil fuel injection devices or ignition systems	(k) Pilot oil fuel injection devices or ignition systems	
(l) Schematic layout or other equivalent documents of gas system on the engine	(l) Schematic layout or other equivalent documents of gas system on the engine	
(m) Gas piping system (including double-walled arrangement where applicable) The documentation to contain specification of design pressures, working pressure, pipe dimensions and materials.	(m) Gas piping system (including double-walled arrangement where applicable)	Footnote 3)
(n) Parts for gas admission system The documentation to contain specifications of design pressures, working pressures, pipe dimensions and materials.	(n) Parts for gas admission system The documentation to contain specifications for pressures, pipe dimensions and materials.	Footnote 3)
(o) Arrangement of explosion relief valves for crankcase (if required by **2.4.3, Part D of the Rules**), charge air manifold and exhaust gas manifold and exhaust gas system on the engine, as applicable	(o) Arrangement of explosion relief valves for crankcase (if required by **2.4.3, Part D of the Rules**), charge air manifold and exhaust gas manifold, as applicable	1.3.1 No.4
(p) List of certified safe equipment and relevant certification	(Newly added)	1.3.1 No.5
(q) Schematic layout or other equivalent documents of pilot fuel system (only for dual fuel engines)	(p) Schematic layout or other equivalent documents of fuel oil system (main and pilot fuel systems) on the engine (only for dual fuel engines)	1.3.2 No.9
(r) Shielding of high pressure fuel pipes for pilot fuel system, assembly (only for dual fuel engines)	(q) Shielding of high pressure fuel pipes for pilot fuel system, assembly (only for dual fuel engines)	1.3.2 No.10
(s) Schematic layout or other equivalent documents of the ignition system (only for gas only engines)	(r) Ignition system (only for gas only engines)	1.3.3 No.12
(t) Other drawings and data deemed necessary by	(s) Other drawings and data deemed necessary by	

Amended-Original Requirements Comparison Table (IACS Unified Requirement for Gas-fuelled Engines)

Amended	Original	Remarks
the Society according to the type of gas-fuelled engine (2) Plans and documents for reference (a) Drawings and data specified in **2.1.3-1(2), Part D of the Rules** (b) Other drawings and data deemed necessary by the Society (3) Drawings and data for the purpose of inspecting and testing engines Items specified in **2.1.3-1, Part D of the Rules**, which are intended for inspection and testing (indicated by "○" in **Table D2.1(1)** and **Table D2.1(2), Part D of the Rules**).	the Society according to the type of low pressure gas-fuelled engine (2) Plans and documents for reference (a) Drawings and data specified in **2.1.3-1(2), Part D of the Rules** (b) Other drawings and data deemed necessary by the Society (3) Drawings and data for the purpose of inspecting and testing engines Items specified in **2.1.3-1, Part D of the Rules**, which are intended for inspection and testing (indicated by "○" in **Table D2.1(1)** and **Table D2.1(2), Part D of the Rules**).	
1.4 Terms	**1.4 Terms**	UR M78(Rev.2) 1.2
1 *Certified safe equipment* is equipment certified by an independent national test institution or competent body to be in accordance with a recognised standard for electrical apparatus in hazardous areas. Refer to *IEC* 60079 series, "Explosive atmospheres" and *IEC* 60092-502:1999 "Electrical installations in ships – Tankers – Special features"	**1** *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.	
2 *Double block and bleed valves* means a set of two valves in series in a pipe and a third valve enabling the pressure release from the pipe between those two valves, specified in **2.2.1-9, Part GF of the Rules**. The arrangement may also consist of a two-way valve and a closing valve instead of three separate valves. The valves are to be in accordance with **9.4.4** to **9.4.6, Part GF of the Rules**.	**2** *Double block and bleed valves* means a set of two valves in series in a pipe and a third valve enabling the pressure release from the pipe between those two valves, specified in **2.2.1-9, Part GF of the Rules**. The arrangement may also consist of a two-way valve and a closing valve instead of three separate valves. The valves are to be in accordance with **9.4.4** to **9.4.6**.	Clarified
3 *Dual fuel engine* means an engine that can burn natural gas as fuel simultaneously with liquid fuel, either as	**3** *Dual fuel engine* means an engine that can burn natural gas as fuel simultaneously with liquid fuel, either as	

Amended-Original Requirements Comparison Table (IACS Unified Requirement for Gas-fuelled Engines)

Amended	Original	Remarks
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).	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).	
(Deleted)	**4** *Engine room* is a machinery space or enclosure containing gas fuelled engine(s).	
4 *Explosion relief device* means a device to protect personnel and component against a determined overpressure in the event of a gas explosion. The device may be a valve, a rupture disc or other, as applicable.	(Newly added)	
5 *Gas* means natural gas used as fuel consisting primarily of methane. Gas may also be bio-methane or synthetic methane, etc. with methane as main component.	**5** *Gas means* a fluid having a vapour pressure exceeding 0.28 *MPa* absolute at a temperature of 37.8℃.	
6 *Gas admission valve* is a valve or injector on the engine, which controls gas supply to the cylinder(s) according to the engine's gas demand.	**6** *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.	
7 *Gas fuelled engine* means a dual fuel engine, a gas fuel only engine, or any variations thereof.	(Newly added)	UR M78.1.1.1 UR M78.1.2.7
8 *Gas fuel only engine* means an engine capable of operating on gas fuel only and not able to switch over to oil fuel operation.	**7** *Gas only engine* means an engine capable of operating on gas fuel only and not able to switch over to oil fuel operation.	
9 *Gas piping* means piping containing gas or air / gas mixtures.	**8** *Gas piping* means piping containing gas or air / gas mixtures, including venting pipes.	
(Deleted)	**9** *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.	Revised to eliminate the use of the wording "GVU" in this annex.
10 *High pressure gas* means gas with a maximum working pressure greater than 1 *MPa* (gauge).	(Newly added)	
11 *Low pressure gas* means gas with a maximum working pressure lower or equal to 1 *MPa*. (gauge).	**10** *Low pressure gas* means gas with a pressure up to 1 *MPa*.	
12 *Lower Heating Value* (*LHV*) means the amount of heat	**11** *Lower Heating Value* (*LHV*) means the amount of heat	

Amended-Original Requirements Comparison Table (IACS Unified Requirement for Gas-fuelled Engines)

Amended	Original	Remarks
produced from the complete combustion of a specific amount of fuel, excluding latent heat of vaporisation of water.	produced from the complete combustion of a specific amount of fuel, excluding latent heat of vaporization of water.	
13 *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.)	**12** *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.)	
14 *Pilot fuel* means the fuel oil that is injected into the cylinder to ignite the main gas-air mixture on dual fuel engines.	**13** *Pilot fuel* means the fuel oil that is injected into the cylinder to ignite the main gas-air mixture on Gas-fuelled engines.	
15 *Pre-mixed engine* means an engine where gas is supplied in a mixture with air through a common manifold for all cylinders, e.g. mixed before or after the turbocharger.	**14** *Pre-mixed engine* means an engine where gas is supplied in a mixture with air before the turbocharger.	
16 *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. The results of the risk analysis are to be reflected in the safety concept. 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.	**15** *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.	
Chapter 2 CONSTRUCTION AND EQUIPMENT OF GAS-FUELLED ENGINES	**Chapter 2 CONSTRUCTION AND EQUIPMENT OF LOW PRESSURE GAS-FUELLED ENGINES**	
2.1 General	**2.1 General**	
(Deleted)	**1** Low pressure gas-fuelled engines are to be dual fuel	Relocated to 1.3

Amended-Original Requirements Comparison Table (IACS Unified Requirement for Gas-fuelled Engines)

Amended	Original	Remarks
	system types capable of operating on oil fuel and gas fuel, or gas-only system types.	
1 Gas-fuelled engines are to be capable of maintaining stable operation even under any of the following **(1)** to **(3)** conditions: (1) switching from one fuel to another (in the cases of dual fuel engines), (2) rapid load fluctuations, and (3) minimum load conditions during gas combustion.	**2** Low pressure gas-fuelled engines are to be capable of maintaining stable operation even under any of the following **(1)** to **(3)** conditions: (1) switching from one fuel to another (in the cases of dual fuel engines), (2) rapid load fluctuations, and (3) minimum load conditions during gas combustion.	
2 Gas fuel supply pressures for gas-fuelled engines are to always be kept higher than suction air pressures at the supply points of gas fuel to combustion chambers or the suction pipes before suction valves in order to prevent any back-flow of air into gas fuel lines.	**3** Gas fuel supply pressures for low pressure gas-fuelled engines are to always be kept higher than suction air pressures at the supply points of gas fuel to combustion chambers or the suction pipes before suction valves in order to prevent any back-flow of air into gas fuel lines.	
3 The manufacturer is to declare the allowable gas composition limits for the engine and the minimum and (if applicable) maximum methane number.	**4** The manufacturer is to declare the allowable gas composition limits for the engine and the minimum and (if applicable) maximum methane number.	
4 Components containing or likely to contain gas are to be designed in accordance with the following **(1) to (3)**. (1) Minimise the risk of fire and explosion so as to demonstrate an appropriate level of safety commensurate with that of an oil-fuelled engine (2) 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 explosion relief devices of an approved type The strength of the component(s) of arrangement of explosion relief devices is to be documented (e.g. as part of risk analysis) or otherwise demonstrated to be sufficient for a worst-case explosion. (3) Refer to **10.2** and **10.3, Part GF of the Rules**	**5** Components containing or likely to contain gas are to be designed in accordance with the following **(1) to (5)**. (1) Minimize the risk of fire and explosion so as to demonstrate an appropriate level of safety commensurate with that of an oil-fuelled engine (2) 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 of an approved type (3) Refer to **10.2** and **10.3, Part GF of the Rules**	UR M78(Rev.2) 2.1.2
5 Discharge from explosion relief devices is to prevent	(4) Discharge from pressure relief devices is to prevent	

Amended-Original Requirements Comparison Table (IACS Unified Requirement for Gas-fuelled Engines)

Amended	Original	Remarks
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.	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	
6 Explosion relief devices are to be fitted with a flame arrester	(5) Relief devices are to be fitted with a flame arrester	
2.2 Construction and Strength	**2.2 Construction and Strength**	
2.2.1 Gas Admission Valves and Actuating Systems	**2.2.1 Gas Fuel Valves and Actuating Systems**	
1 Gas admission valves are to possess satisfactory operating characteristics and durability for the assumed service period.	**1** Gas fuel valves are to possess satisfactory operating characteristics and durability for the assumed service period.	
2 Gas admission valves are to be provided with sealing systems to effectively prevent gas fuel from leaking through spaces around valve spindles.	**2** Gas fuel valves are to be provided with sealing systems to effectively prevent gas fuel from leaking through spaces around valve spindles.	
3 Actuating systems of gas admission valves are to possess satisfactory operating characteristics and reliability.	**3** Actuating systems of gas fuel valves are to possess satisfactory operating characteristics and reliability.	
2.2.2 Cylinder Covers	**2.2.2 Cylinder Covers**	
1 The shapes of combustion chambers and the arrangements of gas admission valves are to be such that reliable ignition and combustion of gas fuel are ensured.	**1** The shapes of combustion chambers and the arrangements of gas fuel valves are to be such that reliable ignition and combustion of gas fuel are ensured.	
2 The portions of cylinder covers where gas admission valves and oil fuel injection valves are fitted are to be so constructed as to prevent the leakages of gas fuels and unburnt gases into cylinders.	**2** The portions of cylinder covers where gas fuel valves and oil fuel injection valves are fitted are to be so constructed as to prevent the leakages of gas fuels and unburnt gases into cylinders.	
2.2.3 Crankcase	**2.2.3 Crankcase**	
1 Crankcase explosion relief valves are to be installed in accordance with **2.4.3, Part D of the Rules**. Refer also to **10.3.1-2, Part GF of the Rules**. For engines not covered by	**1** Crankcase explosion relief valves are to be installed in accordance with **2.4.3, Part D of the Rules**. Refer also to **10.3.1-2, Part GF of the Rules**.	UR M78(Rev.2) 2.2.5.1

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Amended	Original	Remarks
2.4.3, Part D of the Rules, the detailed evaluation required by **8.3, Part 6 of the Guidance for the Approval and Type Approval of Materials and Equipment for Marine Use** is to determine if crankcase explosion relief valves are necessary.		
2 (Omitted)	**2** (Omitted)	
3 Ventilation of crankcase (either supply or extraction), if arranged, is to comply with **2.2.2-6(1), Part D of the Rules**. Relevant evidence is to be documented in Safety Concept. The ventilation systems for crankcase, sump and other similar engine spaces are to be independent from the systems on the other engines.	(Newly added)	UR M78(Rev.2) 2.2.5.3 UR M10.5.1 and UR M10.5.3
2.2.4 Gas Ignition in Cylinder	**2.2.4 Gas Ignition in Cylinder**	
(Omitted)	(Omitted)	
2.3 Safety Systems	**2.3 Safety Systems**	
2.3.1 Protection Against Explosions	**2.3.1 Protection Against Explosions**	
(Deleted)	**1** Suction manifolds and exhaust gas pipes are to be fitted with suitable pressure relief systems in accordance with the requirements of **10.2.2** and **10.3.1-1, Part GF of the Rules**.	Deleted due to duplication with 2.4.1-5
1 (Omitted)	**2** (Omitted)	
(Deleted)	**3** Gas fuel injection lines are to be provided with non-return valves or devices which have capabilities equivalent to those of the valves.	Deleted due to duplication with 2.1-2
2 (Omitted)	**4** (Omitted)	

Amended-Original Requirements Comparison Table (IACS Unified Requirement for Gas-fuelled Engines)

Amended	Original	Remarks
2.3.2 Governors	**2.3.2 Governors**	
1 Governors for gas-fuelled engines are to be capable of being operated during gas fuel combustion mode. In the case of dual fuel engines, the governors are additionally to be capable of being operated either during gas and oil fuel (or pilot oil) combustion mode, and/or oil fuel only combustion mode.	**1** Governors for low pressure gas-fuelled engines are to be capable of being operated during gas fuel combustion mode. In the case of dual fuel engines, the governors are additionally to be capable of being operated either during gas and oil fuel (or pilot oil) combustion mode, and/or oil fuel only combustion mode.	
2 (Omitted)	**2** (Omitted)	
3 Gas-fuelled dual fuel engines are to be operated in any one of the modes specified in the following **(1)** to **(3)**: (1) controllable gas fuel supply and fixed oil fuel (pilot oil) supply, (2) controllable oil fuel (pilot oil) supply and fixed gas fuel supply, or (3) controllable gas fuel and oil fuel supplies.	**3** Low pressure gas-fuelled dual fuel engines are to be operated in any one of the modes specified in the following **(1)** to **(3)**: (1) controllable gas fuel supply and fixed oil fuel (pilot oil) supply, (2) controllable oil fuel (pilot oil) supply and fixed gas fuel supply, or (3) controllable gas fuel and oil fuel supplies.	
2.4 Accessory Equipment	**2.4 Accessory Equipment**	
2.4.1 Charge Air Systems and Exhaust Gas Systems	**2.4.1 Charge Air Systems**	UR M78(Rev.2) 2.2.3
1 The charge air system and the exhaust gas system on the gas-fuelled engine are to be designed in accordance with **2.1-4**.	**1** The charge air system on the low pressure gas-fuelled engine is to be designed in accordance with **2.1-5**.	
2 (Omitted)	**2** (Omitted)	
3 (Omitted)	**3** (Omitted)	
(Deleted)	**2.4.2 Exhaust Gas Systems**	Merged into 2.4.1
(Deleted)	**1** The exhaust gas system on the low pressure gas-fuelled engine is to be designed in accordance with **2.1-5**.	
(Deleted)	**2** In case of a single engine installation, the engine is to	

Amended-Original Requirements Comparison Table (IACS Unified Requirement for Gas-fuelled Engines)

Amended	Original	Remarks
	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.	
4 (Omitted)	**3** (Omitted)	
5 Suitable explosion relief system for air inlet manifolds, scavenge spaces and exhaust system is to be provided unless designed to accommodate the worst-case overpressure due to ignited gas leaks or justified by the safety concept of the engine. A detailed evaluation regarding the hazard potential of overpressure in air inlet manifolds, scavenge spaces and exhaust system is to be carried out and reflected in the safety concept of the engine.	(Newly added)	UR M78(Rev.2) 2.2.3
6 Explosion relief devices for air inlet and exhaust manifold are to be approved according to **Chapter 13, Part 6 of the Guidance for the Approval and Type Approval of Materials and Equipment for Marine Use**.	(Newly added)	
7 The necessary total relief area and the arrangement of the explosion relief devices are to be determined taking into account: (1) The worst-case explosion pressure depending on initial pressure and gas concentration, (2) the volume and geometry of the component, and (3) the strength of the component.	(Newly added)	
8 The arrangement of the explosion relief devices is to be determined in the risk analysis required by **8.3, Part 6 of the Guidance for the Approval and Type Approval of Materials and Equipment for Marine Use** and reflected in the safety concept.	(Newly added)	
(Deleted)	**2.4.3 Starting Systems**	Deleted due to deletion of UR M59.6.1
(Deleted)	Starting air branch pipes to cylinders are to be provided with effective flame arresters.	

