Amendments to Parts A, C and F of the "Rules for the Classification of Ships"– Hydrogen fuelled ships

- **Part A, Chapter 1, Section 2: [6.14.57] (NEW), [6.14.58] (NEW) and Table 3;**
- **Part C, Chapter 1, Section 1, [2.9.1] and Appendix 14 (NEW);**
- **Part F, Chapter 13, Section 38 (NEW SECTION);**

Effective from 1/10/2021

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SECTION 2 CLASSIFICATION NOTATIONS

1 General

1.1 Purpose of the classification notations

1.1.1 The classification notations give the scope according to which the class of the ship has been based and refer to the specific rule requirements which are to be complied with for their assignment. In particular, the classification notations are assigned according to the type, service and navigation of the ship and other criteria which have been provided by the Interested Party, when applying for classification.

The Society may change the classification notations at any time, when the information available shows that the requested or already assigned notations are not suitable for the intended service, navigation and any other criteria taken into account for classification.

Note 1: Reference should be made to Sec 1, [1.3] on the limits of classification and its meaning.

1.1.2 The classification notations assigned to a ship are indicated on the Certificate of Classification, as well as in the Register of Ships published by the Society.

1.1.3

Ships and units, other than those covered in Parts B, C, D, E and F, are to comply with specific Rules published by the Society, which also stipulate the relevant classification notations.

1.1.4 The classification notations applicable to existing ships conform to the Rules of the Society in force at the date of assignment of class, as indicated in Ch 2, Sec 1. However, the classification notations of existing ships may be updated according to the current Rules, as far as applicable.

1.2 Types of notations assigned

1.2.1 The types of classification notations assigned to a ship are the following:

a) main class symbol
b) construction marks
c) service notations with additional service features, as applicable
d) navigation notations
e) operating area notations (optional)
f) additional class notations (optional)

The different classification notations and their conditions of assignment are listed in [2] to [6] below, according to their types.

1.2.2 As an example, the classification notations assigned to a ship may be as follows (the kind of notation shown in brackets does not form part of the classification notation indicated in the Register of Ships and on the Certificate of Classification):

C ✠ HULL ✠ MACH

(main class symbol, construction marks)

oil tanker-chemical tanker-ESP-Flash point > 60°C

(service notation and additional service features)

Unrestricted navigation

(navigation notation)

✠SYS - NEQ

(additional class notation).

2 Main class symbol

2.1 Main class symbol

2.1.1 The main class symbol expresses the degree of compliance of the ship with the rule requirements as regards its construction and maintenance. There is one main class symbol, which is compulsory for every classed ship.

2.1.2

The main class symbol C is assigned to ships built in accordance with the requirements of the Rules or other rules recognised as equivalent, and maintained in a condition considered satisfactory by the Society. The period of class (or interval between class renewal surveys) assigned to a ship is maximum 5 years; see Ch 2, Sec 2, [4].

Except for special cases, class is assigned to a ship only when the hull, propulsion and auxiliary machinery installations, and equipment providing essential services have all been reviewed in relation to the requirements of the Rules.

Note 1: The symbol **C** with the 5 year class period is to be understood as being the highest class granted by the Society.

Note 2: The symbol **C** may be followed by the additional construction feature **light ship** in case of ships or other units having restricted navigation notations and generally having length not greater than 50 m as well as speed greater than 15 knots, whose hull scantlings and outfitting comply with the applicable requirements of Chapters 3 and 6 of the "Rules for the Classification of High Speed Craft", issued separately by the Society.

3 Construction marks

3.1 General

3.1.1 The construction mark identifies the procedure under which the ship and its main equipment or arrangements have been surveyed for initial assignment of the class. The procedures under which the ship is assigned one of the construction marks are detailed in Ch 2, Sec 1.

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polluting substances into the sea, the air and, more in general, the environment (reference is made to **GREEN PLUS** additional class notation)

b) underwater noise limitation (reference is made to **DOLPHIN** additional class notations)

c) noise and vibration limitation on board (reference is made to **COMF-NOISE** and **COMF-VIB** additional class notations)

d) compliance with **COMF-NOISE-PORT(X)** additional class notation

e) compliance with **MLCDESIGN** additional class notation

f) compliance with **BIOSAFE SHIP** additional class notation

g) achievement of EEDI and EEXI values 40% lower than those in Phase 0 EEDI reference lines (see Note 1) in MARPOL Annex VI, according to the 2030 target in Initial IMO strategy on reduction of GHG emissions from ships (Res. MEPC.304(72)).

Note 1: For ro-ro cargo ships and ro-ro passenger ships, reference is made to Phase 2 EEDI reference lines

6.14.56 Maritime Autonomous Surface Ship (MASS) *(1/10/2021)*

The additional class notations **MASS** are assigned to ships having one of the following degrees of autonomy:

- **MASS-ADS**: ship with Automated processes and Decision Support: seafarers are on board to operate and control shipboard systems and functions. Some operations may be automated and at times be unsupervised but with seafarers on board ready to take control.
- **MASS-RCM**: Remotely Controlled Manned ship: the ship is controlled and operated from another location. Seafarers are available on board to take control and to operate the shipboard systems and functions.
- **MASS-RCU**: Remotely Controlled Unmanned ship: the ship is controlled and operated from another location. There are no seafarers on board.
- **MASS-FAS**: Fully Autonomous Ship: the operating system of the ship can make decisions and determine actions by itself.

For the assignment of the additional class notations **MASS**, in its variants, the ship is to comply with the requirements given in Pt F, Ch 13, Sec 37.

6.14.57 H2 FUELLED *(1/10/2021)*

The additional class notation **H2 FUELLED** is assigned to ships using hydrogen as fuel, complying with the design and constructional requirements of Pt C, Ch 1, App 14.

6.14.58 H2 FUELLED READY (X1, X2, X3) *(1/10/2021)*

The additional class notation **H2 FUELLED READY (X1, X2, X3...)** is assigned to ships whose design is in compliance with Pt C, Ch 1, App 14, and the relevant systems and arrangement are partially installed on board, thus easing a future ship conversion into a H2 FUELLED ship.

The requirements for the assignment of this additional class notation are given in Pt F, Ch 13, Sec 38.

7 Other notations

7.1

7.1.1 The Society may also define other notations by means of provisional requirements and guidelines, which may then be published in the form of tentative rules.

Table 3 : List of additional class notations *(1/10/2021)*

Additional class notation	Reference for definition	Reference	Remarks
AIR LUBRICATION SYSTEM (AIR LUB)	[6.14.48]	Pt F, Ch 13, Sec 31	
AIR-MON	[6.14.34]	Pt F, Ch 13, Sec 22	
AUT-CCS	[6.4.3]	Pt F, Ch 3, Sec 2	**(1)**
AUT-PORT	[6.4.4]	Pt F, Ch 3, Sec 3	**(1)**
AUT-UMS	[6.4.2]	Pt F, Ch 3, Sec 1	**(1)**
AVM-APS or AVM-APS-NS	[6.3.2]	Pt F, Ch 2, Sec 1	**(1)**
AVM-IAPS	[6.3.3]	Pt F, Ch 2, Sec 2	**(1)**
AVM-DPS or AVM-DPS-NS	[6.3.4]	Pt F, Ch 2, Sec 3	**(1)**
AVM-IPS	[6.3.5]	Pt F, Ch 2, Sec 4	**(1)**
BATTERY POWERED SHIPS	[6.14.43]	Pt C, Ch 2, App 2	
BIOSAFE SHIP	[6.14.50]	Pt F, Ch 13, Sec 33	
BWM-E	[6.14.15]	NA	**(5)**
BWM-T	[6.14.15]	NA	

(1) A construction mark is added to this notation.
(2) This notation may be completed by the specific notations **-PRECOOLING**, **-QUICKFREEZE** and/or **-AIRCONT** (see [6.9.5]).
(3) This notation may be completed by the specific notations **-MIDSHIP** and **-TRANSFER** (see [6.14.7]).
(4) When ships are assigned the notations **CLEAN-SEA** and **CLEAN-AIR**, the two separate notations are superseded by the cumulative additional class notation **GREEN STAR 3 DESIGN** (see [6.8.4]).
(5) This notation may be completed by the specific features: **sequential, flow-through, dilution**.
(6) This notation may be completed by the specific notation **-HULL** (see [6.10.4]).

Additional class notation	Reference for definition	Reference	Remarks
CARGOCONTROL	[6.14.9]	Pt F, Ch 13, Sec 9	
CARGO HANDLING	[6.14.31]	NA	
CLEAN-AIR	[6.8.3]	Pt F, Ch 7, Sec 3	**(4)**
CLEAN-SEA	[6.8.2]	Pt F, Ch 7, Sec 4	**(4)**
COAT-WBT	[6.14.12]	Pt F, Ch 13, Sec 12	
COMF-AIR	[6.7.4]	Pt F, Ch 6, Sec 3	
COMF-NOISE	[6.7.2]	Pt F, Ch 6, Sec 1	
COMF-NOISE-PORT	[6.7.5]	Pt F, Ch 6, Sec 4	
COMF-VIB	[6.7.3]	Pt F, Ch 6, Sec 2	
COVENT	[6.14.8]	Pt F, Ch 13, Sec 8	
CYBER RESILIENCE (CYR, CYR-OT and CYR-IT)	[6.14.46]	Pt F, Ch 13, Sec 29	
DANGEROUS GOODS	[6.14.35]	NA	
DIGITAL SHIP	[6.14.47]	Pt F, Ch 13, Sec 30	
DIVINGSUPPORT	[6.14.17]	Pt F, Ch 13, Sec 14	
DOLPHIN QUIET SHIP or DOLPHIN TRANSIT SHIP	[6.14.40]	Pt F, Ch 13, Sec 25	
DORS	[6.14.37]	Pt F, Ch 13, Sec 23	
DMS	[6.14.11]	Pt F, Ch 13, Sec 11	
DYNAPOS	[6.14.6] a)	Pt F, Ch 13, Sec 6	**(1)**
DP PLUS	[6.14.6] b)	Pt F, Ch 13, Sec 6	
EGCS-SOX and/or EGCS-NOX	[6.14.42]	Pt F, Ch 13, Sec 26	
EFFICIENT SHIP (S, DWT)	[6.14.29]	Pt F, Ch 13, Sec 19	
FATIGUELIFE (Y)	[6.14.13]	NA	
FIRE	[6.14.23]	Pt F, Ch 13, Sec 17	
FIRE-AS	[6.14.23]	Pt F, Ch 13, Sec 17	
FIRE-MS	[6.14.23]	Pt F, Ch 13, Sec 17	
FIRE-MS (hot-spots)	[6.14.23]	Pt F, Ch 13, Sec 17	
FIRE-CS	[6.14.23]	Pt F, Ch 13, Sec 17	
GAS FUELLED	[6.14.24] a)	Pt C, Ch 1, App 7 and Pt E, Ch 9, Sec 16	
GAS FUELLED (Main)	[6.14.24] b)	Pt C, Ch 1, App 7 and Pt E, Ch 9, Sec 16	
GAS FUELLED (Aux)	[6.14.24] c)	Pt C, Ch 1, App 7 and Pt E, Ch 9, Sec 16	
GAS READY (X1, X2, X3…)	[6.14.38]	Pt F, Ch 13, Sec 24	
GRABLOADING and GRAB (X)	[6.14.2]	Pt F, Ch 13, Sec 2	
GREAT LAKES ST LAW-RENCE SEAWAY	[6.14.41]	NA	
GREEN PLUS	[6.8.4] a)	Pt F, Ch 7, Sec 1	
GREEN PLUS T	[6.8.4] b)	Pt F, Ch 7, Sec 1 and Pt F, Ch 7, Sec 6	
GREEN STAR 3 DESIGN	[6.8.4] c)	Pt F, Ch 7, Sec 2	This cumulative notation supersedes the notations **CLEAN-SEA** and **CLEAN-AIR**, when both are assigned

(1) A construction mark is added to this notation.
(2) This notation may be completed by the specific notations **-PRECOOLING**, **-QUICKFREEZE** and/or **-AIRCONT** (see [6.9.5]).
(3) This notation may be completed by the specific notations **-MIDSHIP** and **-TRANSFER** (see [6.14.7]).
(4) When ships are assigned the notations **CLEAN-SEA** and **CLEAN-AIR**, the two separate notations are superseded by the cumulative additional class notation **GREEN STAR 3 DESIGN** (see [6.8.4]).
(5) This notation may be completed by the specific features: **sequential, flow-through, dilution**.
(6) This notation may be completed by the specific notation **-HULL** (see [6.10.4]).

Additional class notation	Reference for definition	Reference	Remarks
GREEN STAR 3	[6.8.4] d)	Pt F, Ch 7, Sec 5	
GREEN STAR 3 (TOC)	[6.8.4] e)	-	
GC CARGO HANDLING	[6.8.5]	Pt F, Ch 7, Sec 6	
H2 FUELLED	[6.14.57]	Pt C, Ch 1, App 14	
H2 FUELLED READY (X1, X2, X3)	[6.14.58]	Pt F, Ch 13, Sec 38	
HELIDECK	[6.14.20]	Pt F, Ch 13, Sec 16	
HELIDECK-H	[6.14.20]	Pt F, Ch 13, Sec 16	
HYBRID PROPULSION SHIP (HYB-...)	[6.14.45]	Pt F, Ch 13, Sec 28	**(1)**
HVSC	[6.14.18]	Pt F, Ch 13, Sec 15	
ICE	[6.10.5]	-	
ICE CLASS IA	[6.10.2]	Part F, Chapter 9	**(6)**
ICE CLASS IA SUPER	[6.10.2]	Part F, Chapter 9	**(6)**
ICE CLASS IB	[6.10.2]	Part F, Chapter 9	**(6)**
ICE CLASS IC	[6.10.2]	Part F, Chapter 9	**(6)**
ICE CLASS ID	[6.10.3]	Part F, Chapter 9	**(6)**
IMSBC-A	[6.14.25]	Pt F, Ch 13, Sec 18	
IMSBC-nitrate	[6.14.25]	Pt F, Ch 13, Sec 18	
IMSBC-non cohesive	[6.14.25]	Pt F, Ch 13, Sec 18	
INERTGAS-A	[6.14.21]	Pt C, Ch 4, Sec 1	
INERTGAS-B	[6.14.21]	Pt C, Ch 4, Sec 1	
INERTGAS-C	[6.14.21]	Pt C, Ch 4, Sec 1	
INWATERSURVEY	[6.14.3]	Pt F, Ch 13, Sec 3	
INF 1, INF 2, INF 3	[6.14.36]	NA	**(1)**
LASHING	[6.14.5]	Pt F, Ch 13, Sec 5	
LPG FUELLED	[6.14.52]	Pt C, Ch 1, App 13	
MAN OVERBOARD DETECTION SYSTEM (MOB)	[6.14.44]	Pt F, Ch 13, Sec 27	
MANOVR	[6.14.10]	Pt F, Ch 13, Sec 10	
MASS-ADS **MASS-RCM** **MASS-RCU** **MASS-FAS**	[6.14.56]	Pt F, Ch 13, Sec 37	
MLCDESIGN	[6.14.16]	Pt F, Ch 13, Sec 13	
MON-HULL	[6.6.2]	Pt F, Ch 5, Sec 1	
MON-SHAFT	[6.6.3]	Pt F, Ch 5, Sec 2	
MOORING	[6.14.30]	Pt F, Ch 13, Sec 21	
NH3 FUELLED	[6.14.53]	Pt C, Ch 1, App 13	
NH3 FUELLED READY (X1, X2, X3)	[6.14.54]	Pt F, Ch 13, Sec 35	
PERSONS WITH REDUCED MOBILITY (PMR-ITA)	[6.14.49]	Pt F, Ch 13, Sec 32	
PMA	[6.14.14]	NA	
PMS	[6.13.2]	Pt F, Ch 12, Sec 1	
PMS-CM(PROP)	[6.13.3]	Pt F, Ch 12, Sec 2	
PMS-CM(HVAC)	[6.13.4]	Pt F, Ch 12, Sec 3	
PMS-CM(CARGO)	[6.13.5]	Pt F, Ch 12, Sec 4	

(1) A construction mark is added to this notation.
(2) This notation may be completed by the specific notations **-PRECOOLING**, **-QUICKFREEZE** and/or **-AIRCONT** (see [6.9.5]).
(3) This notation may be completed by the specific notations **-MIDSHIP** and **-TRANSFER** (see [6.14.7]).
(4) When ships are assigned the notations **CLEAN-SEA** and **CLEAN-AIR**, the two separate notations are superseded by the cumulative additional class notation **GREEN STAR 3 DESIGN** (see [6.8.4]).
(5) This notation may be completed by the specific features: **sequential, flow-through, dilution**.
(6) This notation may be completed by the specific notation **-HULL** (see [6.10.4]).