Amended-Original Requirements Comparison Table (IACS Unified Requirement for Gas-fuelled Engines)

Amended	Original	Remarks
2.4.2 Gas Pipes	**2.4.4 Gas Fuel Pipes**	
1 Gas pipes are to be provided with effective protective shielding against gas fuel bursting due to pipe failure, except where deemed appropriate by the Society.	**1** Gas fuel pipes are to be provided with effective protective shielding against gas fuel bursting due to pipe failure, except where deemed appropriate by the Society.	
2 (Omitted)	**2** (Omitted)	
3 Gas pipes are to be provided with systems for inerting and gas-freeing.	**3** Gas fuel pipes are to be provided with systems for inerting and gas-freeing.	
4 Expansion joints provided for gas pipes (only those attached to engines) are to be approved as specified separately by the Society.	**4** Expansion joints provided for gas fuel pipes (only those attached to engines) are to be approved as specified separately by the Society.	
5 For piping attached to gas-fuelled engines, the following **(1) to (8)** also apply. (1) The piping is to be designed in accordance with the criteria for gas piping (design pressure, wall thickness, materials, piping fabrication and joining details, etc.) as given in **Chapter 7, Part GF of the Rules**. (2) Other connections as mentioned in **7.3.6-4(4), Part GF of the Rules** may be accepted subject to approval of use in accordance with the requirements of **Chapter 9, Part 6 of the Guidance for the Approval and Type Approval of Materials and Equipment for Marine Use.** (3) Design pressure for gas pipes is to be in accordance with the following rules: (a) Gas pipe (low pressure): **7.3.3-1, Part GF of the Rules** (b) Gas pipe (high pressure): **7.3.3-1, Part GF of the Rules** (c) Outer pipe (low pressure): **9.8.1, Part GF of the Rules** (d) Outer pipe (high pressure): **9.8.2, Part GF of**	**5** For piping attached to low pressure gas-fuelled engines, the following **(1) to (5)** also apply. (1) The piping is to be designed in accordance with the criteria for gas piping (design pressure, wall thickness, materials, piping fabrication and joining details etc.) as given in **Chapter 7, Part GF of the Rules**. (Newly added) (Newly added)	UR M78(Rev.2) 2.2.1.1 UR M78(Rev.2) Table 1

Amended-Original Requirements Comparison Table (IACS Unified Requirement for Gas-fuelled Engines)

Amended	Original	Remarks
the Rules (e) Open ended pipes: **7.3.3-2, Part GF of the Rules**		
(4) Flexible bellows used in the fuel gas system on the engine is to be approved based on the requirements of **16.7.2, Part GF of the Rules.** The number of cycles, pressure, temperature, axial movement, rotational movement and transverse movement which the bellow will encounter in actual service on the engine are to be specified by the engine designer. Endurance against high cycle fatigue due to vibration loads is to be verified by testing or alternatively be documented by the *EJMA* calculation or equivalent (i.e. more than 10^7 cycles). However, the fatigue test due to ship deformations in **16.7.2(4), Part GF of the Rules** is considered not relevant for bellows which are an integral part of the engine.	(Newly added)	
(5) Arrangement of the gas piping system on the engine Pipes and equipment containing fuel gas are defined as hazardous area zone 0 (refer to **12.5.1, Part GF of the Rules**). 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 **12.5.2(6), Part GF of the Rules**).	(2) Arrangement of the gas piping system on the engine Pipes and equipment containing fuel gas are defined as hazardous area zone 0 (refer to **12.5.1, Part GF of the Rules**). 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 **12.5.2(6), Part GF of the Rules**).	UR M78(Rev.2) 2.2.2
(6) Normal “double wall” arrangement (a) The gas piping system on the gas-fuelled engine is to be arranged according to the principles and requirements of **9.6, Part GF of the Rules**. (b) The design criteria for the double pipe or duct are given in the **9.8** and **7.4.1-4, Part GF of the Rules**.	(3) Normal “double wall” arrangement (a) The gas piping system on the low pressure gas-fuelled engine is to be arranged according to the principles and requirements of **9.6, Part GF of the Rules**. (b) The design criteria for the double pipe or duct are given in the **9.8** and **7.4.1-4, Part GF of the Rules**.	UR M78(Rev.2) 2.2.2.1

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Amended	Original	Remarks
(c) In case of a ventilated double wall, the ventilation inlet is to be located in accordance with the provisions of **13.8.3, Part GF of the Rules**. (d) The pipe or duct is to be pressure tested in accordance with **12.6.1-2** to **-4, Part D of the Rules** to ensure gas tight integrity and to show that it can withstand the expected maximum pressure at gas pipe rupture. (7) Alternative arrangement (a) Single walled gas piping is only acceptable: i) for engines supplied with low pressure gas and installed in *ESD* protected machinery spaces, as defined in **5.4.1(2), Part GF of the Rules** and in compliance with other relevant parts of **Part GF of the Rules** (e.g. **5.6, Part GF of the Rules**); ii) when complying with requirements specified separately by the Society. (b) In case of gas leakage in an *ESD*-protected machinery space, which would result in the shutdown of the engine(s) in that space, a sufficient propulsion and manoeuvring capability including essential and safety systems is to be maintained. Therefore the safety concept of the engine is to clearly indicate application of the "double wall" or "alternative" arrangement. The minimum power to be maintained is to be assessed on a case-by-case basis in consideration of the operational characteristics of the ship. (8) Gas admission valves Electrically operated gas admission valves are to be certified safe as follows: (a) The inside of the valve contains gas and therefore	(c) In case of a ventilated double wall, the ventilation inlet is to be located in accordance with the provisions of **13.8.3, Part GF of the Rules**. (d) The pipe or duct is to be pressure tested in accordance with **12.6.1-2** to **-4, Part D of the Rules** to ensure gas tight integrity and to show that it can withstand the expected maximum pressure at gas pipe rupture. (4) Alternative arrangement (a) Single walled gas piping is only acceptable: i) for engines installed in *ESD* protected machinery spaces, as defined in **5.4.1(2), Part GF of the Rules** and in compliance with other relevant parts of **Part GF of the Rules** (e.g. **5.6, Part GF of the Rules**); ii) when complying with requirements specified separately by the Society. (b) In case of gas leakage in an *ESD*-protected machinery space, which would result in the shutdown of the engine(s) in that space, a sufficient propulsion and manoeuvring capability including essential and safety systems is to be maintained. Therefore the safety concept of the engine is to clearly indicate application of the "double wall" or "alternative" arrangement. The minimum power to be maintained is to be assessed on a case-by-case basis in consideration of the operational characteristics of the ship. (5) Gas admission valves Gas admission valves are to be certified safe as follows: (a) The inside of the valve contains gas and therefore	UR M78(Rev.2) 2.2.2.2 UR M78(Rev.2) 2.2.8

Amended-Original Requirements Comparison Table (IACS Unified Requirement for Gas-fuelled Engines)

Amended	Original	Remarks
it is to be certified for zone 0. (b) When the valve is located within a pipe or duct in accordance with **(6)**, the outside of the valve is to be certified for zone 1. (c) When the valve is arranged without enclosure in accordance with the "*ESD*-protected machinery space" (see **(7)**) concept, no certification is required for the outside of the valve, provided that the valve is de-energised upon gas detection in the space. (d) However, if they are not rated for the zone they are intended for, it is to be documented that they are suitable for that zone. Documentation and analysis is to be based on *IEC* 60079-10-1:2015 or *IEC* 60092-502:1999. Gas admission valves operated by hydraulic oil system are to be provided with sealing arrangement to prevent gas from entering the hydraulic oil system.	it is to be certified for zone 0. (b) When the valve is located within a pipe or duct in accordance with **(3)**, the outside of the valve is to be certified for zone 1. (c) When the valve is arranged without enclosure in accordance with the "*ESD*-protected machinery space" (see **(4)**) 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 is to be documented that they are suitable for that zone. Documentation and analysis is to be based on *IEC* 60079-10-1:2015 or *IEC* 60092-502:1999.	
2.4.3 Cylinder Lubrication	**2.4.5 Cylinder Lubrication**	
Cylinder lubricating systems for gas-fuelled dual fuel engines are, in general, to be capable of maintaining adequate alkali values and cylinder oil feeding rates for oil fuel only operation as well as the modes of operation specified in **2.3.2-3(1)** to **(3)**.	Cylinder lubricating systems for low pressure gas-fuelled dual fuel engines are, in general, to be capable of maintaining adequate alkali values and cylinder oil feeding rates for oil fuel only operation as well as the modes of operation specified in **2.3.2-3(1)** to **(3)**.	
2.5 Design Requirements for Each Kind of Engines	**2.5 Design Requirements for Each Kind of Engines**	
2.5.1 Dual Fuel Engine	**2.5.1 Dual Fuel Engine**	
1 General The maximum continuous power that a dual fuel engine can develop in gas mode may be lower than the approved MCR of the engine (i.e. in oil fuel mode), depending in	**1** General (1) The maximum continuous power that a dual fuel engine can develop in gas mode may be lower than the approved MCR of the engine (i.e. in oil fuel	UR M78(Rev.2) 3.1.1

Amended-Original Requirements Comparison Table (IACS Unified Requirement for Gas-fuelled Engines)

Amended	Original	Remarks
particular on the gas composition and its quality or the engine design. This maximum continuous power available in gas mode and the corresponding conditions are to be stated by the engine manufacturer.	mode), depending in particular on the gas quality. This maximum power available in gas mode and the corresponding conditions are to be stated by the engine manufacturer and demonstrated during the type test.	
(Deleted)	(2) Low pressure gas-fuelled dual fuel engines are to be capable of supplying oil fuel to each cylinder in amounts sufficient for maintaining stable combustion of gas fuel under any conditions.	Deleted due to duplication with 1.2.6
(Deleted)	(3) Only oil fuel is, in principle, to be used when operation of low pressure gas-fuelled dual fuel engines are unstable.	Relocated to 2.5.1-2(5)
2 Starting, changeover and stopping	**2** Starting, changeover and stopping	
(1) Dual fuel engines are to be arranged to be started using either oil fuel or gas fuel 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.	(1) Dual fuel 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.	UR M78(Rev.2) 3.1.2
(2) 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.	(2) 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.	
(3) Changeover from gas fuel operation mode to oil fuel operation mode is to be possible at all situations and power levels.	(3) Changeover from gas fuel operation mode to oil fuel operation mode is to be possible at all situations and power levels.	
(4) The changeover process itself from and to gas operation is to be automatic but manual interruption is to be possible in all cases.	(4) The changeover process itself from and to gas operation is to be automatic but manual interruption is to be possible in all cases.	
(5) If the power level or other conditions do not allow safe and reliable gas operation, changeover to oil fuel	(Newly added)	UR M78(Rev.2) 3.1.2

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Amended	Original	Remarks
mode is to be automatically performed. (6) In case of shut-off of the gas supply, the engines are to be capable of continuous operation by oil fuel only.	(5) In case of shut-off of the gas supply, the engines are to be capable of continuous operation by oil fuel only.	
3 (Omitted)	**3** (Omitted)	
2.5.2 Gas Fuel Only Engine	**2.5.2 Gas Only Engine**	UR M78(Rev.2) 3.2
(Omitted)	(Omitted)	
2.5.3 Pre-mixed Engine	**2.5.3 Pre-mixed Engine**	UR M78(Rev.2) 3.3
Inlet manifolds, turbochargers, charge air coolers, etc. are to be regarded as parts of the fuel gas supply system.	Inlet manifolds, turbochargers, charge air coolers, etc. are to be regarded as parts of the fuel gas supply system, and failures of such components likely to result in gas leakages are to be considered in risk analysis by a method deemed appropriate by the Society.	Relocated to Guidance for the Approval and Type Approval of Materials and Equipment for Marine Use
Chapter 3 CONTROL, ALARM AND SAFETY SYSTEMS	**Chapter 3 CONTROL, ALARM AND SAFETY SYSTEMS**	
3.1 General	**3.1 General**	UR M78(Rev.2) 2.2.7
1 Control systems for operating gas-fuelled engines using gas fuel are to be in accordance the requirements in **18.1** to **18.3** and **18.7, Part D of the Rules**: relevant requirements are to be applied mutatis mutandis.	**1** Control systems for operating low pressure gas-fuelled engines using gas fuel are to be in accordance the requirements in **18.1** to **18.3** and **18.7, Part D of the Rules**: relevant requirements are to be applied mutatis mutandis.	
2 Temperatures and pressures (or flow rates) of gas fuel supplied to gas-fuelled engines are to be automatically controlled.	**2** Temperatures and pressures (or flow rates) of gas fuel supplied to low-pressure gas-fuelled engines are to be automatically controlled. In addition, visual and audible alarm devices which activate when temperatures and pressures exceed preset ranges are to be provided.	Merged into Table 3.1
3 (Omitted)	**3** (Omitted)	
4 The gas admission valves are to be controlled by the	**4** The gas supply valves are to be controlled by the	

Amended-Original Requirements Comparison Table (IACS Unified Requirement for Gas-fuelled Engines)

Amended	Original	Remarks
engine control system or by the engine gas demand.	engine control system or by the engine gas demand.	
5 (Omitted)	**5** (Omitted)	
6 (Omitted)	**6** (Omitted)	
7 (Omitted)	**7** (Omitted)	
8 Unless risk analysis by a method deemed appropriate by the Society otherwise proves that risk is within the acceptable range otherwise, alarm and safety system functions for dual fuel or gas only engines are to be provided in accordance with **Table 3.1** (for dual fuel engines, **Table 3.1** applies only to the gas mode). However, even if risk analysis proves that risk is within the acceptable range, the alarm and safety system functions specified in **Part GF of the Rules** are still to be provided. Additional alarms and safety devices may be required if deemed necessary by the Society.	**8** Unless risk analysis by a method deemed appropriate by the Society otherwise proves that risk is within the acceptable range otherwise, alarm and safety system functions for dual fuel or gas only engines are to be provided in accordance with **Table 3.1** (for dual fuel engines, **Table 3.1** applies only to the gas mode). However, even if risk analysis proves that risk is within the acceptable range, the alarm and safety system functions specified in **Part GF of the Rules** are still to be provided.	Relocated from 3.2(1)(c) and (2)(d)
3.2 Gas-fuelled Engines of Ships Subject to the Rules for Automatic Remote Control Systems	**3.2 Low Pressure Gas-fuelled Engines of Ships Subject to the Rules for Automatic Remote Control Systems**	
Gas-fuelled engines of ships subject to the application of the **Rules for Automatic and Remote Control Systems** are also to be in accordance with the requirements in **3.2**, **3.3** and **4.2** of said rules. (Deleted)	Low pressure gas-fuelled engines of ships subject to the application of the **Rules for Automatic and Remote Control Systems** are to be in accordance with the requirements in **3.2**, **3.3** and **4.2** of said rules. In addition, such engines are to be in accordance with the following **(1)** and **(2)** requirements: (1) Low pressure gas-fuelled engines are to be provided with safety systems which automatically cut off the gas fuel supplies when any one of **(a)**, **(b)** or **(c)** given below occur. In addition, in the case of dual fuel engines, such systems are to automatically switch the mode of operation to oil fuel only or are to stop the engines. Automatic cut off of the gas fuel supplies	Merged into Table 3.1

Amended	Original	Remarks
(Deleted)	with the double block and bleed valves specified in **9.4.4, Part GF of the Rules**, however, may be accepted. (a) When operating on gas fuel, abnormalities are detected in the following: i) gas fuel valve function ii) pilot oil fuel injection valve (in the cases of dual fuel engines) or ignition system (in the cases of gas-only engines) function iii) suction valve and exhaust valve function, iv) exhaust gas temperatures at cylinder outlets v) pressure in cylinder vi) blow-by through suction valves or exhaust valves (b) When gas leaks in the air space between the gas fuel piping and the wall of the outer pipe or duct specified in **9.6.1, Part GF of the Rules** are detected. (c) Others deemed necessary by the Society. (2) Low pressure engines are to be provided with systems which automatically reduce speed or switches the mode of operation to oil fuel only, and which issues alarms in the event any of the abnormalities specified in the following **(a)** to **(d)** occurs: (a) abnormal gas fuel temperatures; (b) abnormal gas fuel supply pressures; (c) low pressures of hydraulic and pneumatic sources, or loss of electric power supply for gas fuel combustion control; or (d) others deemed necessary by the Society.	