Additional class notation	Reference for definition	Reference	Remarks
PMS-CM(ELE)	[6.13.6]	Pt F, Ch 12, Sec 5	
PMS-CM(FDS)	[6.13.7]	Pt F, Ch 12, Sec 6	
PMS-CM	[6.13.8]	Pt F, Ch 12, Sec 7	
POLAR CLASS	[6.11.1]	Part F, Chapter 10	
REF-CARGO	[6.9.2]	Pt F, Ch 8, Sec 2	**(1) (2)**
REF-CONT	[6.9.3]	Pt F, Ch 8, Sec 3	**(1) (2)**
REF-STORE	[6.9.4]	Pt F, Ch 8, Sec 4	**(1) (2)**
REMOTE SURVEYABLE SHIP (REMOTE)	[6.14.51]	Pt F, Ch 13, Sec 34	
RISK MITIGATION (...)	[6.14.33]	NA	
ROUTE DEPENDENT LASH-ING (start date - end date)	[6.14.5]	Pt F, Ch 13, Sec 5	
(**SAHARA** **SAHARA**	[6.14.32]	Pt F, Ch 13, Sec 20	
SELF-UNLOADING	[6.14.27]	NA	
SPM	[6.14.4]	Pt F, Ch 13, Sec 4	
SPS	[6.14.26]	NA	
SRTP	[6.14.22]	NA	
STAR	[6.2.4]	Part F, Chapter 1	This cumulative notation supersedes the notations **STAR-HULL** and **STAR-MACH**, when both are assigned
STAR-HULL	[6.2.2]	Pt F, Ch 1, Sec 1	
STAR-MACH	[6.2.3]	Pt F, Ch 1, Sec 2	
STRENGTHBOTTOM-NAABSA	[6.14.1]	Pt F, Ch 13, Sec 1	
SUSTAINABLE SHIP	[6.14.55]	Pt F, Ch 13, Sec 36	
SYS-COM	[6.5.4]	Pt F, Ch 4, Sec 3	
SYS-IBS	[6.5.3]	Pt F, Ch 4, Sec 2	**(1)**
SYS-NEQ **SYS-NEQ-1**	[6.5.2]	Pt F, Ch 4, Sec 1	**(1)**
TAS	[6.14.28]	NA	
TEMPORARY REFUGE (RISKS)	[6.14.39]	NA	
VCS	[6.14.7]	Pt F, Ch 13, Sec 7	**(3)**
WINTERIZATION (temp)	[6.12.1]	Part F, Chapter 11	

(1) A construction mark is added to this notation.
(2) This notation may be completed by the specific notations **-PRECOOLING**, **-QUICKFREEZE** and/or **-AIRCONT** (see [6.9.5]).
(3) This notation may be completed by the specific notations **-MIDSHIP** and **-TRANSFER** (see [6.14.7]).
(4) When ships are assigned the notations **CLEAN-SEA** and **CLEAN-AIR**, the two separate notations are superseded by the cumulative additional class notation **GREEN STAR 3 DESIGN** (see [6.8.4]).
(5) This notation may be completed by the specific features: **sequential, flow-through, dilution**.
(6) This notation may be completed by the specific notation **-HULL** (see [6.10.4]).

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SECTION 1 GENERAL REQUIREMENTS

1 General

1.1 Application

1.1.1 Chapter 1 applies to the design, construction, installation, tests and trials of main propulsion and essential auxiliary machinery systems and associated equipment, boilers and pressure vessels, piping systems, and steering and manoeuvring systems installed on board classed ships, as indicated in each Section of this Chapter.

1.2 Additional requirements

1.2.1 Additional requirements for machinery are given in:

- Part E, for the assignment of the service notations
- Part F, for the assignment of additional class notations.

1.3 Documentation to be submitted

1.3.1 Before the actual construction is commenced, the Manufacturer, Designer or Shipbuilder is to submit to the Society the documents (plans, diagrams, specifications and calculations) requested in the relevant Sections of this Chapter.

The list of documents requested in each Section is to be intended as guidance for the complete set of information to be submitted, rather than an actual list of titles.

The Society reserves the right to request the submission of additional documents to those detailed in the Sections, in the case of non-conventional design or if it is deemed necessary for the evaluation of the system, equipment or component.

Plans are to include all the data necessary for their interpretation, verification and approval.

Unless otherwise stated in the other Sections of this Chapter or agreed with the Society, documents for approval are to be sent in triplicate if submitted by the Shipyard and in four copies if submitted by the equipment supplier. Documents requested for information are to be sent in duplicate.

In any case, the Society reserves the rights to require additional copies when deemed necessary.

1.4 Definitions

1.4.1 Machinery spaces of Category A

Machinery spaces of Category A are those spaces and trunks to such spaces which contain:

- *internal combustion machinery used for main propulsion, or*
- *internal combustion machinery used for purposes other than main propulsion where such machinery has in the aggregate a total power output of not less than 375 kW, or*
- *any oil fired boiler or fuel oil unit,* or
- gas generators, incinerators, waste disposal units, etc., which use oil fired equipment.

1.4.2 Machinery spaces

Machinery spaces are all machinery spaces of Category A and all other spaces containing propulsion machinery, boilers, fuel oil units, steam and internal combustion engines, generators and major electrical machinery, oil filling stations, refrigerating, stabilising, ventilation and air conditioning machinery, and similar spaces, and trunks to such spaces.

1.4.3 Fuel oil unit

Fuel oil unit is the equipment used for the preparation of fuel oil for delivery to an oil fired boiler, or equipment used for the preparation for delivery of heated oil to an internal combustion engine, and includes any oil pressure pumps, filters and heaters dealing with oil at a pressure of more than 0,18 N/mm^2.

For the purpose of this definition, inert gas generators are to be considered as oil fired boilers and gas turbines are to be considered as internal combustion engines.

1.4.4 Dead ship condition

Dead ship condition is the condition under which the whole propulsion system, including the main power supply, is not in operation and auxiliary means for bringing the main propulsion machinery into operation and for the restoration of the main power supply, such as compressed air and starting current from batteries, are not available, but assuming that means are available to start the emergency generator at all times.

2 Design and construction

2.1 General

2.1.1 *The machinery, boilers and other pressure vessels, associated piping systems and fittings are to be of a design and construction adequate for the service for which they are intended and shall be so installed and protected as to reduce to a minimum any danger to persons on board, due regard being paid to moving parts, hot surfaces and other hazards.*

The design is to have regard to materials used in construction, the purpose for which the equipment is intended, the working conditions to which it will be subjected and the environmental conditions on board.

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Table 1 : Inclination of ship *(1/1/2020)*

Installations, components	Angle of inclination (degrees) **(1)**			
	Athwartship		Fore and aft	
	static	dynamic	static	dynamic
Main and auxiliary machinery	15	22,5	5 **(4)**	7,5
Safety equipment, e.g. emergency power installations, emergency fire pumps and their devices Switch gear, electrical and electronic appliances **(3)** and remote control systems	22,5 **(2)**	22,5 **(2)**	10	10

(1) Athwartship and fore-and-aft inclinations may occur simultaneously.
(2) In ships for the carriage of liquefied gases and of chemicals the emergency power supply must also remain operable with the ship flooded to a final athwartship inclination up to a maximum of 30°.
(3) No undesired switching operations or operational changes are to occur.
(4) Where the length of the ship exceeds 100m, the fore-and-aft static angle of inclination may be taken as 500/L degrees, where L is the length of ship, in metres, as defined in Pt B, Ch 1, Sec 2, [3.1.1].

Table 2 : Ambient conditions

AIR TEMPERATURE	
Location, arrangement	Temperature range (°C)
In enclosed spaces	between 0 and +45 **(2)**
On machinery components, boilers In spaces subject to higher or lower temperatures	According to specific local conditions
On exposed decks	between -25 and +45 **(1)**

WATER TEMPERATURE	
Coolant	Temperature (°C)
Sea water or, if applicable, sea water at charge air coolant inlet	up to +32

(1) Electronic appliances are to be designed for an air temperature up to 55°C (for electronic appliances see also Chapter 2).
(2) Different temperatures may be accepted by the Society in the case of ships intended for restricted service.

For main propulsion systems with reversing gears, controllable pitch propellers or electrical propeller drive, running astern is not to lead to an overload of propulsion machinery.

During the sea trials, the ability of the main propulsion machinery to reverse the direction of thrust of the propeller is to be demonstrated and recorded (see also Sec 16).

2.8 Safety devices

2.8.1 *Where risk from overspeeding of machinery exists, means are to be provided to ensure that the safe speed is not exceeded.*

2.8.2 *Where main or auxiliary machinery including pressure vessels or any parts of such machinery are subject to internal pressure and may be subject to dangerous overpressure, means shall be provided, where practicable, to protect against such excessive pressure.*

2.8.3 *Main turbine propulsion machinery and, where applicable, main internal combustion propulsion machinery and auxiliary machinery shall be provided with automatic shut-off arrangements in the case of failures, such as lubricating oil supply failure, which could lead rapidly to complete breakdown, serious damage or explosion.*

The Society may permit provisions for overriding automatic shut-off devices.

See also the specific requirements given in the other Sections of this Chapter.

2.9 Fuels

2.9.1 *(1/10/2021)*

Fuel oils employed for engines and boilers are, in general, to have a flash point (determined using the closed cup test) of not less than 60°C. However, for engines driving emergency generators, fuel oils having a flash point of less than 60°C but not less than 43°C are acceptable.

The use of fuel oil having a flashpoint of less than 60º C but not less than 43º C may be permitted (e.g. for feeding the emergency fire pump's engines and auxiliary machines which are not located in category A machinery spaces):

a) for passenger ships not engaged in international voyages and cargo ships of less than 500 gross tonnage or of 500 gross tonnage and upwards not engaged in international voyages or

b) subject to the following:

- fuel oil tanks except those arranged in double bottom compartments are located outside of category A machinery spaces;
- *provisions for the measurement of oil temperature are provided on the suction pipe of the fuel oil pump;*
- stop valves and/or cocks are provided on the inlet side and outlet side of the fuel oil strainers; and
- pipe joints of welded construction or of circular cone type or spherical type union joint are applied as far as possible.

Fuel oil having flash points of less than 43°C may be employed on board cargo ships provided that it is stored outside machinery spaces and the arrangements adopted are specially approved by the Society.

The use of boil-off gas as fuel for boilers or propulsion engines is allowed on gas carriers subject to the requirements of Pt E, Ch 9, Sec 16.

The use of liquefied or compressed natural gas as fuel is allowed on other ship types subject to the specific requirements given in App 7 or on ships in compliance with the latest edition of the International Code of Safety for Ships Using Gases or Other Low-Flashpoint Fuels (IGF Code), as amended, or equivalent arrangements.

The use of LPG or NH3 as fuel is allowed subject to the specific requirements given in App 13.

The use of hydrogen as fuel is allowed subject to the specific requirements given in App 14.

The arrangement on ships of less than 500 gross tonnage is considered by the Society on a case-by-case basis. The use of other gases as fuel is considered by the Society on a case-by-case basis.

Note 1: The use of gas as fuel in ships requires additional acceptance by the Administration of the State whose flag the ship is entitled to fly.

2.10 Use of asbestos

2.10.1

New installation of materials which contain asbestos is prohibited.

3 Arrangement and installation on board

3.1 General

3.1.1 *Provision shall be made to facilitate cleaning, inspection and maintenance of main propulsion and auxiliary machinery, including boilers and pressure vessels.*

Easy access to the various parts of the propulsion machinery is to be provided by means of metallic ladders and gratings fitted with strong and safe handrails.

Spaces containing main and auxiliary machinery are to be provided with adequate lighting and ventilation.

3.2 Floors

3.2.1 Floors in engine rooms are to be metallic, divided into easily removable panels.

3.3 Bolting down

3.3.1 Bedplates of machinery are to be securely fixed to the supporting structures by means of foundation bolts which are to be distributed as evenly as practicable and of a sufficient number and size so as to ensure a perfect fit.

Where the bedplates bear directly on the inner bottom plating, the bolts are to be fitted with suitable gaskets so as to ensure a tight fit and are to be arranged with their heads within the double bottom.

Continuous contact between bedplates and foundations along the bolting line is to be achieved by means of chocks of suitable thickness, carefully arranged to ensure a complete contact.

The same requirements apply to thrust block and shaft line bearing foundations.

Particular care is to be taken to obtain a perfect levelling and general alignment between the propulsion engines and their shafting (see Sec 7).

3.3.2 Chocking resins are to be type approved.

3.4 Safety devices on moving parts

3.4.1 Suitable protective devices are to be provided in way of moving parts (flywheels, couplings, etc.) in order to avoid injuries to personnel.

3.5 Gauges

3.5.1 All gauges are to be grouped, as far as possible, near each manoeuvring position; in any event, they are to be clearly visible.

3.6 Ventilation in machinery spaces

3.6.1

Machinery spaces of category A are to be sufficiently ventilated so as to ensure that when machinery or boilers therein are operating at full power in all weather conditions, including heavy weather, an adequate supply of air is maintained to the spaces for the safety and comfort of personnel and the operation of the machinery.

Any other machinery space shall be adequately ventilated in relation to the purpose of that machinery space.

This sufficient amount of air is to be supplied through suitably protected openings arranged in such a way that they can be used in all weather conditions, taking into account Regulation 17(3) and Regulation 19 of the 1966 Load Line Convention as amended by the Protocol of 1988.

Special attention is to be paid both to air delivery and extraction and to air distribution in the various spaces. The quantity and distribution of air are to be such as to satisfy

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APPENDIX 14 HYDROGEN FUELLED SHIPS

1 General

1.1 Scope

1.1.1 Application *(1/10/2021)*

The provisions of this Appendix apply to the arrangement, installation, control and monitoring of machinery, equipment and systems of ships using hydrogen as fuel (hereinafter named "hydrogen fuelled ships").

1.1.2 Acceptance by the flag Administration *(1/10/2021)*

The use of hydrogen as fuel in ships requires acceptance by the Administration of the State whose flag the ship is entitled to fly on the basis of the alternative design approach as required in IGF Code 2.3.

1.1.3 IGF Code requirements and the Society's rules *(1/10/2021)*

For hydrogen fuelled ships, the requirements of the latest version of the International Code of Safety for Ships using Gases or other Low-Flashpoint Fuels, as amended (hereinafter named "IGF Code") are to be applied as class requirements as specified and with the deviations given in this Appendix. For the scope of classification, when reference is made to paragraphs of the IGF Code where the wording:

a) “LNG" and "gas" are used, they are to be regarded as referring to hydrogen; and

b) "Administration" is used, it is to be regarded as referring to the "Society".

In general, this Appendix applies to machinery, equipment and systems of ships using hydrogen as fuel and to their interfaces with the other ship systems. Unless otherwise specified, the machinery, equipment and systems of ships using hydrogen as fuel are also to com ply with the requirements given in Part C.

1.1.4 IGF Code requirements not within the scope of classification *(1/10/2021)*

The following requirements of the IGF Code are not within the scope of classification:

- Chapter 11 - Fire Safety
- Chapter 17 - Drills and emergency exercises
- Chapter 18 - Operation
- Chapter 19 - Training

These requirements are applied by the Society when acting on behalf of the flag Administration, within the scope of delegation (see [1.1.6]).

1.1.5 Correspondence of the IGF Code with the Rules *(1/10/2021)*

All the requirements of this Appendix are cross referenced to the applicable Chapters, Sections or paragraphs of the IGF Code, as appropriate.

1.1.6 Certificate of Fitness *(1/10/2021)*

The responsibility for interpretation of the IGF Code requirements for the purpose of issuing an International Certificate of Fitness for the Gas-fuelled Ships lies with the Administration of the State whose flag the ship is entitled to fly.

Whenever the Society is authorised by an Administration to issue on its behalf the "Certificate of Fitness for the Gas-Fuelled ships", or where the Society is authorised to carry out investigations and surveys on behalf of an Administration on the basis of which the "Certificate of Fitness for the Gas-Fuelled ships" will be issued by the Administration, or where the Society is requested to certify compliance with the IGF Code, the full compliance with the requirements of the IGF Code, including the operative requirements mentioned in [1.1.4], will be granted by the Society, subject to [1.1.2].

1.2 Documentation to be submitted

1.2.1 *(1/10/2021)*

Tab 1 lists the plans, information, analysis, etc. which are to be submitted in addition to the information required in the other Parts of the Rules, for the portion of the ship not involved in the hydrogen handling.

The Society reserves the right to request the submission of additional documents in the case of non-conventional design or if it is deemed necessary for the evaluation of the system, equipment or components.