Amended-Original Requirements Comparison Table (IACS Unified Requirement for Gas-fuelled Engines)

Amended	Original	Remarks

Table 3.1 Alarm and Safety System Functions for Dual Fuel and Gas Only Engines

UR M78(Rev.2) Table2

Parameter	Alarm	Automatic activation of the double block and bleed valves	Automatic switching over to oil fuel mode[1)]	Engine shutdown
1. Abnormal pressures in the gas fuel supply line	X	X	X	X [5)]
2. Gas fuel supply systems - malfunction	X	X	X	X [5)]
3. Pilot fuel injection or spark ignition systems - malfunction	X	X [2)]	X	X [2)5)]
4. Exhaust gas temperature after each cylinder - high	X	X [2)]	X	X [2)5)]
5. Exhaust gas temperature after each cylinder - low[3)]	X	X [2)]	X	X [2)5)]
6. Cylinder pressure or ignition - failure, including misfiring, knocking and unstable combustion	X	X [2)4)]	X [4)]	X [2)4)5)]
7. Oil mist concentration in crankcase or bearing temperature[6)] - high	X	X	-	X [9)]
8. Pressure in the crankcase - high ~~2)~~8)	X	X	X	-
9. Engine stops - any cause	X	X	-	-
10. Failure of the control-actuating medium of the block and bleed valves	X	X	X	-
11. Failure of crankcase ventilation system,if applicable	X	X [7)]	X [7)]	-
12. Abnormal temperature in the gas fuel supply line	X	X [10)]	X [10)]	X [5)10)11)]
13. Leak detection between gas piping and outer pipes or ducts as specified in **9.6.1, Part GF of the Rules** [10)]	X	X	X	X [5)]
14. Low pressures of hydraulic and pneumatic sources, or loss of electric power supply for gas fuel combustion control [10)]	X	X	X	X [5)11)]

12: Relocated from 3.1-2 and 3.2(2)(a)

13: Relocated from 3.2(1)(b)

14: Relocated from 3.2(2)(c)

Notes:

1) Dual fuel engine only, when running in gas mode

Amended	Original	Remarks
2) For gas fuel only 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. In addition, deviation from average is to be used for the operation setting of each function. 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) Only for Gas fuel only engine ~~only~~ 6) Where required by **2.4.5, Part D of the Rules** 7) Automatic safety actions to be activated as specified by the engine manufacturer (see **2.2.2-6, Part D of the Rules**) 8) Only for trunk piston engines. 9) Only for trunk piston engines. For crosshead engines slow down applies (see **2.4.5, Part D of the Rules**) 10) Only for gas-fuelled engines installed on board ships subject to **1.1.1, Rules for Automatic and Remote Control Systems** 11) Slowdown is acceptable instead of shutdown. In this case, "automatic activation of the double block and bleed valves" does not apply.		
Chapter 4 TESTS	**Chapter 4 TESTS**	
4.1 Approval of Use	**4.1 Approval of Use**	
For each type of gas-fuelled engine, approval of use is to be obtained by the engine designer (licensor) in accordance with requirements specified in **Chapter 8, Part 6 of the Guidance for the Approval and Type Approval of Materials and Equipment for Marine Use**.	For each type of low pressure gas-fuelled engine, approval of use is to be obtained by the engine designer (licensor) in accordance with requirements specified separately by the Society.	
4.2 Shop Tests	**4.2 Shop Tests**	
4.2.1 Hydraulic Tests	**4.2.1 Hydraulic Tests**	
Pressure parts and accessory equipment with pressure	Pressure parts and accessory equipment with pressure	

Amended	Original	Remarks
parts of gas-fuelled engines are to be subjected to hydraulic tests in accordance with the requirements of **2.6.1, Part D of the Rules** and **16.7.3, Part GF of the Rules**: relevant requirements are to be applied mutatis mutandis.	parts of low pressure gas-fuelled engines are to be subjected to hydraulic tests in accordance with the requirements of **2.6.1, Part D of the Rules** and **16.7.3, Part GF of the Rules**: relevant requirements are to be applied mutatis mutandis.	
4.2.2 Shop Trials	**4.2.2 Shop Trials**	
Gas-fuelled engines are to be tested as specified in **2.6.1-3, Part D of the Rules**. To implement surveys of tests, in lieu of traditional ordinary surveys where the Surveyor is in attendance, the Society may approve survey methods which it considers to be able to obtain information equivalent to that obtained through traditional ordinary surveys.	Low pressure gas-fuelled engines are to be tested as specified in **2.6.1-3, Part D of the Rules**. To implement surveys of tests, in lieu of traditional ordinary surveys where the Surveyor is in attendance, the Society may approve survey methods which it considers to be able to obtain information equivalent to that obtained through traditional ordinary surveys.	
4.3 Tests after Installation On Board	**4.3 Tests after Installation On Board**	
1 Control systems of gas-fuelled engines and related equipment are to be tested depending upon their installation characters in accordance with the requirements of **18.7.3, Part D of the Rules** or the requirements of **2.2.4 of the Rules for Automatic and Remote Control Systems**: relevant requirements are to be applied mutatis mutandis.	Control systems of low pressure gas-fuelled engines and related equipment are to be tested depending upon their installation characters in accordance with the requirements of **18.7.3, Part D of the Rules** or the requirements of **2.2.4 of the Rules for Automatic and Remote Control Systems**: relevant requirements are to be applied mutatis mutandis.	
2 A leak test is to be carried out for the gas piping system after assembly on board in accordance with **16.7.3-3, Part GF of the Rules**.	(Newly added)	UR M78(Rev.2) 4.3
3 The efficiency of the ventilation arrangement, or other approved principle, of the double walled gas piping system is to be verified.	(Newly added)	UR M78(Rev.2) 4.3
4.4 Sea Trials	**4.4 Sea Trials**	
1 Performance of control systems of gas-fuelled engines and related equipment is to be verified during operations using the gas fuel depending upon their installation characters in accordance with the requirements of **2.2.5 of the**	**1** Performance of control systems of low pressure gas-fuelled engines and related equipment is to be verified during operations using the gas fuel depending upon their installation characters in accordance with the requirements of **2.2.5 of the**	

Amended-Original Requirements Comparison Table (IACS Unified Requirement for Gas-fuelled Engines)

Amended	Original	Remarks
Rules for Automatic and Remote Control Systems: relevant requirements are to be applied mutatis mutandis.	**Rules for Automatic and Remote Control Systems**: relevant requirements are to be applied mutatis mutandis.	
2 (Omitted)	**2** (Omitted)	

Amended-Original Requirements Comparison Table (IACS Unified Requirement for Gas-fuelled Engines)

Amended	Original	Remarks
RULES FOR THE SURVEY AND CONSTRUCTION OF STEEL SHIPS **Part N SHIPS CARRYING LIQUEFIED GASES IN BULK**	**RULES FOR THE SURVEY AND CONSTRUCTION OF STEEL SHIPS** **Part N SHIPS CARRYING LIQUEFIED GASES IN BULK**	
Chapter 16 USE OF CARGO AS FUEL	**Chapter 16 USE OF CARGO AS FUEL**	
16.1 General (*IGC Code* 16.1)	**16.1 General (*IGC Code* 16.1)**	
16.1.1 General*	**16.1.1 General***	
1 (Omitted)	**1** (Omitted)	
2 (Deleted)	**2** In addition to **-1** above, engines designed to directly inject methane gas fuel (boil-off gases and cargo vapour) precompressed to a high pressure into cylinders at a high pressure upon termination of the compression stroke and then ignite with an appropriate source of ignition for due combustion (hereinafter referred to as "high pressure gas-fuelled engines") as well as gas fuel supply systems are to be in accordance with **Annex 16.1.1-2.**	Deleted following the integration of the annexes. Left as "2 (Deleted)"
3 In addition to **-1** above, engines supplied with natural gas as fuel (hereinafter referred to as "gas-fuelled engines") and gas fuel supply systems are to be in accordance with **Annex 16.1.1-3**.	**3** In addition to **-1** above, trunk-piston type engines supplied with low pressure natural gas as fuel (hereinafter referred to as "low pressure gas-fuelled engines") and gas fuel supply systems are to be in accordance with **Annex 16.1.1-3**.	

Amended-Original Requirements Comparison Table (IACS Unified Requirement for Gas-fuelled Engines)

Amended	Original	Remarks
Annex 16.1.1-2 (Deleted)	**Annex 16.1.1-2 HIGH PRESSURE GAS-FUELLED ENGINES**	Deleted following the integration of the annexes. Left as "Annex 16.1.1-2 (Deleted)"
Annex 16.1.1-3 GAS-FUELLED ENGINES	**Annex 16.1.1-3 LOW PRESSURE GAS-FUELLED ENGINES**	
Chapter 1 GENERAL	**Chapter 1 GENERAL**	
1.1 Scope	**1.1 Scope**	
1 The Guidance applies to engines supplied with natural gas (including similar fuels with main component methane such as bio-methane or synthetic methane) as fuel and gas fuel supply systems in accordance with the requirements of **16.1.1, Part N of the Rules**.	**1** The Guidance applies to trunk-piston type engines supplied with low pressure natural gas as fuel (hereinafter referred to as "low pressure gas-fuelled engines") and gas fuel supply systems in accordance with the requirements of **16.1.1, Part N of the Rules**.	UR M78(Rev.2) 1.1.1
2 It is to be ensured by the gas supply system that the gas supplied to the engine is always in gaseous state. This Annex does not cover requirements for liquid or cryogenic gas.	(Newly added)	UR M78(Rev.2) 1.1.1
3 Dual fuel engines and gas fuel only engines may not be permitted for emergency applications.	(Newly added)	UR M78(Rev.2) 1.1.1
4 Gas-fuelled engines and gas fuel supply systems are to comply with relevant requirements of **Part D** and **Part N of the Rules**, in addition to the requirements of this Guidance and **Chapter 16, Part N of the Rules**.	**2** Low pressure gas-fuelled engines and gas fuel supply systems are to comply with relevant requirements of **Part D** and **Part N of the Rules**, in addition to the requirements of this Guidance and **Chapter 16, Part N of the Rules**.	
5 The following requirements specified in **Part GF of the Rules** as well as other requirements specified separately by the Society apply to gas-fuelled engines regardless of ship type, ship size and ship service area except where explicitly	**3** The following requirements specified in **Part GF of the Rules** as well as other requirements specified separately by the Society apply to low pressure gas-fuelled engines regardless of ship type, ship size and ship service area except	

Amended-Original Requirements Comparison Table (IACS Unified Requirement for Gas-fuelled Engines)

Amended	Original	Remarks
specified otherwise. (1) **2.1-4(3)** (2) **2.2.3-1** (3) **2.4.2-4(5)** (4) **2.4.2-4(6)(b)** (5) **4.1-7**	where explicitly specified otherwise. (1) **2.1-5(3)** (2) **2.2.3-1** (3) **2.4.4-4(2)** (4) **2.4.4-4(3)(b)** (5) **4.1-7**	
1.2 Equivalency	**1.2 Equivalency**	
(Omitted)	(Omitted)	
1.3 Drawings and Data	**1.3 Drawings and Data**	
The drawings and data to be submitted are as follows. (1) Drawings and data for approval (a) Drawings and data specified in **2.1.3-1(1), Part D of the Rules** (b) Drawings and data specified in **18.1.3(1)(a), (b)** and **(e), Part D of the Rules** (c) Gas admission valves and actuating systems (d) Gas fuel injection pipe and shielding arrangements (e) Arrangement of gas detectors (f) Combustion monitoring device (g) Governor (h) Engine control system diagram (including monitor, safety and alarm systems) for gas fuel combustion operation (i) Gas leak protection system at connections between engines and gas fuel supply piping systems (j) Gas fuel make-up plant (including construction, equipment, and control systems) (k) Gas fuel supply piping system (including details	The drawings and data to be submitted are as follows. (1) Drawings and data for approval (a) Drawings and data specified in **2.1.3-1(1), Part D of the Rules** (b) Drawings and data specified in **18.1.3(1)(a), (b)** and **(e), Part D of the Rules** (c) Gas fuel injection valves and actuating systems (d) Gas fuel injection pipe and shielding arrangements (e) Arrangement of gas detectors (f) Combustion monitoring device (g) Governor (h) Engine control system diagram (including monitor, safety and alarm systems) for gas fuel combustion operation (i) Gas leak protection system at connections between engines and gas fuel supply piping systems (j) Gas fuel make-up plant (including construction, equipment, and control systems) (k) Gas fuel supply piping system (including details	UR M78(Rev.2) 1.3

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Amended	Original	Remarks
of valves and pipe fittings) and protective device for gas leaks from them	of valves and pipe fittings) and protective device for gas leaks from them	
(l) Automatic control and remote control systems for gas fuel supply systems	(l) Automatic control and remote control systems for gas fuel supply systems	
(m) Pilot fuel injection devices or injection arrangements	(m) Pilot fuel injection devices or injection arrangements	
(n) Schematic layout or other equivalent documents of gas system on the engine	(n) Schematic layout or other equivalent documents of gas system on the engine	
(o) Gas piping system (including double-walled arrangement where applicable) The documentation to contain specification of design pressures, working pressure, pipe dimensions and materials.	(o) Gas piping system (including double-walled arrangement where applicable)	Footnote 3)
(p) Parts for gas admission system The documentation to contain specifications of design pressures, working pressures, pipe dimensions and materials.	(p) Parts for gas admission system The documentation to contain specifications for pressures, pipe dimensions and materials.	Footnote 3)
(q) Arrangement of explosion relief valves for crankcase (if required by **2.4.3, Part D of the Rules**), charge air manifold and exhaust gas manifold and exhaust gas system on the engine, as applicable	(q) Arrangement of explosion relief valves for crankcase (if required by **2.4.3, Part D of the Rules**), charge air manifold and exhaust gas manifold, as applicable	1.3.1 No.4
(r) List of certified safe equipment and relevant certification	(Newly added)	1.3.1 No.5
(s) Schematic layout or other equivalent documents of pilot fuel system (only for dual fuel engines)	(r) Schematic layouts or other equivalent documents for fuel oil systems (main and pilot fuel systems) of the engine (in the case of dual fuel engines)	1.3.2 No.9
(t) Assembly drawings for the shielding of high pressure fuel pipes of pilot fuel system (in the case of dual fuel engines)	(s) Assembly drawings for the shielding of high pressure fuel pipes of pilot fuel system (in the case of gas only engines)	1.3.2 No.9
(u) Schematic layout or other equivalent documents of the ignition system (only for gas only engines)	(Newly added)	1.3.3 No.12

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Amended	Original	Remarks
(v) Other drawings and data as deemed necessary by the Society according to the type of low pressure gas-fuelled engines (2) Drawings and data for reference (a) Drawings and data specified in **2.1.3-1(2), Part D of the Rules** (b) Other drawings and data as deemed necessary by the Society (3) Drawings and data for the purpose of inspecting and testing engines Items specified in **2.1.3-1, Part D of the Rules**, which are intended for inspection and testing (indicated by "○" in **Table D2.1(1)** and **Table D2.1(2), Part D of the Rules**).	(t) Other drawings and data as deemed necessary by the Society according to the type of low pressure gas-fuelled engines (2) Drawings and data for reference (a) Drawings and data specified in **2.1.3-1(2), Part D of the Rules** (b) Other drawings and data as deemed necessary by the Society (3) Drawings and data for the purpose of inspecting and testing engines Items specified in **2.1.3-1, Part D of the Rules**, which are intended for inspection and testing (indicated by "○" in **Table D2.1(1)** and **Table D2.1(2), Part D of the Rules**).	
1.4 Terms	**1.4 Terms**	UR M78(Rev.2) 1.2
1 *Certified safe equipment* is equipment certified by an independent national test institution or competent body to be in accordance with a recognised standard for electrical apparatus in hazardous areas. Refer to *IEC* 60079 series "Explosive atmospheres" and *IEC* 60092-502:1999 "Electrical installations in ships – Tankers – Special features"	**1** *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.	
2 *Double block and bleed valve* means valves which have the functionality specified in **16.4.5, Part N of the Rules**.	**2** *Double block and bleed valve* means valves which have the functionality specified in **16.4.5, Part N of the Rules**.	
3 *Dual fuel 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).	**3** *Dual fuel 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).	
(Deleted)	**4** *Engine room* is a machinery space or enclosure	

Amended-Original Requirements Comparison Table (IACS Unified Requirement for Gas-fuelled Engines)

Amended	Original	Remarks
	containing gas fuelled engine(s).	
4 *Explosion relief device* means a device to protect personnel and component against a determined overpressure in the event of a gas explosion. The device may be a valve, a rupture disc or other, as applicable.	(Newly added)	
5 *Gas* means natural gas used as fuel consisting primarily of methane. Gas may also be bio-methane or synthetic methane, etc. with methane as main component.	**5** *Gas* means a fluid having a vapour pressure exceeding 0.28 *MPa* absolute at a temperature of 37.8℃.	
6 *Gas admission valve* is a valve or injector on the engine, which controls gas supply to the cylinder(s) according to the engine's gas demand.	**6** *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.	
7 *Gas fuelled engine* means a dual fuel engine, a gas fuel only engine, or any variations thereof.	(Newly added)	UR M78.1.1.1 UR M78.1.2.7
8 *Gas fuel only engine* means an engine that can be operated only with gas fuel and cannot be switched to oil-fuelled operation.	**7** *Gas only engine* means an engine that can be operated only with gas fuel and cannot be switched to oil-fuelled operation.	
9 *Gas piping* means piping containing gas or air / gas mixtures.	**8** *Gas piping* means piping containing gas or air / gas mixtures, including venting pipes.	
(Deleted)	**9** *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.	Revised to eliminate the use of the wording "GVU" in this annex.
10 *High pressure gas* means gas with a maximum working pressure greater than 1 *MPa* (gauge).	(Newly added)	
11 *Low pressure gas* means gas with a maximum working pressure lower or equal to 1 *MPa* (gauge).	**10** *Low pressure gas* means gas with a pressure up to 1 *MPa*.	
12 *Lower Heating Value* (*LHV*) means the amount of heat produced from the complete combustion of a specific amount of fuel, excluding latent heat of vaporisation of water.	**11** *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.	
13 *Methane Number* is a measure of resistance of a gas fuel to knock, which is assigned to a test fuel based upon	**12** *Methane Number* is a measure of resistance of a gas fuel to knock, which is assigned to a test fuel based upon	