Table 1 : **Documents to be submitted** *(1/10/2021)*

No.	A/I (1)	Document
1	I	Propulsion system general arrangement - Design philosophy including information on the machinery configuration, engine room arrangements, fuel arrangements, shutdown philosophy (if applicable), redundancy considerations etc. are to be submitted before other documentation
2	I	Fuel system Risk assessment
3	A	Fuel system arrangement plan - including: • gas tanks and gas containment systems with indication of distances required in [5.4] and calculations per [5.4.4], if applicable • tank connection spaces • fuel storage hold spaces • fuel preparation rooms • bunkering stations and other shore connections • machinery and boiler spaces, service and control station spaces • doors and openings to fuel preparation rooms and other hazardous areas
4	I	Fuel gas system operational manual including procedures for: • bunkering, including filling limits curve • gas freeing and inerting • normal operation • emergency operation
5	A	Fuel gas tanks including drawings of: • tanks • supports and stays • secondary barriers • insulation • marking plates • tank hatches, pipes and any other openings to gas tanks Fuel gas tank design analysis: • specification of design loads and structural analysis of gas tanks • complete stress analysis for independent tanks type B and type C. Fuel gas tanks production process including: • fuel gas tank non-destructive testing (NDT) plan including: • information about strength and tightness testing • specification of stress relieving procedures for independent tanks type C (thermal or mechanical). • fuel gas tank welding procedures • fuel gas tank material specifications including connected pipes
6	A	Fuel gas tank safety relief valves and associated vent piping specification, piping capacity analysis including back pressure
7	A	Fuel gas tank gas freeing and purging system piping diagram
8	A	Fuel gas tank control and monitoring system
9	A	Fuel gas piping system: Pipe routing sketch Piping diagram (including bunkering lines and vent lines for safety relief valves or similar piping, vent mast, and secondary enclosure for gas pipes)
10	I	Fuel gas piping system - Specification of valves, flanges and fittings including offsets, loops, bends, expansion elements such as bellows and slip joints. For valves intended for service with a design temperature below -55°C, documentation of leak test and functional test at design temperature (type test) is to be included
11	A	Fuel gas system drip trays - System arrangement plan - Hull protection beneath liquid piping where leakages may be anticipated, such as at shore connections and at pump seals. Including specification
12	I	Electrical bonding of piping - Specification
(1) A = to be submitted for approval, in four copies I = to be submitted for information, in duplicate.		

No.	A/I **(1)**	Document
13	A	Cooling system - Piping diagram in connection with fuel gas system
14	A	Heating system - Piping diagram in connection with fuel gas system
15	A	Fuel gas system control, monitoring and safety systems, including a test program for safety functions
16	A	Fuel gas driven engines - Failure mode and effect analysis
17	A	Exhaust gas system - Piping diagram
18	A	Hazardous area classification drawing, including air-lock location, construction details and alarm equipment
19	A	Gastight bulkhead penetrations - Detailed drawing
20	A	Ventilation of gas fuel system spaces - Ducting diagram for spaces containing gas installations, such as gas pipe ducts led through enclosed spaces, storage tanks below deck. Including capacity and location of fans and their motors
21	I	Explosion protection • System arrangement plan of electrical equipment in hazardous areas • Single line diagrams for all intrinsically safe circuits, for each circuit, including data for verification of the compatibility between the barrier and the field components • Documentation to demonstrate the fulfilment of [4.3] • List of certified safe type equipment/instruments (Ex) • Certificates of the safe type (Ex) equipment/instrumentation as per [1.3.2]
22	A	Fixed gas detection system arrangement plan Detectors, call points and alarm devices specification
23	I	FMEA of the whole gas-fuelled system
24	A	Test procedures of safety-critical items, in particular those related to the gas system as ascertained by the FMEA
25	I	Documentation of alternative design as per [2], as applicable
(1) A = to be submitted for approval, in four copies I = to be submitted for information, in duplicate.		

1.3 Definitions

1.3.1 *(1/10/2021)*

IGF CODE REFERENCE: Ch. 2, 2.1

Unless otherwise stated below, definitions are as defined in SOLAS chapter II-2 and IGF Code 2.2.

1.3.2 *(1/10/2021)*

IGF CODE REFERENCE: Ch. 2, 2.2

Certified safe type means electrical equipment that is certified safe by the relevant recognized authorities for operation in a flammable atmosphere based on a recognized standard.

Note 1: *Refer to IEC 60079 series, Explosive atmospheres and IEC 60092-502:1999 Electrical Installations in Ships - Tankers - Special Features.*

1.3.3 *(1/10/2021)*

LH2 means liquefied hydrogen gas, but it also means hydrogen vapours.

1.3.4 *(1/10/2021)*

Fuel, Gas and Gas Fuel in the context of this appendix in general mean either hydrogen in liquefied or vapour form (except specified otherwise, like "inert gas" or "liquid gas").

1.3.5 *(1/10/2021)*

High pressure means a maximum working pressure greater than 2.0 MPa.

2 Alternative design

IGF CODE REFERENCE: Ch. 2, 2.3

2.1

2.1.1 *(1/10/2021)*

Appliances and arrangements may deviate from those set out in this Appendix provided that they meet the intent of the goal and functional requirements concerned and provide an equivalent level of safety of the relevant paragraphs.

2.1.2 *(1/10/2021)*

The equivalence of the alternative design is to be demonstrated as specified in SOLAS regulation II-1/55, and approved by the Society. Operational methods or procedures will not be allowed as an alternative to a particular fitting, material, appliance, apparatus, item of equipment, or type thereof which is prescribed by this Appendix.

3 Goal and functional requirements

IGF CODE REFERENCE: Ch. 3

3.1 Goal

3.1.1 *(1/10/2021)*

The goal of this Appendix is to provide for safe and environmentally-friend design, construction and operation of ships and in particular their installations of systems for propulsion machinery, auxiliary power generation machinery and/or other purpose machinery using gas as fuel.

3.2 Functional requirements

3.2.1 *(1/10/2021)*

The safety, reliability and dependability of the systems is to be equivalent to that achieved with new and comparable conventional oil-fuelled main and auxiliary machinery. A FMEA consistent with the "Tasneef Guide for FMEA" is to be carried out for the whole gas-fuelled system, including process system, electrical power supplies and control system, to check the potential existence of failure modes that can jeopardize the ship's safety. The results of the FMEA are then to be used to establish a trial program.

3.2.2 *(1/10/2021)*

The probability and consequences of fuel-related hazards are to be limited to a minimum through arrangement and system design, such as ventilation, detection and safety actions. In the event of gas leakage or failure of the risk reducing measures, necessary safety actions are to be initiated.

3.2.3 *(1/10/2021)*

The design philosophy is to ensure that risk reducing measures and safety actions for the gas fuel installation do not lead to an unacceptable loss of power.

3.2.4 *(1/10/2021)*

Hazardous areas are to be restricted, as far as practicable, to minimize the potential risks that might affect the safety of the ship, persons on board, and equipment.

3.2.5 *(1/10/2021)*

Equipment installed in hazardous areas are to be minimized to that required for operational purposes and are to be suitably and appropriately certified.

3.2.6 *(1/10/2021)*

Unintended accumulation of explosive, flammable or toxic gas concentrations are to be prevented.

3.2.7 *(1/10/2021)*

System components are to be protected against external damages.

3.2.8 *(1/10/2021)*

Sources of ignition in hazardous areas are to be minimized to reduce the probability of explosions.

3.2.9 *(1/10/2021)*

It is to be arranged for safe and suitable fuel supply, storage and bunkering arrangements capable of receiving and containing the fuel in the required state without leakage. Other than when necessary for safety reasons, the system is to be designed to prevent venting under all normal operating conditions including idle periods.

3.2.10 *(1/10/2021)*

Piping systems, containment and over-pressure relief arrangements that are of suitable design, construction and installation for their intended application are to be provided.

3.2.11 *(1/10/2021)*

Machinery, systems and components are to be designed, constructed, installed, operated, maintained and protected to ensure safe and reliable operation.

3.2.12 *(1/10/2021)*

Fuel containment system and machinery spaces containing source that might release gas into the space are to be arranged and located such that a fire or explosion in either will not lead to an unacceptable loss of power or render equipment in other compartments inoperable.

3.2.13 *(1/10/2021)*

Suitable control, alarm, monitoring and shutdown systems are to be provided to ensure safe and reliable operation.

3.2.14 *(1/10/2021)*

Fixed gas detection suitable for all spaces and areas concerned are to be arranged.

3.2.15 *(1/10/2021)*

Fire detection, protection and extinction measures appropriate to the hazards concerned are to be provided.

3.2.16 *(1/10/2021)*

Commissioning, trials and maintenance of fuel systems and gas utilization machinery are to satisfy the goal in terms of safety, availability and reliability.

3.2.17 *(1/10/2021)*

The technical documentation is to permit an assessment of the compliance of the system and its components with the applicable rules, guidelines, design standards used and the principles related to safety, availability, maintainability and reliability.

3.2.18 *(1/10/2021)*

A single failure in a technical system or component is not to lead to an unsafe or unreliable situation.

4 General requirements

IGF CODE REFERENCE: Ch. 4, 4.1

4.1 Goal

4.1.1 *(1/10/2021)*

The goal of this paragraph is to ensure that the necessary assessments of the risks involved are carried out in order to eliminate or mitigate any adverse effect to the persons on board, the environment or the ship.

4.2 Risk assessment

IGF CODE REFERENCE: Ch. 4, 4.2.

4.2.1 *(1/10/2021)*

A risk assessment is to be conducted to ensure that risks arising from the use of hydrogen as fuel and potentially affecting persons on board, the environment, the structural strength or the integrity of the ship are addressed. Considerations are to be given to the hazards associated with physical layout, operation and maintenance, following any reasonably foreseeable failure.

4.2.2 *(1/10/2021)*

For ships to which this Appendix applies, the risk assessment required by [4.2.1] need to be conducted:

a) where explicitly required by:

- IGF Code paragraphs 5.10.5, 5.12.3, 6.4.1.1, 6.4.15.4.7.2, 8.3.1.1, 13.4.1, 13.7 and 15.8.1.10, and
- paragraphs 4.4 and 6.8 of Annex to IGF Code, and
- paragraphs 5.2.1, 5.4.1, 5.10.2, 5.12.2, 6.3.2, 6.6.2, 6.7.2, 6.9.2, 6.11.1, 8.3.1, 8.5.4, 12.5.2, 13.7.1 and 15.8.2 of this Appendix, and

b) when other potential hazards connected with the use of hydrogen as fuel are to be addressed.

4.2.3 *(1/10/2021)*

The risks are to be analysed using acceptable and recognized risk analysis techniques, and loss of function, component damage, fire, explosion and electric shock are as a minimum to be considered. The analysis is to ensure that risks are eliminated wherever possible. Risks which cannot be eliminated are to be mitigated as necessary. Details of risks, and the means by which they are mitigated, are to be documented to the satisfaction of the Society. Guidance on risk analysis techniques can be found in the "Tasneef Guide on Risk Analysis".

4.2.4 *(1/10/2021)*

The assumptions for the risk assessment are to be agreed by a team of experts acceptable to the Society. It may include a representative of Class, Flag Administration, owner, builder or designer, and consultants having the necessary knowledge and experience in safety, design and/or operation as necessary for the specific evaluation at hand. Other members may include marine surveyors, ship operators, safety engineers, equipment manufacturers, human factors experts, naval architects and marine engineers, according to the problem under scope.

4.2.5 *(1/10/2021)*

The risk assessment can be qualitative or quantitative and is to cover the following aspects:

- Accidental release and dispersion (scenario for hydrogen leakages due to piping rupture and permeability, hydrogen effects on material e.g. embrittlement or permeation, calculation methods for hydrogen diluition in enclosed space)
- Ignition (spontaneous ignition of hydrogen during sudden release, minimum energy for ignition)
- Deflagration and detonation (hydrogen explosion hazards due to overpressure)
- Fires (jet fire, radiative heat fluxes, fire resistance of hydrogen system)
- Impact on people, asset and environment (severity of hydrogen incidents)
- Mitigation techniques (detection method, barriers, ventilation level)
- Emergency operation (strategy control of incident)
- Oxyigen enrichment due to cryogenic hydrogen temperature

The risk assessment is to include the following hazards:

- Creation of explosive atmosphere (hydrogen concentration in air)
- High flammability
- Back firing in pipes
- Chemical reaction with oxidant agents
- Asphyxiation at high hydrogen concentration and at high inert gas concentration
- Hydrogen accumulation on the upper part of spaces
- Invisible and very hot flame during H2 burning
- Hydrogen embrittlement of metals at high pressure

4.3 Limitation of explosion consequences

IGF CODE REFERENCE: Ch. 4, 4.3

4.3.1 *(1/10/2021)*

The preferred safety policy is to be the elimination of either any source of release or any source of ignition, or both. Only in case this is demonstrated not to be feasible, the following applies.

An explosion in any space containing any potential sources of release (note 1) and potential ignition sources is not to:

a) *cause damage to or disrupt the proper functioning of equipment/systems located in any space other than that in which the incident occurs;*

b) *damage the ship in such a way that flooding of water below the main deck or any progressive flooding occurs;*

c) *damage work areas or accommodation in such a way that persons who stay in such areas under normal operating conditions are injured;*

d) *disrupt the proper functioning of control stations and switchboard rooms necessary for power distribution;*

e) *damage life-saving equipment or associated launching arrangements;*

f) *disrupt the proper functioning of fire-fighting equipment located outside the explosion-damaged space;*

g) *affect other areas of the ship in such a way that chain reactions involving, inter alia, cargo, gas and bunker oil may arise; or*

h) *prevent persons access to life-saving appliances or impede escape routes.*

Note 1: Double wall fuel pipes are not considered as potential sources of release.

The aforesaid points are to be demonstrated in a way acceptable to the Society.

5 Ship design and arrangement

IGF CODE REFERENCE: Ch. 5

5.1 Goal

IGF CODE REFERENCE: Ch. 5, 5.1

5.1.1 *(1/10/2021)*

The goal of this paragraph [5] is to provide for safe location, space arrangements and mechanical protection of power generation equipment, fuel storage systems, fuel supply equipment and refuelling systems.

5.2 Functional requirements

IGF CODE REFERENCE: Ch. 5, 5.2

5.2.1 *(1/10/2021)*

This paragraph [5] is related to functional requirements in IGF Code paragraphs 3.2.1 to 3.2.3, 3.2.5, 3.2.6, 3.2.8, 3.2.12 to 3.2.15 and 3.2.17. In particular the following apply:

a) location of the fuel tank(s) on open deck or under deck is subject to risk assessment; in both cases, the tank(s) is (are) to be *located in such a way that the probability for the tank(s) to be damaged following a collision or grounding is reduced to a minimum taking into account the safe operation of the ship and other hazards that may be relevant to the ship;*

b) fuel containment systems, fuel piping and other sources of release of fuel are to be so located and arranged that released gas is lead to a safe location in the open air;

c) the access or other openings to spaces containing fuel sources of release are to be so arranged that flammable, asphyxiating or toxic gas cannot escape to spaces that are not designed for the presence of such gases;

d) fuel piping is to be protected against mechanical damage;

e) the propulsion and fuel supply system are to be so designed that safety actions after any gas leakage do not lead to an unacceptable loss of power; and

f) the probability of a gas explosion in a machinery space with gas or low-flashpoint fuelled machinery is to be minimized.

5.3 Regulations - General

IGF CODE REFERENCE: Ch. 5, 5.3

5.3.1 *(1/10/2021)*

The requirements in IGF Code 5.3 apply.

5.4 Machinery space concepts

IGF CODE REFERENCE: Ch. 5, 5.4

5.4.1 *(1/10/2021)*

In a machinery space with hydrogen fuelled machinery, only gas safe machinery concept is allowed, such that the spaces are considered gas safe under all conditions, normal as well as abnormal conditions, i.e. inherently gas safe.

In a gas safe machinery space, a single failure cannot lead to release of fuel gas into the machinery space.

Special consideration may be given to the arrangement of the fuel cell space.

Consideration may be given to accept an ESD protected machinery space on ships below 100 GT, provided that the arrangement is considered in the risk assessment in [4.2].

5.5 Regulations for gas safe machinery space

IGF CODE REFERENCE: Ch. 5, 5.5

5.5.1 *(1/10/2021)*

The requirements in IGF Code 5.5 apply.

5.6 Regulations for ESD-protected machinery spaces

5.6.1 *(1/10/2021)*

ESD protected Machinery spaces are generally not acceptable and [5.4.1] applies.

5.7 Regulations for location and protection of fuel piping

IGF CODE REFERENCE: Ch. 5, 5.7

5.7.1 *(1/10/2021)*

The requirements in IGF Code 5.7 apply.

5.8 Regulations for fuel preparation room design

IGF CODE REFERENCE: Ch. 5, 5.8

5.8.1 *(1/10/2021)*

The requirements in IGF Code 5.8 apply.

5.9 Regulations for bilge systems

IGF CODE REFERENCE: Ch. 5, 5.9

5.9.1 *(1/10/2021)*

The requirements in IGF Code 5.9 apply.