Amended	Original	Remarks
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.)	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.)	
14 *Pilot fuel* means the fuel oil that is injected into the cylinder to ignite the main gas-air mixture on Gas-fuelled engines.	**13** *Pilot fuel* means the fuel oil that is injected into the cylinder to ignite the main gas-air mixture on Gas-fuelled engines.	
15 *Pre-mixed engine* means an engine where gas is supplied in a mixture with air through a common manifold for all cylinders, e.g. mixed before or after the turbocharger.	**14** *Pre-mixed engine* means an engine where gas is supplied in a mixture with air before the turbocharger.	
16 *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. The results of the risk analysis are to be reflected in the safety concept. 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.	**15** *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.	
Chapter 2 CONSTRUCTION AND EQUIPMENT OF GAS-FUELLED ENGINES	**Chapter 2 CONSTRUCTION AND EQUIPMENT OF LOW PRESSURE GAS-FUELLED ENGINES**	
2.1 General	**2.1 General**	
(Deleted)	**1** Low pressure gas-fuelled engines are to be dual fuel system types capable of operating on oil fuel and gas fuel, or gas-only system types.	Relocated to 1.3
1 Gas-fuelled engines are to be capable of maintaining stable operation even under any of the following **(1)** to **(3)**	**2** Low pressure gas-fuelled engines are to be capable of maintaining stable operation even under any of the following	

Amended-Original Requirements Comparison Table (IACS Unified Requirement for Gas-fuelled Engines)

Amended	Original	Remarks
conditions: (1) switching from one fuel to another (in the case of dual fuel engines), (2) rapid load transient, and (3) minimum load condition during gas combustion	**(1)** to **(3)** conditions: (1) switching from one fuel to another (in the case of dual fuel engine), (2) rapid load transient, and (3) minimum load condition during gas combustion	
2 Gas fuel supply pressures for gas-fuelled engines are to always be kept higher than suction air pressures at the supply points of gas fuel to combustion chambers or the suction pipes before suction valves in order to prevent any back-flow of air into gas fuel lines.	**3** Gas fuel supply pressures for low pressure gas-fuelled engines are to always be kept higher than suction air pressures at the supply points of gas fuel to combustion chambers or the suction pipes before suction valves in order to prevent any back-flow of air into gas fuel lines.	
3 The manufacturer is to declare the allowable gas composition limits for the engine and the minimum and (if applicable) maximum methane number.	**4** The manufacturer is to declare the allowable gas composition limits for the engine and the minimum and (if applicable) maximum methane number.	
4 Components containing or likely to contain gas are to be designed in accordance with the following **(1) to (3)**. (1) Minimise the risk of fire and explosion so as to demonstrate an appropriate level of safety commensurate with that of an oil-fuelled engine (2) 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 of an approved type The strength of the component(s) of arrangement of explosion relief devices is to be documented (e.g. as part of risk analysis) or otherwise demonstrated to be sufficient for a worst-case explosion. (3) Refer to **10.2** and **10.3, Part GF of the Rules**	**5** Components containing or likely to contain gas are to be designed in accordance with the following **(1) to (5)**. (1) Minimize the risk of fire and explosion so as to demonstrate an appropriate level of safety commensurate with that of an oil-fuelled engine (2) 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 of an approved type (3) Refer to **10.2** and **10.3, Part GF of the Rules**	UR M78(Rev.2) 2.1.2
5 Discharge from explosion relief devices is to 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.	(4) Discharge from pressure relief devices is to 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	
6 Explosion relief devices are to be fitted with a flame	(5) Relief devices are to be fitted with a flame arrester	

Amended-Original Requirements Comparison Table (IACS Unified Requirement for Gas-fuelled Engines)

Amended	Original	Remarks
arrester		
2.2 Construction and Strength	**2.2 Construction and Strength**	
2.2.1 Gas Admission Valves and Actuating Systems	**2.2.1 Gas Fuel Valves and Actuating Systems**	
1 Gas admission valves are to have satisfactory operating characteristics and durability for the assumed service period.	**1** Gas fuel valves are to have satisfactory operating characteristics and durability for the assumed service period.	
2 Gas admission valves are to be provided with a sealing system to effectively prevent gas fuel from leaking through spaces around valve spindles.	**2** Gas fuel valves are to be provided with a sealing system to effectively prevent gas fuel from leaking through spaces around valve spindles.	
3 The actuating systems of gas admission valves are to have satisfactory operating characteristics and reliability.	**3** The actuating systems of gas fuel valves are to have satisfactory operating characteristics and reliability.	
2.2.2 Cylinder Covers	**2.2.2 Cylinder Covers**	
1 The shape of combustion chambers and the arrangements of gas admission valves are to be such that reliable ignition and combustion of gas fuel are ensured.	**1** The shape of combustion chambers and the arrangements of gas fuel valves are to be such that reliable ignition and combustion of gas fuel are ensured.	
2 The portions of cylinder covers where gas admission valves and oil fuel injection valves are fitted are to be so constructed as to prevent the leakage of gas fuel and unburnt gases in the cylinders.	**2** The portions of cylinder covers where gas fuel valves and oil fuel injection valves are fitted are to be so constructed as to prevent the leakage of gas fuel and unburnt gases in the cylinders.	
2.2.3 Crankcase	**2.2.3 Crankcase**	
1 Crankcase explosion relief valves are to be installed in accordance with **2.4.3, Part D of the Rules**. Refer also to **10.3.1-2, Part GF of the Rules**. For engines not covered by **2.4.3, Part D of the Rules**, the detailed evaluation required by **8.3, Part 6 of the Guidance for the Approval and Type Approval of Materials and Equipment for Marine Use** is to determine if crankcase explosion relief valves are necessary.	**1** Crankcase explosion relief valves are to be installed in accordance with **2.4.3, Part D of the Rules**. Refer also to **10.3.1-2, Part GF of the Rules**.	UR M78(Rev.2) 2.2.5.1
2 (Omitted)	**2** (Omitted)	

Amended-Original Requirements Comparison Table (IACS Unified Requirement for Gas-fuelled Engines)

Amended	Original	Remarks
3 Ventilation of crankcase (either supply or extraction), if arranged, is to comply with **2.2.2-6(1), Part D of the Rules**. Relevant evidence is to be documented in Safety Concept. The ventilation systems for crankcase, sump and other similar engine spaces are to be independent from the systems on the other engines.	(Newly added)	UR M78(Rev.2) 2.2.5.3 UR M10.5.1, M10.5.3
2.2.4 Gas Ignition in Cylinder	**2.2.4 Gas Ignition in Cylinder**	
(Omitted)	(Omitted)	
2.3 Safety Systems	**2.3 Safety Systems**	
2.3.1 Protection against Explosions	**2.3.1 Protection against Explosions**	
(Deleted)	**1** Suction manifolds and exhaust gas pipes are to be fitted with suitable pressure relief systems in accordance with **16.7.1-4, Part N of the Rules**.	Deleted due to duplication with 2.4.1-5
1 (Omitted)	**2** (Omitted)	
(Deleted)	**3** Each gas fuel injection line is to be provided with a non-return valve or devices which have capabilities equivalent to those of the valves.	Deleted due to duplication with 2.1-2
2 (Omitted)	**4** (Omitted)	
3 (Omitted)	**5** (Omitted)	
2.3.2 Governors	**2.3.2 Governors**	
1 In addition to operations using gas fuel, governors of gas-fuelled engines are to be functional in either the simultaneous combustion mode of gas and oil fuel (or pilot oil) or the combustion mode of oil fuel.	**1** In addition to operations using gas fuel, governors of low pressure gas-fuelled engines are to be functional in either the simultaneous combustion mode of gas and oil fuel (or pilot oil) or the combustion mode of oil fuel.	
2 (Omitted)	**2** (Omitted)	
3 Gas-fuelled dual fuel engines are to be operated in any one of the modes specified in the following **(1)** to **(3)**: (1) controllable gas fuel supply and fixed oil fuel (pilot	**3** Low pressure gas-fuelled dual fuel engines are to be operated in any one of the modes specified in the following **(1)** to **(3)**: (1) controllable gas fuel supply and fixed oil fuel (pilot	

Amended-Original Requirements Comparison Table (IACS Unified Requirement for Gas-fuelled Engines)

Amended	Original	Remarks
oil) supply, (2) controllable oil fuel (pilot oil) supply and fixed gas fuel supply, or (3) controllable gas fuel and oil fuel supplies.	oil) supply, (2) controllable oil fuel (pilot oil) supply and fixed gas fuel supply, or (3) controllable gas fuel and oil fuel supplies.	
2.4 Accessory Equipment	**2.4 Accessory Equipment**	
2.4.1 Charge Air Systems and Exhaust Gas Systems	**2.4.1 Charge Air Systems**	UR M78(Rev.2) 2.2.3
1 The charge air system and the exhaust gas system on the gas-fuelled engine are to be designed in accordance with **2.1-4**.	**1** The charge air system on the low pressure gas-fuelled engine is to be designed in accordance with **2.1-5**.	
2 (Omitted)	**2** (Omitted)	
3 (Omitted)	**3** (Omitted)	
(Deleted)	**2.4.2 Exhaust Gas Systems**	Merged into 2.4.1
(Deleted)	**1** The exhaust gas system on the low pressure gas-fuelled engine is to be designed in accordance with **2.1-5**.	
(Deleted)	**2** 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.	
4 (Omitted)	**3** (Omitted)	
5 Suitable explosion relief system for air inlet manifolds, scavenge spaces and exhaust system is to be provided unless designed to accommodate the worst-case overpressure due to ignited gas leaks or justified by the safety concept of the engine. A detailed evaluation regarding the hazard potential of overpressure in air inlet manifolds, scavenge spaces and exhaust system is to be carried out and reflected in the safety concept of the engine.	(Newly added)	UR M78(Rev.2) 2.2.3
6 Explosion relief devices for air inlet and exhaust	(Newly added)	

Amended-Original Requirements Comparison Table (IACS Unified Requirement for Gas-fuelled Engines)

Amended	Original	Remarks
manifold are to be approved according to **Chapter 13, Part 6 of the Guidance for the Approval and Type Approval of Materials and Equipment for Marine Use**.		
7 The necessary total relief area and the arrangement of the explosion relief devices are to be determined taking into account: (1) The worst-case explosion pressure depending on initial pressure and gas concentration, (2) the volume and geometry of the component, and (3) the strength of the component.	(Newly added)	
8 The arrangement of the explosion relief devices is to be determined in the risk analysis required by **8.3, Part 6 of the Guidance for the Approval and Type Approval of Materials and Equipment for Marine Use** and reflected in the safety concept.	(Newly added)	
(Deleted)	**2.4.3 Starting Systems**	Deleted due to deletion of UR M59.6.1
(Deleted)	Starting air branch pipes to each cylinder are to be provided with effective flame arresters.	
2.4.2 Gas Pipes	**2.4.4 Gas Fuel Injection Pipes**	
1 Gas pipes is to be provided with effective shielding against gas fuel bursting due to failures of pipes, except where deemed appropriate by the Society.	**1** Except where specifically approved by the Society, gas fuel injection pipes is to be provided with effective shielding against gas fuel bursting due to failures of pipes.	
2 Spaces between the gas pipes and the shielding is to be provided with means according to the requirements in **3.2.2-2**.	**2** Spaces between the gas fuel injection pipes and the shielding is to be provided with means according to the requirements in **3.2.2-2**.	
3 (Omitted)	**3** (Omitted)	
4 For piping attached to gas-fuelled engines, the following (1) to (8) also apply. (1) Requirements of **5.1** to **5.9** and **Chapter 16, Part GF of the Rules** are applied. (2) Other connections as mentioned in **7.3.6-4(4), Part**	**4** For piping attached to low pressure gas-fuelled engines, the following (1) to (5) also apply. (1) Requirements of **5.1** to **5.9** and **Chapter 16, Part GF of the Rules** are applied. (Newly added)	UR M78(Rev.2) 2.2.1.1

Amended	Original	Remarks
GF of the Rules may be accepted subject to approval of use in accordance with the requirements of **Chapter 9, Part 6 of the Guidance for the Approval and Type Approval of Materials and Equipment for Marine Use.**		
(3) Design pressure for gas pipes are to be in accordance with the following rules: (a) Gas pipe (low pressure): **5.4.1, Part N of the Rules** (b) Gas pipe (high pressure): **5.4.1, Part N of the Rules** (c) Outer pipe (low pressure): **5.4.4, Part N of the Rules** (d) Outer pipe (high pressure): **5.4.4, Part N of the Rules** (e) Open ended pipes: **5.4.1, Part N of the Rules**	(Newly added)	UR M78(Rev.2) Table 1
(4) Flexible bellows used in the fuel gas system on the engine is to be approved based on the requirements of **5.13.1-2, Part N of the Rules**. The number of cycles, pressure, temperature, axial movement, rotational movement and transverse movement which the bellow will encounter in actual service on the engine are to be specified by the engine designer. Endurance against high cycle fatigue due to vibration loads is to be verified by testing or alternatively be documented by the *EJMA* calculation or equivalent (i.e., more than 10^7 cycles). However, the fatigue test due to ship deformations in **16.7.2(4), Part GF of the Rules** is considered not relevant for bellows which are an integral part of the engine.	(Newly added)	
(5) Arrangement of the gas piping system on the engine	(2) Arrangement of the gas piping system on the engine	UR M78(Rev.2) 2.2.2

Amended-Original Requirements Comparison Table (IACS Unified Requirement for Gas-fuelled Engines)

Amended	Original	Remarks
Pipes and equipment containing fuel gas are defined as hazardous area zone 0 (refer to **12.5.1, Part GF of the Rules**). 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 **12.5.2(6), Part GF of the Rules**).	Pipes and equipment containing fuel gas are defined as hazardous area zone 0 (refer to **12.5.1, Part GF of the Rules**). 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 **12.5.2(6), Part GF of the Rules**).	UR M78(Rev.2) 2.2.2.1
(6) Normal "double wall" arrangement (a) The gas piping system on the gas-fuelled engine are applied the requirements of **16.4.3, Part N of the Rules**. (b) The design criteria for the double pipe or duct are given in the **9.8** and **7.4.1-4, Part GF of the Rules**. (c) In case of a ventilated double wall, the ventilation inlet is applied the provisions of **16.4.3(2), Part N of the Rules**. (d) The pipe or duct is to be pressure tested in accordance with **12.6.1-2** to **-4, Part D of the Rules** to ensure gas tight integrity and to show that it can withstand the expected maximum pressure at gas pipe rupture.	(3) Normal "double wall" arrangement (a) The gas piping system on the low pressure gas-fuelled engine are applied the requirements of **16.4.3, Part N of the Rules**. (b) The design criteria for the double pipe or duct are given in the **9.8** and **7.4.1-4, Part GF of the Rules**. (c) In case of a ventilated double wall, the ventilation inlet is applied the provisions of **16.4.3(2), Part N of the Rules**. (d) The pipe or duct is to be pressure tested in accordance with **12.6.1-2** to **-4, Part D of the Rules** to ensure gas tight integrity and to show that it can withstand the expected maximum pressure at gas pipe rupture.	
(7) Alternative arrangement Single walled gas piping is only acceptable in cases where the requirements of **Part N of the Rules** permit (e.g. **16.4.4-1, Part N of the Rules**).	(4) Alternative arrangement Single walled gas piping is only acceptable in cases where the requirements of **Part N of the Rules** permit (e.g. **16.4.4-1, Part N of the Rules**).	
(8) Gas admission valves Electrically operated Gas admission valves are to be certified safe as follows: (a) The inside of the valve contains gas and therefore it is to be certified for zone 0. (b) When the valve is located within a pipe or duct in accordance with **(6)**, the outside of the valve is to be certified for zone 1.	(5) Gas admission valves Gas admission valves are to be certified safe as follows: (a) The inside of the valve contains gas and therefore it is to be certified for zone 0. (b) When the valve is located within a pipe or duct in accordance with **(3)**, the outside of the valve is to be certified for zone 1.	UR M78(Rev.2) 2.2.8

Amended-Original Requirements Comparison Table (IACS Unified Requirement for Gas-fuelled Engines)

Amended	Original	Remarks
(c) However, if they are not rated for the zone they are intended for, it is to be documented that they are suitable for that zone. Documentation and analysis is to be based on *IEC* 60079-10-1:2015 or *IEC* 60092-502:1999. Gas admission valves operated by hydraulic oil system are to be provided with sealing arrangement to prevent gas from entering the hydraulic oil system.	(c) However, if they are not rated for the zone they are intended for, it is to be documented that they are suitable for that zone. Documentation and analysis is to be based on *IEC* 60079-10-1:2015 or *IEC* 60092-502:1999.	
2.4.3 Cylinder Lubrication	**2.4.5 Cylinder Lubrication**	
Cylinder lubricating systems for gas-fuelled engines are to be capable of maintaining adequate alkali values and cylinder oil feeding rates according to the mode of operation on oil fuel only and also the modes of operation specified in **2.3.2-3(1)** to **(3)** as standard.	Cylinder lubricating systems for low pressure gas-fuelled engines are to be capable of maintaining adequate alkali values and cylinder oil feeding rates according to the mode of operation on oil fuel only and also the modes of operation specified in **2.3.2-3(1)** to **(3)** as standard.	
2.5 Design Requirements for Each Kind of Engines	**2.5 Design Requirements for Each Kind of Engines**	
2.5.1 Dual Fuel Engine	**2.5.1 Dual Fuel Engine**	
1 General The maximum continuous power that a dual fuel 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 composition and its quality or the engine design. This maximum power available in gas mode and the corresponding conditions are to be stated by the engine manufacturer.	**1** General (1) The maximum continuous power that a dual fuel 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 are to be stated by the engine manufacturer and demonstrated during the type test.	UR M78(Rev.2) 3.1.1
(Deleted)	(2) Low pressure gas-fuelled dual fuel engines are to be capable of supplying oil fuel to each cylinder in amounts sufficient for maintaining stable combustion of gas fuel under any conditions.	Deleted due to duplication with 1.2.6
(Deleted)	(3) Only oil fuel is, in principle, to be used when	Relocated to 2.5.1-2(5)

Amended-Original Requirements Comparison Table (IACS Unified Requirement for Gas-fuelled Engines)

Amended	Original	Remarks
	operation of low pressure gas-fuelled dual fuel engines are unstable.	
2 Starting, changeover and stopping (1) Dual fuel engines are to be arranged to be started using either oil fuel or gas fuel 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. (2) 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. (3) Changeover from gas fuel operation mode to oil fuel operation mode is to be possible at all situations and power levels. (4) The changeover process itself from and to gas operation is to be automatic but manual interruption is to be possible in all cases. (5) If the power level or other conditions do not allow safe and reliable gas operation, changeover to oil fuel mode is to be automatically performed. (6) In case of shut-off of the gas supply, the engines are to be capable of continuous operation by oil fuel only.	**2** Starting, changeover and stopping (1) Dual fuel 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. (2) 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. (3) Changeover from gas fuel operation mode to oil fuel operation mode is to be possible at all situations and power levels. (4) The changeover process itself from and to gas operation is to be automatic but manual interruption is to be possible in all cases. (Newly added) (5) In case of shut-off of the gas supply, the engines are to be capable of continuous operation by oil fuel only.	UR M78(Rev.2) 3.1.2 UR M78(Rev.2) 3.1.2
3 (Omitted)	**3** (Omitted)	
2.5.2 Gas only engine	**2.5.2 Gas only engine**	UR M78(Rev.2) 3.2
(Omitted)	(Omitted)	

Amended-Original Requirements Comparison Table (IACS Unified Requirement for Gas-fuelled Engines)

Amended	Original	Remarks
2.5.3 Pre-mixed Engine	**2.5.3 Pre-mixed Engine**	UR M78(Rev.2) 3.3
Inlet manifolds, turbochargers, charge air coolers, etc. are to be regarded as parts of fuel gas supply systems.	Inlet manifolds, turbochargers, charge air coolers, etc. are to be regarded as parts of fuel gas supply systems, and failures of such components likely to result in gas leakages are to be considered in risk analysis by a method deemed appropriate by the Society.	Relocated to Guidance for the Approval and Type Approval of Materials and Equipment for Marine Use
Chapter 3 GAS FUEL SUPPLY SYSTEMS	**Chapter 3 GAS FUEL SUPPLY SYSTEMS**	
3.1 Gas Fuel make-up Plants	**3.1 Gas Fuel make-up Plants**	
3.1.1 General	**3.1.1 General**	
1 Gas fuel make-up plants and oil fuel supply systems for gas-fuelled engines are to be capable of sustaining main engine operation so that at least normal navigation can be maintained even if one of the fuel systems for gas fuel or oil fuel fails.	**1** Gas fuel make-up plants and oil fuel supply systems for low pressure gas-fuelled engines are to be capable of sustaining main engine operation so that at least normal navigation can be maintained even if one of the fuel systems for gas fuel or oil fuel fails.	
2 (Omitted)	**2** (Omitted)	
3 (Omitted)	**3** (Omitted)	
4 (Omitted)	**4** (Omitted)	
3.2 Gas Fuel Supply Piping Systems	**3.2 Gas Fuel Supply Piping Systems**	
3.2.1 General	**3.2.1 General**	
(Omitted)	(Omitted)	
3.2.2 Protection against Gas Fuel Leaks	**3.2.2 Protection against Gas Fuel Leaks**	
1 (Omitted)	**1** (Omitted)	
2 (Omitted)	**2** (Omitted)	

Amended-Original Requirements Comparison Table (IACS Unified Requirement for Gas-fuelled Engines)

Amended	Original	Remarks
Chapter 4 CONTROL, ALARM AND SAFETY SYSTEMS	**Chapter 4 CONTROL, ALARM AND SAFETY SYSTEMS**	
4.1 General	**4.1 General**	UR M78(Rev.2) 2.2.7
1 Control systems for operating gas-fuelled engines using gas fuel are to comply with the requirements in **18.1** to **18.3** and **18.7, Part D of the Rules**.	**1** Control systems for operating low pressure gas-fuelled engines using gas fuel are to comply with the requirements in **18.1** to **18.3** and **18.7, Part D of the Rules**.	
2 (Omitted)	**2** (Omitted)	
3 The exit temperature and pressure or flow rate of the gas fuel at the gas fuel make-up plant are to be automatically controlled.	**3** The exit temperature and pressure or flow rate of the gas fuel at the gas fuel make-up plant are to be automatically controlled. Visual and audible alarm device are also to be provided such as to be activated when the temperature and pressure exceed the preset ranges.	Merged into Table 3.1
4 (Omitted)	**4** (Omitted)	
5 The gas admission valves are to be controlled by the engine control system or by the engine gas demand.	**5** The gas supply valves are to be controlled by the engine control system or by the engine gas demand.	
6 (Omitted)	**6** (Omitted)	
7 (Omitted)	**7** (Omitted)	
8 (Omitted)	**8** (Omitted)	
9 Unless risk analysis by a method deemed appropriate by the Society proves that risk is within the acceptable range, alarm and safety system functions of dual fuel or gas only engines are to be provided in accordance with **Table 4.1**. (for dual fuel engines, **Table 4.1** applies only to gas mode) However, even if risk analysis proves that risk is within the acceptable range, the alarm and safety system functions specified in **Part N of the Rules** are still to be provided. Additional alarms and safety devices may be required if deemed necessary by the Society.	**9** Unless risk analysis by a method deemed appropriate by the Society proves that risk is within the acceptable range, alarm and safety system functions of dual fuel or gas only engines are to be provided in accordance with **Table 4.1**. (for dual fuel engines, **Table 4.1** applies only to gas mode) However, even if risk analysis proves that risk is within the acceptable range, the alarm and safety system functions specified in **Part N of the Rules** are still to be provided.	Relocated from 4.2(1)(c) and (2)(f)

Amended-Original Requirements Comparison Table (IACS Unified Requirement for Gas-fuelled Engines)

Amended	Original	Remarks

Table 4.1 Alarm and Safety System Functions for Dual Fuel Engines

Parameter	Alarm	Automatic activation of the double block and bleed valves	Automatic switching over to oil fuel mode 5)	Engine shutdown
1. Abnormal pressures in the gas fuel supply line	X	X	X	X 5)
2. Gas fuel supply systems - malfunction	X	X	X	X 5)
3. Pilot fuel injection or spark ignition systems - malfunction	X	X 2)	X	X 2)5)
4. Exhaust gas temperature after each cylinder - high	X	X 2)	X	X 2)5)
5. Exhaust gas temperature after each cylinder - low~~1)~~3)	X	X 2)	X	X 2)5)
6. Cylinder pressure or ignition - failure, including misfiring, knocking and unstable combustion	X	X 2)4)	X~~2~~4)	X 2)4)5)
7. Oil mist concentration in crankcase or bearing temperature~~2)~~6) - high	X	X	-	X 9)
8. Pressure in the crankcase - high~~3)~~8)	X	X	X	-
9 Engine stops - any cause	X	X	-	-
10. Failure of the control-actuating medium of the block and bleed valves	X	X	X	-
11. Failure of crankcase ventilation system,if applicable	X	X 7)	X 7)	-
12. Abnormal temperature in the gas fuel supply line	X	X 10)	X 10)	X 5)10)11)
13. Leak detection between gas piping and outer pipes or ducts as specified in **16.4.3, Part N of the Rules** 10)	X	X	X	X 5)
14. Low pressures of hydraulic and pneumatic sources, or loss of electric power supply for gas fuel combustion control 10)	X	X	X	X 5)11)

Notes:

UR M78(Rev.2) Table2

12: Relocated from 4.1-2 and 4.2(2)(a)

13: Relocated from 4.2(1)(b)

14: Relocated from 4.2(2)(e)

Amended	Original	Remarks
1) Dual fuel engine only, when running in gas mode 2) For gas fuel only 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. ~~1~~3) Required only if necessary for the detection of misfiring. In addition, deviation from average is to be used for the operation setting of each function. ~~2~~4) In ~~the~~ cases 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) Only for Gas fuel only engine ~~3~~6) Where required by **2.4.5, Part D of the Rules**. 7) Automatic safety actions to be activated as specified by the engine manufacturer (see **2.2.2-6, Part D of the Rules)** 8) Only for trunk piston engines. 9) Only for trunk piston engines. For crosshead engines slow down applies (see **2.4.5, Part D of the Rules)** 10) Only for gas-fuelled engines installed onboard ships subject to the application of **1.1.1, Rules for Automatic and Remote Control Systems** 11) Slowdown is acceptable instead of shutdown. In this case, "automatic activation of the double block and bleed valves" does not apply.		
4.2 Gas-fuelled engines of Ships to which the Rules for Automatic Remote Control Systems Apply	**4.2 Low Pressure Gas-fuelled engines of Ships to which the Rules for Automatic Remote Control Systems Apply**	
Gas-fuelled engines of ships to which the requirement **1.1.1, Rules for Automatic and Remote Control Systems** apply are also to comply with the requirements of **3.2** and **3.3** or **4.2 of Rules for Automatic and Remote Control Systems**. (Deleted)	Low pressure gas-fuelled engines of ships to which the requirement **1.1.1, of Rules for Automatic and Remote Control Systems** apply are to comply with the requirements of **3.2** and **3.3** or **4.2 of Rules for Automatic and Remote Control Systems**, in addition to the following requirements **(1)** and **(2)**. (1) Low pressure gas-fuelled engines are to be provided with safety systems which automatically cut off the gas fuel supply, and in addition, automatically transfer the mode of operation to oil fuel alone or stop the engines when abnormalities **(a)** to **(c)** given below occur. However, automatic cut off of the gas fuel	Merged into Table 4.1

Amended	Original	Remarks
(Deleted)	supply with the automatic double block and bleed valves specified in **16.4.5, Part N of the Rules** may be accepted. (a) When operating on gas fuel, abnormalities are detected in the following: i) gas fuel valve function ii) pilot oil fuel injection valve function iii) suction valve and exhaust valve function iv) exhaust gas temperatures at cylinder outlets v) pressure in cylinder vi) blow-by through suction valves or exhaust valves (b) When gas leaks to double wall pipes or void spaces of ducts specified in **3.2.2-2** are detected. (c) Others as deemed necessary by the Society. (2) Low pressure gas-fuelled engines are to be provided with a system which automatically reduces speed or transfers the mode of operation to oil fuel alone and issues an alarm in the event of the following **(a)** through **(f)**: (a) Abnormal gas fuel temperature. (b) Abnormal gas fuel supply pressure. (c) Activation of an alarm issued before the pressure of the space between concentric pipes specified in **3.2.2-2** drops to below the atmospheric pressure. (d) Low inert gas supply pressure for purging gas fuel pipe lines. (e) Low pressures of hydraulic and pneumatic sources or loss of electric power supply for gas fuel combustion control. (f) Others as deemed necessary by the Society.	

Amended-Original Requirements Comparison Table (IACS Unified Requirement for Gas-fuelled Engines)

Amended	Original	Remarks
4.3 Gas Fuel Supply Compressors for Ships to which the Rules for Automatic and Remote Control Systems Apply	**4.3 Gas Fuel Supply Compressors for Ships to which the Rules for Automatic and Remote Control Systems Apply**	
(Omitted)	(Omitted)	
Chapter 5 TESTS	**Chapter 5 TESTS**	
5.1 Approval of Use	**5.1 Approval of Use**	
For each type of gas-fuelled engine, approval of use is to be obtained by the engine designer (licensor) in accordance with requirements specified in **Chapter 8, Part 6 of the Guidance for the Approval and Type Approval of Materials and Equipment for Marine Use**.	For each type of low pressure gas-fuelled engine, approval of use is to be obtained by the engine designer (licensor) in accordance with requirements specified separately by the Society.	
5.2 Shop Test	**5.2 Shop Test**	
5.2.1 Hydrostatic Tests	**5.2.1 Hydrostatic Tests**	
The parts and accessory equipment of gas-fuelled engines, which are exposed to pressures, are to be subjected to hydrostatic tests in accordance with **2.6.1-1, Part D of the Rules** and **16.7.3, Part GF of the Rules**: relevant requirements are to be applied mutatis mutandis.	The parts and accessory equipments of low pressure gas-fuelled engines, which are exposed to pressures, are to be subjected to hydrostatic tests in accordance with the requirements of **2.6.1-1, Part D of the Rules**.	
5.2.2 Shop Trials	**5.2.2 Shop Trials**	
Gas-fuelled engines are to be tested as specified in **2.6.1-3, Part D of the Rules**. To implement surveys of tests, in lieu of traditional ordinary surveys where the Surveyor is in attendance, the Society may approve survey methods which it considers to be able to obtain information equivalent to that obtained through traditional ordinary surveys.	Low pressure gas-fuelled engines are to be tested as specified in **2.6.1-3, Part D of the Rules**. To implement surveys of tests, in lieu of traditional ordinary surveys where the Surveyor is in attendance, the Society may approve survey methods which it considers to be able to obtain information equivalent to that obtained through traditional ordinary surveys.	

Amended-Original Requirements Comparison Table (IACS Unified Requirement for Gas-fuelled Engines)

Amended	Original	Remarks
5.3 Tests after Installation On Board	**5.3 Tests after Installation On Board**	
1 The control systems of gas-fuelled engines and related equipment are to be subjected to tests in accordance with **18.7.3, Part D of the Rules** or **2.2.4, Rules for Automatic and Remote Control Systems** according to the kind of Installations Character.	The control systems of low pressure gas-fuelled engines and related equipment are to be subjected to tests in accordance with the requirements of **18.7.3, Part D of the Rules** or the requirements of **2.2.4 of the Rules for Automatic and Remote Control Systems** according to the kind of Installations Character.	
2 A leak test is to be carried out for the gas piping system after assembly on board in accordance with **16.7.3-3, Part GF of the Rules**.	(Newly added)	UR M78(Rev.2) 4.3
3 The efficiency of the ventilation arrangement, or other approved principle, of the double walled gas piping system is to be verified.	(Newly added)	UR M78(Rev.2) 4.3
5.4 Sea Trials	**5.4 Sea Trials**	
1 Performance of control systems of gas-fuelled engines and related equipment is to be verified during operations using gas fuel depending upon their installation characters in accordance with the requirements of **2.2.5, Rules for Automatic and Remote Control Systems**: relevant requirements are to be applied mutatis mutandis.	**1** Performance of control systems of high pressure gas-fuelled engines and related equipment is to be verified during operations using gas fuel depending upon their installation characters in accordance with the requirements of **2.2.5 of the Rules for Automatic and Remote Control Systems**: relevant requirements are to be applied mutatis mutandis.	
2 (Omitted)	**2** (Omitted)	

Amended-Original Requirements Comparison Table (IACS Unified Requirement for Gas-fuelled Engines)

Amended	Original	Remarks
RULES FOR THE SURVEY AND CONSTRUCTION OF INLAND WATERWAY SHIPS **Part 7 MACHINERY INSTALLATIONS**	**RULES FOR THE SURVEY AND CONSTRUCTION OF INLAND WATERWAY SHIPS** **Part 7 MACHINERY INSTALLATIONS**	
Chapter 2 RECIPROCATING INTERNAL COMBUSTION ENGINES	**Chapter 2 RECIPROCATING INTERNAL COMBUSTION ENGINES**	
2.2 Materials, Construction and Strength	**2.2 Materials, Construction and Strength**	
2.2.2 Construction, Installation and General*	**2.2.2 Construction, Installation and General***	
6 Ventilation of crankcase, and any arrangement which could produce a flow of external air into the crankcase, is not permitted except in cases **(1)** to **(3)** below. (1) Ventilation pipes, where provided, are to be as small as practicable to minimise the inrush of air after a crankcase explosion. In addition, ventilation pipes for each engine are to be independent of any other engine. Ventilation pipes from the crankcase of main propulsion engine are to lead to a safe position on deck or to some other approved position. (2) If provision is made for the extraction of gases from the crankcase (e.g. for oil mist detection purposes), the vacuum in the crankcase is not to exceed 2.5×10^{-4} *MPa* (3) In cases where dual fuel engines are provided with crankcase ventilation for preventing the accumulation of leaked gas.	**6** Ventilation of crankcase, and any arrangement which could produce a flow of external air into the crankcase, is not permitted except in cases **(1)** to **(3)** below. (1) Ventilation pipes, where provided, are to be as small as practicable to minimize the inrush of air after a crankcase explosion. In addition, ventilation pipes for each engine are to be independent of any other engine. Ventilation pipes from the crankcase of main propulsion engine are to lead to a safe position on deck or to some other approved position. (2) If provision is made for the extraction of gases from the crankcase (*e.g.* for oil mist detection purposes), the vacuum in the crankcase is not to exceed 2.5×10^{-4} *MPa* (3) In cases where <u>trunk piston type</u> dual fuel <u>reciprocating internal combustion</u> engines are provided with crankcase ventilation for preventing the accumulation of leaked gas.	Same as Part D of the Rules