5.10 Regulations for drip trays

IGF CODE REFERENCE: Ch. 5, 5.10

5.10.1 *(1/10/2021)*

The requirements in IGF Code 5.10 apply.

5.10.2 *(1/10/2021)*

The risk assessment is to follow the steps outlined below.

a) The team of experts is to conduct a Hazard Identification (HAZID) to agree on the scenarios to be subjected to the risk assessment, and on the assumptions regarding the most critical events (typically, connection failures causing an hydrogen release) considering also available internationally recognized standard (e.g. ISO/TR 15916) for the identification of hazards and risks.

b) Reasonable assumptions on the extent of connection failures or other selected events and the process parameters of the hydrogen are to be made by the team of experts, preferably on the basis of statistics available in the public domain or provided and documented by stakeholders.

c) Reasonable assumptions on the operation of ventilation system are to be made according to layout and procedures of the affected space.

d) In order to verify that the hydrogen release will not create flammable concentrations and to demonstrate the drip tray capacity for a hydrogen cryogenic spill, a specific simulation is to be set up, aimed at evaluating the maximum amount of hydrogen spilled and its cloud, the evaporation rate and the possibility to fully accommodate the liquid hydrogen in the drip tray. The dispersion of vapors resulting from hydrogen evaporation in the affected space is also to be ascertained in respect of explosive atmosphere.

e) The simulation is to be conducted by commercially available and validated tools (typically, by CFD tools). It is to focus on the calculation of the amount of hydrogen spilled before the stop of hydrogen flow. Other calculation methods (e.g. empirical formulas based on literature) will be subject to special consideration.

f) As a precaution, in order to maximize the accumulation of hydrogen into the drip tray, hydrogen release is to be assumed as directed downward, impinging on the drip tray, and ambient temperature is to be set to the minimum credible winter temperature. Equipment and space surfaces and drip tray are to be considered adiabatic, to conservatively minimize the heat exchange with the hydrogen droplets, and to increase the amount of liquid accumulated in the drip tray.

g) Reasonable assumptions are to be made by the expert team regarding detection time, hydrogen flow stop time and human reaction time, in case operators are credited in the emergency.

h) If the simulation demonstrates that the drip tray cannot accommodate the hydrogen spill, mitigating measures are to be provided and subjected to the same simulation process, to appreciate the risk reduction.

5.11 Regulations for arrangement of entrances and other openings in enclosed spaces

IGF CODE REFERENCE: Ch. 5, 5.11

5.11.1 *(1/10/2021)*

The requirements in IGF Code 5.11 apply.

5.12 Regulations for airlocks

IGF CODE REFERENCE: Ch. 5, 5.12

5.12.1 *(1/10/2021)*

The requirements in IGF Code 5.12 apply.

5.12.2 *(1/10/2021)*

In the context of the risk assessment required in IGF Code 5.12.3, the team of experts is to conduct a Hazard Identification (HAZID) to agree on the worst scenario for hydrogen release including the configuration of the airlocks.

In order to assess the structural integrity of the room and the suitability of the designed airlock, the maximum pressure within the spaces identified by the HAZID has to be evaluated, considering the effectiveness of the ventilation system. This calls for a simulation by means of the tools mentioned in [5.10.2]. The following steps, as a minimum, are to be performed.

a) Representative accidental scenarios of loss of hydrogen from failures in process or containment systems are to be selected by the team of experts in the identified spaces. The simulation is to focus on the calculation of the amount of hydrogen spilled before the stop of the hydrogen flow

b) Reasonable assumptions on the extent of containment failure and the process parameters of the hydrogen are to be made by the team of experts, preferably based on statistics available in the public domain or provided and documented by stakeholders.

c) Reasonable assumptions on the operation of ventilation system are to be made according to layout and procedures of the selected spaces.

d) As a precaution, in order to maximize the accumulation of hydrogen onto the space floor, hydrogen release is to be directed downward, impinging on the floor, and ambient temperature is to be set to the maximum credible summer temperature in the space. The surfaces are to be considered isothermal at ambient temperature, to conservatively increase the evaporation rate and, consequently, the pressure buildup.

e) Reasonable assumptions are to be made by the team of experts regarding detection time, hydrogen flow stop time and human reaction time, in case operators are credited in the emergency.

If the simulation demonstrates that the analysed airlocks cannot prevent gas release in safe space, mitigating measures are to be provided and subjected to the same simulation process, to appreciate the risk reduction.

6 Fuel containment system

IGF CODE REFERENCE: Ch. 6

6.1 Goal

6.1.1 *(1/10/2021)*

The goal of this paragraph [6] is to provide that gas storage is adequate so as to minimize the risk to personnel, the ship and the environment to a level that is equivalent to a conventional oil fuelled ship.

6.2 Functional requirements

6.2.1 *(1/10/2021)*

This paragraph [6] relates to functional requirements in IGF Code 3.2.1, 3.2.2, 3.2.5 and 3.2.8 to 3.2.17. In particular the following apply:

a) *the fuel containment system is to be so designed that a leak from the tank or its connections does not endanger the ship, persons on board or the environment. Potential dangers to be avoided include:*

   1) *exposure of ship materials to temperatures below acceptable limits;*

   2) *flammable fuels spreading to locations with ignition sources;*

   3) *toxicity potential and risk of oxygen deficiency due to fuels and inert gases;*

   4) *restriction of access to assembly stations, escape routes and life-saving appliances (LSA); and*

   5) *reduction in availability of LSA.*

b) *the pressure and temperature in the fuel tank are to be kept within the design limits of the containment system and possible carriage requirements of the fuel;*

c) *the fuel containment arrangement is to be so designed that safety actions after any gas leakage do not lead to an unacceptable loss of power; and*

d) *if portable tanks are used for fuel storage, the design of the fuel containment system is to be equivalent to permanent installed tanks as described in this paragraph.*

6.3 Regulations - General

6.3.1 *(1/10/2021)*

The requirements in IGF Code 6.3 apply, with the following deviations from IGF Code 6.3.1 and 6.3.4.

6.3.2 *(1/10/2021)*

Hydrogen in a liquid state may be stored with a maximum allowable relief valve setting (MARVS) of up to 1.0 MPa. Higher values are subject to special consideration on the basis of the risk assessment aimed to assess all related risks.

6.3.3 *(1/10/2021)*

All tank connections, fittings, flanges and tank valves are to be enclosed in a tank connection space able to safely contain leakage from the tank connections.

When the fuel storage tank is in an enclosed space, the tank connection space is to be gastight toward other spaces.

6.3.4 *(1/10/2021)*

The vacuum insulation capability is to be evaluated for the upper limit of cold vacuum pressure (CVP), and loss of vacuum is to be defined with respect to the CVP upper limit. Accordingly, cargo containment systems and piping are to be designed and tested taking into account the effect of vacuum pressure. Supporting structure and adjacent hull structure are to be designed taking into account the cooling owing to loss of vacuum insulation.

6.4 Regulations for liquefied gas fuel containment

6.4.1 *(1/10/2021)*

The requirements in IGF Code 6.4 apply.

6.4.2 Materials and construction *(1/10/2021)*

Austenitic stainless steel - such as AISI 304, 316, 304L and 316L - is to be used for materials in contact with hydrogen. Other materials may be approved after special consideration and/or testing, in accordance to an international recognized standard (e.g. EN 13445-2) and subject to the submission of the relevant documentation including material specification with chemical and mechanical properties, material test report as base material and as welded with reference to IMO guideline in MSC.1/Circ.1622.

Materials having a melting point below 925°C are not to be used for piping outside the fuel tanks (ref. chapter 7.4.1.2 of the IGF Code), with a possible exception for short lengths of pipes attached to, or in the close proximity of, the fuel tanks. In such case the low melting point materials are to be protected by A-60 rating insulation.

When applying IGF Code 6.4.13.1.1.1.5, loss of vacuum for vacuum insulated tanks is also to be considered.

6.4.3 *(1/10/2021)*

Where minimum design temperature is lower than -196°C, property testing for insulation materials is to be carried out with the appropriate medium, over a range of temperatures expected in service. The testing or inspection record of previous satisfactory applications with relevant technical analysis and simulations may be acceptable as an alternative.

6.5 Regulations for portable liquefied gas fuel tanks

6.5.1 *(1/10/2021)*

The requirements in IGF Code 6.5 apply.

6.6 Regulations for high compressed hydrogen containment system and chemical containment system using metal hydrides

6.6.1 *(1/10/2021)*

The high compressed hydrogen containment system consists of a group of pressure vessels supported by rack whereby the hydrogen gas is kept under pressure to increase the storage capacity at ambient temperature. The following requirements are applicable to systems with maximum allowable working pressure up to 90 MPa. Special considerations will be given to systems with design pressure above 90 MPa.