Amended-Original Requirements Comparison Table (IACS Unified Requirement for Gas-fuelled Engines)

Amended	Original	Remarks
GUIDANCE FOR THE SURVEY AND CONSTRUCTION OF STEEL SHIPS **Part GF SHIPS USING LOW-FLASHPOINT FUELS**	**GUIDANCE FOR THE SURVEY AND CONSTRUCTION OF STEEL SHIPS** **Part GF SHIPS USING LOW-FLASHPOINT FUELS**	
GF1 GENERAL	**GF1 GENERAL**	
GF1.1 General	**GF1.1 General**	
GF1.1.3 Approval of Systems and Equipment, etc.	**GF1.1.3 Approval of Systems and Equipment, etc.**	
1 The wording "to be approved as specified separately by the Society" specified in **1.1.3-1, Part GF of the Rules** means that an approval is to be obtained in accordance with **Annex 1.1.3-3, Part GF of the Rules**, and Annexes **1** to **2A**.	**1** The wording "to be approved as specified separately by the Society" specified in **1.1.3-1, Part GF of the Rules** means that an approval is to be obtained in accordance with Annexes **1.1.3-2** and **1.1.3-3, Part GF of the Rules**, and Annexes **1** to **2A**.	Amended following the integration of the annexes.
(Deleted)	**2** In applying **1.1.3, Part GF of the Rules, Annex 1.1.3-2, Part GF of the Rules** is to be dealt with as follows: (1) The wording "specified separately by the Society" specified in **2.4.3-5, Annex 1.1.3-2, Part GF of the Rules** refers to **Annex 1.** (2) The wording "specified separately by the Society" specified in **4.1, Annex 1.1.3-2, Part GF of the Rules** refers to **Chapter 8, Part 6 of the Guidance for the Approval and Type Approval of Materials and Equipment for Marine Use.**	Deleted following the integration of the annexes.
2 In applying **1.1.3, Part GF of the Rules**, **Annex 1.1.3-3, Part GF of the Rules** is to be dealt with as follows: (1) The wording "specified separately by the Society"	**3** In applying **1.1.3, Part GF of the Rules**, **Annex 1.1.3-3, Part GF of the Rules** is to be dealt with as follows: (1) The wording "specified separately by the Society"	

Amended	Original	Remarks
specified in **1.1-5, Annex 1.1.3-3, Part GF of the Rules** refers to **8.3(4)(i), Chapter 8, Part 6 of the Guidance for the Approval and Type Approval of Materials and Equipment for Marine Use**. (2) The wording "specified separately by the Society" specified in **2.4.2-4, Annex 1.1.3-3, Part GF of the Rules** refers to **Annex 1**. (3) The wording "specified separately by the Society" specified in **2.4.2-5(7)(a)ii), Annex 1.1.3-3, Part GF of the Rules** refers to **GF9.6.2**. (4) The wording "deemed appropriate by the Society" specified in **3.1-8, Annex 1.1.3-3, Part GF of the Rules** refers to **8.3, Chapter 8, Part 6 of the Guidance for the Approval and Type Approval of Materials and Equipment for Marine Use**.	specified in **1.1-3, Annex 1.1.3-3, Part GF of the Rules** refers to **8.3(4)(i), Chapter 8, Part 6 of the Guidance for the Approval and Type Approval of Materials and Equipment for Marine Use**. (2) The wording "specified separately by the Society" specified in **2.4.4-4, Annex 1.1.3-3, Part GF of the Rules** refers to **Annex 1**. (3) The wording "specified separately by the Society" specified in **2.4.4-5(4)(a)ii), Annex 1.1.3-3, Part GF of the Rules** refers to **GF9.6.2**. (4) The wording "deemed appropriate by the Society" specified in **2.5.3 and 3.1-8, Annex 1.1.3-3, Part GF of the Rules** refers to **8.3, Chapter 8, Part 6 of the Guidance for the Approval and Type Approval of Materials and Equipment for Marine Use**. (5) The wording "specified separately by the Society" specified in **4.1, Annex 1.1.3-3, Part GF of the Rules** refers to **Chapter 8, Part 6 of the Guidance for the Approval and Type Approval of Materials and Equipment for Marine Use**.	
(Deleted)		
GF10 POWER GENERATION INCLUDING PROPULSION AND OTHER GAS CONSUMERS	**GF10 POWER GENERATION INCLUDING PROPULSION AND OTHER GAS CONSUMERS**	
GF10.2 Functional Requirements	**GF10.2 Functional Requirements**	
GF10.2.2 Additional Requirements	**GF10.2.2 Additional Requirements**	
(Deleted)	**1** In applying **10.2.2-2, Part GF of the Rules**, air inlet manifolds and scavenge spaces which are not capable of withstanding a pressure 7 times the design pressure are to be provided with pressure relief systems approved by the Society in accordance with **Chapter 6, Part 13 of the Guidance for**	Deleted due to duplication with 2.4.1-5, Annex 1.1.3-3

Amended-Original Requirements Comparison Table (IACS Unified Requirement for Gas-fuelled Engines)

Amended	Original	Remarks
	the Approval and Type Approval of Materials and Equipment for Marine Use.	
In applying **10.2.2-2, Part GF of the Rules**, pressure relief systems are not to continuously discharge exhaust gas into enclosed spaces.	**2** In applying **10.2.2-2, Part GF of the Rules**, pressure relief systems are not to continuously discharge exhaust gas into enclosed spaces.	

Amended-Original Requirements Comparison Table (IACS Unified Requirement for Gas-fuelled Engines)

Amended	Original	Remarks
GUIDANCE FOR THE SURVEY AND CONSTRUCTION OF STEEL SHIPS **Part N SHIPS CARRYING LIQUEFIED GASES IN BULK**	**GUIDANCE FOR THE SURVEY AND CONSTRUCTION OF STEEL SHIPS** **Part N SHIPS CARRYING LIQUEFIED GASES IN BULK**	
N16 USE OF CARGO AS FUEL	**N16 USE OF CARGO AS FUEL**	
N16.1 General	**N16.1 General**	
N16.1.1 General	**N16.1.1 General**	
1 The requirements for gas fuel engines, gas fuel boilers and gas combustion units are to be in accordance with **Annex 16.1.1-3, Part N of the Rules**, **Annex 2** "**Guidance for Dual Fuel Boilers**" and **Annex 2A** "**Guidance for Gas Combustion Units**" respectively. In addition, gas fuel turbines are to be as deemed appropriate by the Society.	**1** The requirements for gas fuel engines, gas fuel boilers and gas combustion units are to be in accordance with **Annex 16.1.1-2, Part N of the Rules** or **Annex 16.1.1-3, Part N of the Rules**, **Annex 2** "**Guidance for Dual Fuel Boilers**" and **Annex 2A** "**Guidance for Gas Combustion Units**" respectively. In addition, gas fuel turbines are to be as deemed appropriate by the Society.	Amended following the integration of the annexes.
2 (Omitted)	**2** (Omitted)	
(Deleted)	**3** In applying **16.1.1, Part N of the Rules, Annex 16.1.1-2, Part N of the Rules** is to be dealt with as follows: (1) The wording "specified separately by the Society" specified in **3.1.1-2, Annex 16.1.1-2, Part N of the Rules** refers to **Chapter 2** to **Chapter 4 of Annex 1**. (2) The wording "requirements specified separately by the Society" and "tests specified separately by the Society" specified in **3.2.2-3, Annex 16.1.1-2, Part N of the Rules** mean to be in accordance with the following **(a)** and **(b)** respectively:	Deleted following the integration of the annexes.

Amended	Original	Remarks
	(a) The wording "requirements specified separately by the Society" refers to **Guidance for the Approval and Type Approval of Materials and Equipment for Marine Use**. (b) The wording "tests specified separately by the Society" refers to **Chapter 5** and **Chapter 7 of Annex 1**. (3) The wording "specified separately by the Society" specified in **4.3(1)(a), Annex 16.1.1-2, Part N of the Rules** refers to **2.4.3 of Annex 1**. (4) The wording "specified separately by the Society" specified in **4.3(2), Annex 16.1.1-2, Part N of the Rules** refers to **2.4.2-1 of Annex 1**. (5) The wording "specified separately by the Society" specified in **5.1, Annex 16.1.1-2, Part N of the Rules** refers to **Chapter 8, Part 6 of the Guidance for the Approval and Type Approval of Materials and Equipment for Marine Use**.	
3 In applying **16.1.1, Part N of the Rules**, **Annex 16.1.1-3, Part N of the Rules** is to be dealt with as follows: (1) The wording "specified separately by the Society" specified in **1.1-5, Annex 16.1.1-3, Part N of the Rules** refers to **8.3(4)(i), Chapter 8, Part 6 of the Guidance for the Approval and Type Approval of Materials and Equipment for Marine Use**. (Deleted) (2) The wording "specified separately by the Society" specified in **3.1.1-2, Annex 16.1.1-3, Part N of the Rules** refers to **Chapter 2** to **Chapter 4 of Annex 1**.	**4** In applying **16.1.1, Part N of the Rules**, **Annex 16.1.1-3, Part N of the Rules** is to be dealt with as follows: (1) The wording "specified separately by the Society" specified in **1.1-3, Annex 16.1.1-3, Part N of the Rules** refers to **8.3(4)(i), Chapter 8, Part 6 of the Guidance for the Approval and Type Approval of Materials and Equipment for Marine Use**. (2) The wording "deemed appropriate by the Society" specified in **2.5.3, Annex 16.1.1-3, Part N of the Rules** refers to **8.3, Chapter 8, Part 6 of the Guidance for the Approval and Type Approval of Materials and Equipment for Marine Use**. (3) The wording "specified separately by the Society" specified in **3.1.1-2, Annex 16.1.1-3, Part N of the Rules** refers to **Chapter 2** to **Chapter 4 of Annex 1**.	

Amended-Original Requirements Comparison Table (IACS Unified Requirement for Gas-fuelled Engines)

Amended	Original	Remarks
(3) The wording “deemed appropriate by the Society” specified in **4.1-9, Annex 16.1.1-3, Part N of the Rules** refers to **8.3, Chapter 8, Part 6 of the Guidance for the Approval and Type Approval of Materials and Equipment for Marine Use**.	(4) The wording “deemed appropriate by the Society” specified in **4.1-9, Annex 16.1.1-3, Part N of the Rules** refers to **8.3, Chapter 8, Part 6 of the Guidance for the Approval and Type Approval of Materials and Equipment for Marine Use**.	
(4) The wording “specified separately by the Society” specified in **4.3(1), Annex 16.1.1-3, Part N of the Rules** refers to **2.4.2 of Annex 1**.	(5) The wording “specified separately by the Society” specified in **4.3(1), Annex 16.1.1-3, Part N of the Rules** refers to **2.4.2 of Annex 1**.	
(5) The wording “specified separately by the Society” specified in **4.3(2), Annex 16.1.1-3, Part N of the Rules** refers to **2.4.3 of Annex 1**.	(6) The wording “specified separately by the Society” specified in **4.3(2), Annex 16.1.1-3, Part N of the Rules** refers to **2.4.3 of Annex 1**.	

Amended-Original Requirements Comparison Table (IACS Unified Requirement for Gas-fuelled Engines)

Amended	Original	Remarks
GUIDANCE FOR AUTOMATIC AND REMOTE CONTROL SYSTEMS	**GUIDANCE FOR AUTOMATIC AND REMOTE CONTROL SYSTEMS**	
Chapter 2 SURVEYS OF AUTOMATIC AND REMOTE CONTROL SYSTEMS	**Chapter 2 SURVEYS OF AUTOMATIC AND REMOTE CONTROL SYSTEMS**	
2.2 Registration Surveys	**2.2 Registration Surveys**	
2.2.5 Sea Trials	**2.2.5 Sea Trials**	
2 Monitoring and control systems for periodically unattended machinery spaces (1) The tests specified in **2.2.5-2(1) of the Rules** are to be carried out under the condition of unattended machinery operation for more than 4 *hours*. In addition, according to circumstances, the surveyor may allow persons for safety purposes and persons in charge of measurements to enter machinery spaces. (2) For dual fuel engines, the duration required by **(1)** may be considered as the total duration demonstrated in all fuel modes (gas mode, diesel mode, etc.) However, demonstration at each mode is not to be less than 1 *hour*. (3) (Omitted) (4) (Omitted) (5) Regarding those tests for controllable pitch propellers specified in **2.2.5-2(2) of the Rules**, those test procedures given in **(3)** above are to be applied.	**2** Monitoring and control systems for periodically unattended machinery spaces (1) The tests specified in **2.2.5-2(1) of the Rules** are to be carried out under the condition of unattended machinery operation for more than 4 *hours*. In addition, according to circumstances, the Surveyor may allow persons for safety purposes and persons in charge of measurements to enter machinery spaces. (Newly added) (2) (Omitted) (3) (Omitted) (4) Regarding those tests for controllable pitch propellers specified in **2.2.5-2(2) of the Rules**, those test procedures given in **(2)** above are to be applied.	Clarifies the M0 test requirements for dual fuel engines.

Amended-Original Requirements Comparison Table (IACS Unified Requirement for Gas-fuelled Engines)

Amended	Original	Remarks
GUIDANCE FOR HIGH SPEED CRAFT **Part 2 CLASS SURVEYS**	**GUIDANCE FOR HIGH SPEED CRAFT** **Part 2 CLASS SURVEYS**	
Chapter 2 CLASSIFICATION SURVEYS	**Chapter 2 CLASSIFICATION SURVEYS**	
2.3 Sea Trials and Stability Experiments	**2.3 Sea Trials and Stability Experiments**	
2.3.1 Sea Trials	**2.3.1 Sea Trials**	
Details of each test to be carried out during sea trials are to be in accordance with the following requirements. (1) Speed test (Omitted) (2) Astern test The astern test is to be carried out in accordance with the following **(a)** to **(d)**: (a) (Omitted) (b) (Omitted) (c) For gas-fuelled dual fuel engines, the confirmation specified in **(b)** is to be carried out for all operating modes (gas mode, diesel mode, etc.). (Deleted) (3) Steering test and change-over test from the main to auxiliary steering gears (Omitted)	Details of each test to be carried out during sea trials are to be in accordance with the following requirements. (1) Speed test (Omitted) (2) Astern test The astern test is to be carried out in accordance with the following **(a)** to **(d)**: (a) (Omitted) (b) (Omitted) (c) For <u>low pressure</u> gas-fuelled dual fuel engines, the confirmation specified in **(b)** is to be carried out for all operating modes (gas mode, diesel mode, etc.). <u>This test is to be carried out at the maximum power available in gas mode.</u> (d) To high pressure gas-fuelled dual fuel engines, the requirements for low pressure gas-fuelled dual fuel engines specified in **(c)** apply mutatis mutandis. (3) Steering test and change-over test from the main to auxiliary steering gears (Omitted)	Same as Part B of the Rules Deleted following the integration of the annexes.

Amended-Original Requirements Comparison Table (IACS Unified Requirement for Gas-fuelled Engines)

Amended	Original	Remarks
(4) Turning test (Omitted)	(4) Turning test (Omitted)	
(5) Operating test of machinery installations (Omitted)	(5) Operating test of machinery installations (Omitted)	
(6) Performance test of windlass (Omitted)	(6) Performance test of windlass (Omitted)	
(7) Performance test of automatic and remote control systems for main propulsion machinery or the controllable pitch propellers, boilers and electric generating sets (Omitted)	(7) Performance test of automatic and remote control systems for main propulsion machinery or the controllable pitch propellers, boilers and electric generating sets (Omitted)	
(8) The accumulation test of a boiler (Omitted)	(8) The accumulation test of a boiler (Omitted)	
(9) Measurement of the torsional vibration for the shafting systems Measurement of the torsional vibration for the shafting systems are to be carried out in accordance with the following **(a)** and **(b)**: (a) Measurement is to be in accordance with the requirement specified in **5.4, Part 9 of the Rules**. (b) Measurements in either diesel mode or in the gas mode (but not both modes) may be omitted where considered appropriate by the Society based upon relevant torsional vibration calculation sheets of diesel and gas mode.	(9) Measurement of the torsional vibration for the shafting systems Measurement of the torsional vibration for the shafting systems are to be carried out in accordance with the following **(a)** to **(c)**: (a) Measurement is to be in accordance with the requirement specified in **5.4, Part 9 of the Rules**. (b) For low pressure (i.e. pressure less than 1 *MPa*) gas-fuelled dual fuel engines, the measurements specified in **(a)** are to be carried out for both the diesel and gas mode. However, measurements in either diesel mode or in the gas mode (but not both modes) may be omitted where considered appropriate by the Society based upon relevant torsional vibration calculation sheets of diesel and gas mode.	Requirements (b) and (c) were rearranged following the integration of the annexes.
(Deleted)	(c) For high pressure gas-fuelled dual fuel engines, the requirements for low pressure gas-fuelled dual fuel engines specified in **(b)** apply mutatis mutandis.	

Amended-Original Requirements Comparison Table (IACS Unified Requirement for Gas-fuelled Engines)

Amended	Original	Remarks
(10) (Omitted) (11) Other tests where deemed necessary by the Society (Omitted)	(10) (Omitted) (11) Other tests where deemed necessary by the Society (Omitted)	
Part 9 MACHINERY INSTALLATIONS	**Part 9 MACHINERY INSTALLATIONS**	
Chapter 2 RECIPROCATING INTERNAL COMBUSTION ENGINES	**Chapter 2 RECIPROCATING INTERNAL COMBUSTION ENGINES**	
2.1 General	**2.1 General**	
2.1.1 General	**2.1.1 General**	
1 (Omitted)	**1** (Omitted)	
2 The wording "the requirements specified otherwise by the Society" in **2.1.1-5, Part 9 of the Rules** means **Annex 1.1.3-3, Part GF of the Rules for the Survey and Construction of Steel Ships**.	**2** The wording "the requirements specified otherwise by the Society" in **2.1.1-5, Part 9 of the Rules** means **Annex 1.1.3-2** or **Annex 1.1.3-3, Part GF of the Rules for the Survey and Construction of Steel Ships**.	Deleted following the integration of the annexes.

Amended-Original Requirements Comparison Table (IACS Unified Requirement for Gas-fuelled Engines)

Amended	Original	Remarks
GUIDANCE FOR THE SURVEY AND CONSTRUCTION OF INLAND WATERWAY SHIPS **Part 2 CLASS SURVEYS**	**GUIDANCE FOR THE SURVEY AND CONSTRUCTION OF INLAND WATERWAY SHIPS** **Part 2 CLASS SURVEYS**	
Chapter 2 CLASSIFICATION SURVEYS	**Chapter 2 CLASSIFICATION SURVEYS**	
2.3 River Trials and Stability Experiments	**2.3 River Trials and Stability Experiments**	
2.3.1 River Trials	**2.3.1 River Trials**	
1 The Astern test required by **2.3.1-1(1), Part 2 of the Rules** is to be carried out in accordance with the following **(1)** to **(3)**. (1) (Omitted) (2) (Omitted) (3) For gas-fuelled dual fuel engines, the confirmation specified in **(2)** is to be carried out for all operating modes (gas mode, diesel mode, etc.). (Deleted)	**1** The Astern test required by **2.3.1-1(1), Part 2 of the Rules** is to be carried out in accordance with the following **(1)** to **(4)** below. (1) (Omitted) (2) (Omitted) (3) For low pressure gas-fuelled dual fuel engines, the confirmation specified in **(2)** is to be carried out for all operating modes (gas mode, diesel mode, etc.). This test is to be carried out at the maximum power available in gas mode (*See* **2.5.1-1(1) in Annex 1.1.3-3, Part GF** or **2.5.1-1(1) in Annex 16.1.1-3, Part N of the Rules for the Survey and Construction of Steel Ships**). (4) To high pressure gas-fuelled dual fuel engines, the requirements for low pressure gas-fuelled dual fuel engines specified in **(3)** apply mutatis mutandis.	Same as Part B of the Guidance
3 The performance tests of machinery installations required by **2.3.1-1(3), Part 2 of the Rules** are to include the	**3** The performance tests of machinery installations required by **2.3.1-1(3), Part 2 of the Rules** are to include the	Same as Part B of the Rules

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following **(1)** to **(9)** in order to verify that the machinery installations have sufficient normal functions and reliability and are free from detrimental vibration within the numbers of revolutions used. However, these tests may be dispensed with where such tests have been conducted while the ship was anchored or at dockside. The details of these tests may be found in *JIS F* 0801 "Test Code of Propelling Machinery at Sea Trials" or other documents considered equivalent thereto. The preparations specified in **1.4.2-8** are to be made before tests are carried out. ((1) to (7) are omitted.) (8) Gas-fuelled engines are to comply with the requirements specified in **(1)**, **(5)** and for gas-fuelled dual fuel engines, the following **(a)** to **(c)** apply. (a) The output tests and governor tests are to be carried out for all operating modes (i.e. the applicable gas mode, diesel mode, etc.). The 110 % load test is not required for the gas mode provided that changeover to oil fuel mode is automatically performed in case of overload. (b) During the output tests specified in **(b)**, if a test load is performed in all applicable operation modes without interruption (direct changeover at same power and speed), the duration of 100 % power run required by **Table 2.2.3.1-5.** may be considered as the total duration demonstrated in all fuel modes. However, demonstration at each mode is not to be less than 1 *hour*. (c) Automatic switching over to oil fuel mode is to be tested. Further, manual changeover from	following **(1)** to **(9)** in order to verify that the machinery installations have sufficient normal functions and reliability and are free from detrimental vibration within the numbers of revolutions used. However, these tests may be dispensed with where such tests have been conducted while the ship was anchored or at dockside. The details of these tests may be found in *JIS F* 0801 "Test Code of Propelling Machinery at Sea Trials" or other documents considered equivalent thereto. The preparations specified in **1.4.2-8** are to be made before tests are carried out. ((1) to (7) are omitted.) (8) Low pressure (i.e. pressure less than 1 *MPa*) gas-fuelled engines are to comply with the requirements specified in **(1)** and **(5)**. For low pressure gas-fuelled dual-fuel engines, the output tests and governor tests are to be carried out for all operating modes (i.e. the gas mode, diesel mode, etc.). This test is to be carried out at the maximum power available in gas mode (*See* **2.5.1-1(1) in Annex 1.1.3-3, Part GF** or **2.5.1-1(1) in Annex 16.1.1-3, Part N of the Rules for the Survey and Construction of the Steel Ships).** The 110% load test is not required for the gas mode. (Newly added) (Newly added)	

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Amended	Original	Remarks
diesel to gas mode and vice versa is to be tested. (Deleted)	(9) For high pressure gas-fuelled dual fuel engines, the requirements for low pressure gas-fuelled dual fuel engines specified in **(8)** apply mutatis mutandis.	
7 The measurements of the torsional vibration for shafting systems required by **2.3.1-1(7), Part 2 of the Rules** are to be carried out in accordance with the following requirements. (1) Measurement is to be in accordance with the requirement specified in **6.1.3, Part 7 of the Rules**. In cases where the confirmation of engine running conditions specified in **6.1.3-2, Part 7 of the Rules** is performed at the estimated upper and lower borders by calculation, it is recommended that the fuel index around estimated borders also be confirmed with consideration given to possible differences between estimated borders and actual borders confirmed through measurements. (2) For gas-fuelled dual fuel engines, the measurements specified in **(1)** are to be carried out for both the diesel and gas mode. However, measurements in either diesel mode or in the gas mode (but not both modes) may be omitted where considered appropriate by the Society based upon relevant torsional vibration calculation sheets of diesel and gas mode. (Deleted)	**7** The measurements of the torsional vibration for shafting systems required by **2.3.1-1(7), Part 2 of the Rules** are to be carried out in accordance with the following requirements (1) Measurement is to be in accordance with the requirement specified in **6.1.3, Part 7 of the Rules**. In cases where the confirmation of engine running conditions specified in **6.1.3-2, Part 7 of the Rules** is performed at the estimated upper and lower borders by calculation, it is recommended that the fuel index around estimated borders also be confirmed with consideration given to possible differences between estimated borders and actual borders confirmed through measurements. (2) For low pressure (i.e. pressure less than 1 *MPa*) gas-fuelled dual fuel engines, the measurements specified in **(1)** are to be carried out for both the diesel and gas mode. However, measurements in either diesel mode or in the gas mode (but not both modes) may be omitted where considered appropriate by the Society based upon relevant torsional vibration calculation sheets of diesel and gas mode. (3) For high pressure gas-fuelled dual fuel engines, the requirements for low pressure gas-fuelled dual fuel engines specified in **(2)** apply mutatis mutandis.	Same as Part B of the Rules

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Amended	Original	Remarks
Part 7 MACHINERY INSTALLATIONS	**Part 7 MACHINERY INSTALLATIONS**	
Chapter 2 RECIPROCATING INTERNAL COMBUSTION ENGINES	**Chapter 2 RECIPROCATING INTERNAL COMBUSTION ENGINES**	
2.1 General	**2.1 General**	
2.1.1 General	**2.1.1 General**	
2 The wording "the requirements specified otherwise by the Society" in **2.1.1-5, Part 7 of the Rules** means or **Annex 16.1.1-3, Part N of the Rules for the Survey and Construction of Steel Ships** for gas-fuelled engines to which **Chapter 16, Part N of the Rules** apply, and **Annex 1.1.3-3, Part GF of the Rules for the Survey and Construction of Steel Ships** for gas-fuelled engines to which **Chapter 16, Part N of the Rules** does not apply (**Part GF of the Rules** applies instead).	**2** The wording "the requirements specified otherwise by the Society" in **2.1.1-5, Part 7 of the Rules** means **Annex 16.1.1-2** or **Annex 16.1.1-3** of **Part N of the Rules for the Survey and Construction of Steel Ships** for gas-fuelled engines to which **Chapter 16, Part N of the Rules** apply, and **Annex 1.1.3-2** or **Annex 1.1.3-3** of **Part GF of the Rules for the Survey and Construction of Steel Ships** for gas-fuelled engines to which **Chapter 16, Part N of the Rules** does not apply (**Part GF of the Rules** apply instead).	Same as Part D of the Rules

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Amended	Original	Remarks
GUIDANCE FOR THE APPROVAL AND TYPE APPROVAL OF MATERIALS AND EQUIPMENT FOR MARINE USE **Part 6 MACHINERY**	**GUIDANCE FOR THE APPROVAL AND TYPE APPROVAL OF MATERIALS AND EQUIPMENT FOR MARINE USE** **Part 6 MACHINERY**	
Chapter 8 APPROVAL OF USE OF RECIPROCATING INTERNAL COMBUSTION ENGINES	**Chapter 8 APPROVAL OF USE OF RECIPROCATING INTERNAL COMBUSTION ENGINES**	
8.1 General	**8.1 General**	
8.1.1 General	**8.1.1 General**	
1 The requirements in this chapter apply to the approval of use for the following **(1)** and **(2)**.	**1** The requirements in this chapter apply to the approval of use for the following **(1)** and **(2)**. In addition, requirements for low pressure gas-fuelled engines in this Chapter apply mutatis mutandis to the approval of use of high pressure gas fuelled engines (as required by **3.1 of Annex 1.1.3-2, Part GF** or **4.1 of Annex 16.1.1-2, Part N of the Rules for the Survey and Construction of Steel Ships**).	Deleted following the integration of the annexes.
(1) Approval of use of reciprocating internal combustion engines required by **2.1.1-3** and **2.6.1-3, Part D of the Rules for the Survey and Construction of Steel Ships**, **2.1.1-2, Part 9 of the Rules for High Speed Craft** as well as **2.1.1-2** and **2.6.1-3, Part 7 of the Rules for the Survey and Construction of Inland Waterway Ships**; and	(1) Approval of use of reciprocating internal combustion engines as required by **2.1.1-3** and **2.6.1-3, Part D of the Rules for the Survey and Construction of Steel Ships**, **2.1.1-2, Part 9 of the Rules for High Speed Craft** as well as **2.1.1-2** and **2.6.1-3, Part 7 of the Rules for the Survey and Construction of Inland Waterway Ships**; and	
(2) Approval of use of gas-fuelled engines required by **4.1, Annex 1.1.3-3, Part GF** or **5.1, Annex 16.1.1-3,**	(2) Approval of use of low pressure gas-fuelled engines as required by **4.1 of Annex 1.1.3-3, Part GF** or **5.1**	

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Amended	Original	Remarks
Part N of the Rules for the Survey and Construction of Steel Ships.	**of Annex 16.1.1-3, Part N of the Rules for the Survey and Construction of Steel Ships**.	
4 The requirements in this chapter apply, in general, to each engine type of which either of the following is different to that of an approved engine type. ((1) to (10) are omitted.) (11) For gas-fuelled engines, the following **(a)** to **(d)** are to be considered in addition to **(1)** to **(10)** above. (a) Gas admission method (cylinder injection after compression stroke, cylinder-individual injection before compression stroke or pre-mixed) (b) Gas admission 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) (Note) Cylinder-individual injection before compression stroke specified in **(a)** may be port injection into the air inlet channel before the cylinder inlet valve, injection into the cylinder before or during compression stroke, or similar arrangements.	**4** The requirements in this chapter apply, in general, to each engine type of which either of the following is different to that of an approved engine type. ((1) to (10) are omitted.) (11) For low pressure gas-fuelled engines, the following **(a)** to **(d)** are to be considered in addition to **(1)** to **(10)** above. (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) (Newly added)	UR M78(Rev.2) 4.1.2
8.1.2 Terminology	**8.1.2 Terminology**	
5 For gas-fuelled engines, the terminology is as specified in the **1.4, Annex 1.1.3-3, Part GF** or **1.4, Annex 16.1.1-3, Part N of the Rules for the Survey and Construction of Steel Ships**.	**5** For low pressure gas-fuelled engines, the terminology is as specified in the **1.4 of Annex 1.1.3-3, Part GF** or **1.4 of Annex 16.1.1-3, Part N of the Rules for the Survey and Construction of Steel Ships**.	

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Amended	Original	Remarks
8.2 Application and Approval of Submitted Documents	**8.2 Application and Approval of Submitted Documents**	
8.2.2 Drawings and Data	**8.2.2 Drawings and Data**	
1 Drawings and data to be submitted are as specified in the following **(1)** and **(2)**, as appropriate for the type of the reciprocating internal combustion engine. Upon review and approval of the submitted drawings and data, they are returned to the licensor.	**1** Drawings and data to be submitted are as specified in the following **(1)** and **(2)**, as appropriate for the type of the reciprocating internal combustion engine. Upon review and approval of the submitted drawings and data, they are returned to the licensor.	UR M78(Rev.2) 1.3
(1) Drawings and data to be submitted for information for approval	(1) Drawings and data to be submitted for information for approval	
((a) to (w) are omitted.)	((a) to (w) are omitted.)	
(x) For gas-fuelled engines, the following **i)** to **viii)**:	(x) For <u>low pressure</u> gas-fuelled engines, the following **i)** to **viii)**:	
i) Schematic layout or other equivalent documents of gas system on the engine	i) Schematic layout or other equivalent documents of gas system on the engine	
ii) Gas piping system (including double-walled arrangement where applicable) <u>The documentation to contain specification of design pressures, working pressure, pipe dimensions and materials.</u>	ii) Gas piping system (including double-walled arrangement where applicable) (Newly added)	Footnote 3)
iii) Parts for gas admission systems <u>The d</u>ocumentation <u>to contain</u> specification <u>of design</u> pressures, <u>working pressure,</u> pipe dimensions and materials.	iii) Parts for gas admission systems <u>D</u>ocumentation <u>is to include</u> specifications <u>for</u> pressures, pipe dimensions and materials.	Footnote 3)
iv) Arrangement of explosion relief valves for crankcases (if required by **2.4.3, Part D of the Rules for the Survey and Construction of Steel Ships**), charge air manifolds<u>,</u> exhaust gas manifolds<u> and exhaust gas system on the engine,</u> as applicable.	iv) Arrangement of explosion relief valves for crankcases (if required by **2.4.3, Part D of the Rules for the Survey and Construction of Steel Ships**), charge air manifolds <u>and</u> exhaust gas manifolds, as applicable.	1.3.1 No.4
v) List of certified safe equipment and relevant certification	v) List of certified safe equipment and <u>evidence of</u> relevant certification	1.3.1 No.5

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Amended	Original	Remarks
vi) Schematic layout or other equivalent documents pilot fuel systems (only for dual fuel engines) vii) Shielding of high pressure fuel pipes for pilot fuel system, assembly (only for dual fuel engines) viii) Schematic layout or other equivalent documents of the ignition system (only for gas only engines) (2) Drawings and data to be submitted for information on an overview of the engine's design, engine characteristics and performance ((a) to (ac) are omitted.) (ad) For gas-fuelled engines, the following **i)** to **iii)**: i) Safety concept ii) Report of the risk analysis (see **8.3**) iii) Gas specification (ae) (Omitted)	vi) Schematic layout or other equivalent documents of fuel oil system (main and pilot fuel systems) on the engine (only for dual fuel engines) vii) Shielding of high pressure fuel pipes for pilot fuel system, assembly (only for dual fuel engines) viii) Ignition system (only for gas only engines) (2) Drawings and data to be submitted for information on an overview of the engine's design, engine characteristics and performance ((a) to (ac) are omitted.) (ad) For low pressure gas-fuelled engines, the following **i)** to **iii)**: i) Safety concept ii) Report of the risk analysis (see **8.3**) iii) Gas specification (ae) (Omitted)	1.3.2 No.9 1.3.2 No.10 1.3.3 No.12
8.3 Risk Analysis	**8.3 Risk Analysis**	
1 For low pressure gas fuelled engines, risk analysis is to be carried out in accordance with the following **(1)** to **(4)**. (1) Scope of the risk analysis The risk analysis is to address the following **(a)** to **(d)**. With regard to the scope of the risk analysis it is to 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. (a) A failure or malfunction of any system or	For low pressure gas fuelled engines, risk analysis is to be carried out in accordance with the following **(1)** to **(4)**. (1) Scope of the risk analysis The risk analysis is to address the following **(a)** to **(d)**. With regard to the scope of the risk analysis it is to 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. (a) A failure or malfunction of any system or	UR M78(Rev.2) 1.4

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component involved in the gas operation of the engine (b) A gas leakage downstream of the double block and bleed valves (c) The safety of the engine in case of emergency shutdown or blackout, when running on gas (d) The interactions between the gas fuel system and the engine	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 interactions between the gas fuel system and the engine	UR M78(Rev.2) 1.4.1
(2) Form of the risk analysis The risk analysis is to be carried out in accordance with international standard *IEC* 31010:2019 or other recognised standards. 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.	(2) Form of the risk analysis The risk analysis is to be carried out in accordance with international standard *ISO* 31010:2009 or other recognized standards. 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.	UR M78(Rev.2) 1.4.2
(3) Procedure for the risk analysis The risk analysis is to be accordance with the following procedure. 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 to the following: i) the presence of gas in components or locations not designed for such purpose; and/or ii) ignition, fire or explosion. (b) Evaluate the consequences of **(a)** **(see 2.1-4, Annex 1.1.3-3, Part GF or 2.1-4, Annex 16.1.1-3, Part N of the Rules for the Survey and Construction of Steel Ships)**	(3) Procedure for the risk analysis The risk analysis is to be accordance with the following procedure. 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 to the following: i) the presence of gas in components or locations not designed for such purpose; and/or ii) ignition, fire or explosion. (b) Evaluate the consequences of **(a)**	UR M78(Rev.2) 1.4.3

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(c) Where necessary, identify the failure detection method (d) Where risk cannot be eliminated, identify the corrective measures: i) system design, such as: 1) redundancies 2) safety devices, monitoring or alarm provisions which permit restricted operation of the system ii) system operation, such as: 1) initiation of the redundancy 2) activation of an alternative mode of operation	(c) Where necessary, identify the failure detection method (d) Where risk cannot be eliminated, identify the corrective measures: i) system design, such as: 1) redundancies 2) safety devices, monitoring or alarm provisions which permit restricted operation of the system ii) system operation, such as: 1) initiation of the redundancy 2) activation of an alternative mode of operation	
(4) Equipment and systems to be analysed The risk analysis required for engines is to cover at least the following aspects. Failures of the gas supply components not located directly on the engine, such as block and bleed valves and other components of the gas supply system, are not to be considered in the analysis. (a) Failure of the gas-related systems or components, in particular the following **i)** and **ii)** i) gas piping and its enclosure, where provided ii) cylinder gas supply valves (b) Failure of the ignition system (oil fuel pilot injection, sparking plugs and glow 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 supplied 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	(4) Equipment and systems to be analysed The risk analysis required for engines is to cover at least the following aspects. 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. (a) Failure of the gas-related systems or components, in particular the following **i)** and **ii)** i) gas piping and its enclosure, where provided ii) cylinder gas supply valves (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	UR M78(Rev.2) 1.4.4

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Amended	Original	Remarks
combustion (misfiring, knocking) (f) Failure of the engine monitoring, control and safety systems (g) Presence of gas in engine components (e.g. air inlet manifold or scavenge space and exhaust manifold) and in the external systems connected to the engines (e.g. exhaust duct, cooling water system, hydraulic oil system, etc.). (h) Changes of operating modes for dual fuel engines (i) Hazard potential for crankcase fuel gas accumulation, for trunk-piston engines, refer to **10.3.1-2, Part GF** and **2.2.2-6, Part D of the Rules for the Survey and Construction of Steel Ships** (j) Risk of crankcase explosion in connection with active crankcase ventilation which produces a flow of external air into the crankcase (see **2.2.2-6, Part D of the Rules for the Survey and Construction of Steel Ships**).	combustion (misfiring, knocking) (f) Failure of the engine monitoring, control and safety systems (g) Abnormal presence of gas in engine components (e.g. air inlet manifold and exhaust manifold of dual fuel or gas only 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 **10.3.1-2, Part GF of the Rules for the Survey and Construction of Steel Ships** (Newly added)	
2 For pre-mixed engines, failures of such components likely to result in gas leakages are to be considered in risk analysis.	(Newly added)	Relocated from 2.5.3, Annex 1.1.3-2, Part GF and Annex 16.1.1-2, Part N
3 The risk analysis is to cover the possible gas accumulation in a scavenge space and the possible failure of a piston rod stuffing box.	(Newly added)	UR M78(Rev.2) 3.4
8.4 Preparation for Surveys	**8.4 Preparation for Surveys**	
5 For gas-fuelled engines, measures to verify that gas fuel piping on engine is gas tight are to be carried out prior to start-up of the engine.	**5** For low pressure gas-fuelled engines, measures to verify that gas fuel piping on engine is gas tight are to be carried out prior to start-up of the engine.	UR M78(Rev.2) 4.1.3

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Amended	Original	Remarks
8.5 Approval Tests	**8.5 Approval Tests**	
8.5.1 Test Stages	**8.5.1 Test Stages**	
4 During all approval tests, ambient conditions (i.e. air temperature, air pressure and humidity) are to be recorded. At a minimum, the engine data as listed in the following **(1)** to **(9)** are to be measured and recorded. Calibration records for the instrumentation used to collect data listed below are to be presented to the attending surveyor for review. Additional measurements may be required in connection with the design assessment as deemed necessary by the Society. ((1) to (8) are omitted.) (9) For gas-fuelled engines, the following **(a)** to **(d)** are to be measured and recorded (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) Pilot fuel temperature and pressure (supply or common rail as appropriate) (d) Gas concentration in the crankcase (The gas concentration in the crankcase should normally be measured inside the crankcase or at the crankcase outlet (crankcase vent pipe). Gas concentration measurements may be carried out as part of stage *A* if the method and the results are properly documented.)	**4** During all approval tests, ambient conditions (i.e., air temperature, air pressure and humidity) are to be recorded. At a minimum, the engine data as listed in the following **(1)** to **(9)** are to be measured and recorded. Calibration records for the instrumentation used to collect data listed below are to be presented to the attending surveyor for review. Additional measurements may be required in connection with the design assessment as deemed necessary by the Society. ((1) to (8) are omitted.) (9) For low pressure gas-fuelled engines, the following **(a)** to **(c)** are to be measured and recorded (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 (Newly added) (c) Gas concentration in the crankcase	UR M78(Rev.2) 4.1.5
6 For gas-fuelled engines, the following are also to be applied. (1) For dual fuel engines, the load tests specified in **8.5.2-1(1)** and **8.5.2-2(2)** are to be carried out in gas mode.	**6** For low pressure gas-fuelled engines, the following are also to be applied. (1) For dual fuel engines, the load tests specified in **8.5.2-1(1)** and **8.5.2-2(2)** are to be carried out in gas mode at the different percentages of the maximum power available in gas mode (see **2.5.1-1(1) of Annex**	Deleted due to dupli-

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Amended	Original	Remarks
	16.1.1-3, Part N or 2.5.1-1(1) of Annex 1.1.3-3, Part GF of the Rules for the Survey and Construction of Steel Ships). The 110% load tests are not required in the gas mode.	cation with 8.5.2
(2) (Omitted) (3) (Omitted)	(2) (Omitted) (3) (Omitted)	
8.5.2 Details of Tests	**8.5.2 Details of Tests**	
1 During stage *A*, the following items of tests are to be included: ((1) to (8) are omitted.) (9) For gas fuelled engines, the following **(a) to (d)** are also to be included. (a) For dual fuel engines, the engines are to run the load points defined in **(1)** in both gas and diesel modes (with and without pilot injection in service) as found applicable for the engine type. (b) For dual fuel 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 dual fuel engines, switch over between gas and diesel modes are to be tested at different loads. (d) The influence of the methane number and *LHV* of the fuel gas on the engine's maximum continuous power available in gas mode is to be verified. (10) Other items deemed to be verified by the Society.	**1** During the stage *A*, the following items of tests are to be included: ((1) to (8) are omitted.) (9) For low pressure gas fuelled engines, the following **(a) to (c)** are also to be included. (a) For dual fuel engines, the engines are to run the load points defined in **(1)** in both gas and diesel modes (with and without pilot injection in service) as found applicable for the engine type. (b) For dual fuel 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 dual fuel engines, switch over between gas and diesel modes are to be tested at different loads. (Newly added) (10) Other items deemed to be verified by the Society.	UR M78(Rev.2) 4.1.6
2 During stage *B*, the following items of tests are to be included. Deviations from the items, if any, are to be agreed with the Society. ((1) to (10) are omitted.) (11) For gas-fuelled engines, the following **(a) to (k)** are	**2** During the stage *B*, the following items of tests are to be included. Deviations from the items, if any, are to be agreed with the Society. ((1) to (10) are omitted.) (11) For low pressure gas-fuelled engines, the following	UR M78(Rev.2) 4.1.7

Amended-Original Requirements Comparison Table (IACS Unified Requirement for Gas-fuelled Engines)

Amended	Original	Remarks
also to be applied. (a) For dual fuel engines, all load points of **(2)** are to be run in both gas and diesel modes that apply for the engine type as defined by the engine designer. (b) For dual fuel engines, the independent overspeed protection device has to be tested in both gas and diesel modes. (c) For dual fuel engines with variable liquid/gas ratios, selected load tests of **(a)** are to be carried out at different ratios between the minimum and the maximum allowable values. (The most relevant and critical loads and ratios are to be selected for the test.) (d) The maximum continuous power available in gas mode (see **2.5.1-1.(1), Annex 1.1.3-3, Part GF** or **2.5.1-1.(1), Annex 16.1.1-3, Part N of the Rules for the Survey and Construction of Steel Ships**) is to be demonstrated. (e) Overload testing is not required in gas mode for dual fuel engines, provided that changeover to oil fuel mode is automatically performed in case of overload. (f) The load tests are to be carried out in diesel mode and in gas mode at the different percentages of the engine's MCR. (g) For dual fuel engines, the lowest specified speed is to be verified in diesel mode and gas mode. (h) For dual fuel engines, switch over between gas and diesel modes are to be tested at different loads. (i) The efficiency of the ventilation arrangement of	**(a)** to **(i)** are also to be applied. (a) For dual fuel engines, all load points of **(2)** are to be run in both gas and diesel modes that apply for the engine type as defined by the engine designer (see **8.5.1-6(1)**). (b) For dual fuel engines, the overspeed test of **(1)** is to be carried out in both gas and diesel modes that apply for the engine type as defined by the engine designer (see **8.5.1-6(1)**). (c) For dual fuel engines with variable liquid/gas ratios, the load tests of **(a)** are to be carried out at different ratios between the minimum and the maximum allowable values. (Newly added) (Newly added) (Newly added) (d) For dual fuel engines, the lowest specified speed is to be verified in diesel mode and gas mode. (e) For dual fuel engines, switch over between gas and diesel modes are to be tested at different loads. (f) The efficiency of the ventilation arrangement of	

Amended	Original	Remarks
the double walled gas piping system is to be verified. (Deleted) (j) For engines which may be used as engines driving generator sets, the characteristics of governors specified in **2.4.1-5(1)** and **(2), Part D of the Rules for the Survey and Construction of Steel Ships** are to be verified. (k) For gas only and pre-mixed engines which may be used as engines driving generator sets, the influences of *LHV*, methane number and ambient conditions on the governor test results are to be theoretically determined and specified in the test report. Referring to the limitations specified in **2.1-4(1)** and **(2), Annex 16.1.1-3, Part N** or **2.1-4(1)** and **(2), Annex 1.1.3-3, Part GF of the Rules for the Survey and Construction of Steel Ships**, the margin for satisfying characteristics of governors are to be determined. (12) Other test items deemed necessary by the Society	the double walled gas piping system is to be verified. (g) Simulation of a gas leakage in way of a cylinder gas supply valve. (h) For engines which may be used as engines driving generator sets, the characteristics of governors specified in **2.4.1-5(1)** and **(2), Part D of the Rules for the Survey and Construction of Steel Ships** are to be verified. (i) For gas only and pre-mixed engines which may be used as engines driving generator sets, the influences of *LHV*, methane number and ambient conditions on the governor test results are to be theoretically determined and specified in the test report. Referring to the limitations specified in **2.1-5(1)** and **(2) of Annex 16.1.1-3, Part N** or **2.1-5(1)** and **(2) of Annex 1.1.3-3, Part GF of the Rules for the Survey and Construction of Steel Ships**, the margin for satisfying characteristics of governors are to be determined. (12) Other test items deemed necessary by the Society	
3 During stage *C*, the following items are to be included. (1) Measurement of crankshaft deflections To be measured according to specified (by designer) conditions (except for engines where no specification exists). (2) Upon completion of the test run, the components of one cylinder for in-line engines and two cylinders for *V*-engines are to be presented for inspection as follows. For *V*-engines, the cylinder units are to be selected from both cylinder banks and different crank throws. For high-speed engines, two cylinders are normally to	**3** During the stage *C*, the following items are to be included. (1) Measurement of crankshaft deflections To be measured according to specified (by designer) conditions (except for engines where no specification exists). (2) Upon completion of the test run, the components of one cylinder for in-line engines and two cylinders for *V*-engines are to be presented for inspection as follows. For *V*-engines, the cylinder units are to be selected from both cylinder banks and different crank throws.	

Amended-Original Requirements Comparison Table (IACS Unified Requirement for Gas-fuelled Engines)

Amended	Original	Remarks
be stripped down for a complete inspection after the type test. ((a) to (h) are omitted) (i) For gas-fuelled engines, the following **i)** to **iii)** are also to be included. i) Gas admission valve including pre-chamber as found applicable ii) Spark igniter (for gas only engines) iii) Pilot fuel injection valve (for dual fuel engines) (j) Further components deemed necessary by the Society	For high-speed engines, two cylinders are normally to be stripped down for a complete inspection after the type test. ((a) to (h) are omitted) (i) For low pressure gas-fuelled engines, the following **i)** to **iii)** are also to be included. i) Gas supply valve including pre-chamber as found applicable ii) Spark igniter (for gas only engines) iii) Pilot fuel injection valve (for dual fuel engines) (j) Further components deemed necessary by the Society	
8.6 Handling after Approval	**8.6 Handling after Approval**	
8.6.1 Notification of Approval	**8.6.1 Notification of Approval**	
1 After the requirements in the preceding sections have been satisfactorily completed, the Society will issue a certificate of approval specifying the approval number, date and conditions, etc. upon examination of the submitted documents and surveyor reports.	After the requirements in the preceding sections have been satisfactorily completed, the Society will issue a certificate of approval specifying the approval number, date and conditions, etc. upon examination of the submitted documents and surveyor's reports.	
2 For dual fuel engines, the maximum continuous power available in gas mode is specified on the certificate of approval in addition to the maximum continuous rating in diesel mode if differing.	(Newly added)	M78.4.1.9

Amended-Original Requirements Comparison Table (IACS Unified Requirement for Gas-fuelled Engines)

Amended	Original	Remarks
Chapter 11 APPROVAL OF USE FOR EXHAUST DRIVEN TURBOCHARGERS	**Chapter 11 APPROVAL OF USE FOR EXHAUST DRIVEN TURBOCHARGERS**	
11.1 General	**11.1 General**	
11.1.1 Scope	**11.1.1 Scope**	
1 The requirements in this chapter apply to tests and inspection for the approval of use for new type exhaust driven turbochargers (hereinafter referred to as "turbochargers") intended for installation for the first time on board ships which are classed or to be classed with the Society and which the engine power at maximum continuous rating (*MCR*) supplied by a group of cylinders served by the turbocharger is not less than 1000 *kW*, on the basis of the requirements in **2.6.1-7, Part D of the Rules for the Survey and Construction of Steel Ships** and **2.6.1-6, Part 7 of the Rules for the Survey and Construction of Inland Waterway Ships**.	**1** The requirements in this chapter apply to tests and inspection for the approval of use for new type exhaust driven turbochargers (hereinafter referred to as "turbochargers") intended for installation for the first time on board ships which are classed or to be classed with the Society and which the engine power at maximum continuous rating (*MCR*) supplied by a group of cylinders served by the turbocharger is not less than 1000 *kW*, on the basis of the requirements in **2.6.1-6, Part D of the Rules for the Survey and Construction of Steel Ships** and **2.6.1-6, Part 7 of the Rules for the Survey and Construction of Inland Waterway Ships**.	
EFFECTIVE DATE AND APPLICATION **1.** The effective date of the amendments is 1 January 2025. **2.** Notwithstanding the amendments, the current requirements apply to gas-fuelled engines other than those which fall under the following: (1) gas-fuelled engines for which the application for approval of use is submitted to the Society on or after the effective date; or (2) gas-fuelled engines for which the application for renewal of approval of use is submitted to the Society on or after the effective date.		