The chemical containment system using metal hydrides consists of a group of pressure vessels supported by rack whereby the hydrogen is absorbed in the metal hydrides (metal powder). The following requirements are applicable to systems with design pressure up to 10 MPa.

6.6.2 *(1/10/2021)*

The requirements in IGF Code 6.6 apply.

Special consideration mentioned in IGF Code 6.6.4 is to be intended as risk assessment according to [4.2].

6.6.3 *(1/10/2021)*

The pressure vessels (cylinders) are to be designed and tested according to international recognized standards with loads and allowable stress to be preliminary agreed with the Society.

6.6.4 *(1/10/2021)*

The rack supporting the pressure vessels and its connection to adjacent structure are to be designed taking into account at least the following loads as defined in IGF code 6.4.9.3.3 and 6.4.9.4:

- thermally induced loads if any
- vibration
- hull interaction
- weight of containment system
- static heel
- wind impact, wave impact, green sea effects and ice for installations on open deck
- loads due to ship motion
- collision load.

6.7 Regulations for pressure relief system

6.7.1 General *(1/10/2021)*

The requirements in IGF Code 6.7 apply with the following deviations.

6.7.2 Pressure relief systems for gas fuel tanks *(1/10/2021)*

The distances given in IGF Code 6.7.2.7.3 and 6.7.2.8 are to be replaced with proper values established by suitable techniques, in the context of the risk assessment required in

[4.2], considering the physical properties of the released gas and relevant dispersion.

For containment system other than liquefied gas fuel tanks, the sizing of pressure relief systems is to be determined according to international recognized standard where the discharge conditions are to be defined during the risk assessment taking into account the arrangement and location of containment system.

Pressure-relief devices and the inlet and discharge piping are to be designed and installed to minimize moisture accumulation and ice build up from atmospheric condensation, that could cause them to fail to function properly.

6.8 Regulations on loading limit for liquefied gas fuel tanks

6.8.1 *(1/10/2021)*

The requirements in IGF Code 6.8 apply.

6.9 Regulations for the maintaining of fuel storage condition

6.9.1 *(1/10/2021)*

The requirements in IGF Code 6.9 apply except for IGF Code 6.9.1 which is replaced by [6.9.2] below.

6.9.2 Control of liquefied gas fuel tank pressure and temperature *(1/10/2021)*

With the exception of liquefied gas fuel tanks designed to withstand the full gauge vapor pressure of the fuel under conditions of the upper ambient design temperature, liquefied gas fuel tanks' pressure and temperature are to be maintained at all times within their design range by means acceptable to the Society, e.g. by one of the following methods:

a) *reliquefaction of vapours;*

b) *thermal oxidation of vapours;*

c) pressure accumulation in a separate tank; or

d) *liquefied gas fuel cooling.*

The method chosen is to be capable of maintaining tank pressure below the set pressure of the tank pressure relief valves for a period of 15 days assuming full tank at normal service pressure, a tank valve closed by the safety system and the ship in idle condition, i.e. only power for domestic load is generated.

e) Venting of fuel vapor for control of the tank pressure, subject to risk assessment [4.2].

6.10 Regulations on atmospheric control within the fuel containment system

6.10.1 *(1/10/2021)*

The requirements in IGF Code 6.10 apply.

6.11 Regulations on atmosphere control within fuel storage hold spaces (Fuel containment systems other than type C independent tanks)

6.11.1 *(1/10/2021)*

Interbarrier and fuel storage hold spaces associated with liquefied gas fuel containment systems requiring full or partial secondary barriers are to be arranged to prevent fire risk due to hydrogen leakage and the arrangement is subject to risk assessment according to [4.2].

6.12 Regulations on environmental control of spaces surrounding type C independent tanks

6.12.1 *(1/10/2021)*

Spaces surrounding liquefied gas fuel tanks are to be filled with suitable gas and be maintained in this condition with a suitable gas provided by shipboard storage, which is to be sufficient for normal consumption for at least 30 days. This is only applicable for liquefied gas fuel tanks where condensation and icing due to cold surfaces is an issue.

For vacuum insulated tanks the above requirement is not applicable if the insulation arrangement is made to prevent condensation of oxygen and of water vapor on the outer tank and it can be demonstrated through thermal analysis.

6.12.2 *(1/10/2021)*

The spaces surrounding gas fuel tanks (in gaseous form at ambient temperature) are to have a mechanical exhaust ventilation having a capacity of at least 30 air changes per hour. The fan motors are to comply with the required explosion protection in the installation area. The ventilation outlet is to be covered by a protection screen and placed in a position where no flammable gas-air mixture may be ignited.

6.13 Regulations on inerting

6.13.1 *(1/10/2021)*

The requirements in IGF Code 6.13 apply.

6.13.2 *(1/10/2021)*

The spaces where the inert gas double block and bleed valves and closable non-return valve are fitted are to be classified as a Zone 1 hazardous spaces.

6.14 Regulations on inert gas production and storage on board

6.14.1 *(1/10/2021)*

The requirements in IGF Code 6.14 apply.

7 Material and general pipe design

IGF CODE REFERENCE: Ch. 7

7.1 Goal

7.1.1 *(1/10/2021)*

The goal of this paragraph [7] is to ensure the safe handling of fuel, under all operating conditions, to minimize the risk to the ship, personnel and to the environment, having regard to the nature of the products involved.

7.2 Functional requirements

7.2.1 *(1/10/2021)*

This paragraph [7] relates to functional requirements in IGF Code 3.2.1, 3.2.5, 3.2.6, 3.2.8, 3.2.9 and 3.2.10. In particular the following apply:

a) *Fuel piping is to be capable of absorbing thermal expansion or contraction caused by extreme temperatures of the fuel without developing substantial stresses.*

b) *Provision is to be made to protect the piping, piping system and components and fuel tanks from excessive stresses due to thermal movement and from movements of the fuel tank and hull structure.*

c) *If the fuel gas contains heavier constituents that may condense in the system, means for safely removing the liquid are to be fitted.*

d) *Low temperature piping is to be thermally isolated from the adjacent hull structure, where necessary, to prevent the temperature of the hull from falling below the design temperature of the hull material.*

e) *Oxygen condensation on the surface of low temperature piping is to be prevented.*

7.3 Regulations for general pipe design

7.3.1 General *(1/10/2021)*

The requirements in IGF Code 7.3 apply.

Fuel pipes in spaces made gas safe are not to include expansion joints, flexible hoses, bellows or other pipe components with poorer strength, fatigue or leakage properties than the fully welded pipe. The use of metallic flexible components can be only allowed if of double walled type, designed and tested in accordance with international recognized standard and where the sufficient flexibility of piping system cannot be granted with other methods.

7.3.2 Prevention of oxygen condensation *(1/10/2021)*

For fuel pipes containing liquid hydrogen and cold hydrogen vapor, measures are to be taken to prevent the exposed surfaces from reaching -183°C. For places where preventive measures against low surface temperature are not sufficiently effective, other appropriate measures such as ventilation which avoids the formation of highly enriched oxygen and the installation of trays recovering liquid air may be permitted in lieu of the preventive measures. Insulation on liquid hydrogen piping systems exposed to air is to be of non-combustible material and is to be designed to have a seal in the outer covering to prevent the condensation of air and subsequent oxygen enrichment within the insulation.

7.3.3 Joining of piping *(1/10/2021)*

Butt welded connections of piping are to be used.

Bolted flange connections of piping may be used where welded connections are not feasible.

Threaded connections complying with recognized standards may only be used for accessory lines and instrumentation lines with external diameters of 25 mm or less. The threaded connections are to have an increased pipe thickness and higher nominal pressure (PN). For external diameters exceeding 25 mm and up to 50 mm the use will be case by case evaluated by the Society considering the arrangement and the rupture risks.

In any case, threaded connections are to be in accordance with standards approved by the Society, and the use will be specially evaluated by the Society.

Heat treatment post-welding is to be required for all butt welds of pipes made of carbon, carbon-manganese and low-alloy steels. The Society may waive the recommendation for thermal stress relieving of pipes having wall thickness less than 10 mm in relation to the design temperature and pressure of the piping system.

7.4 Regulations for materials

7.4.1 Metallic materials *(1/10/2021)*

The requirements in IGF Code 7.4 apply.

7.4.2 *(1/10/2021)*

The materials whose design temperature is lower than -165°C, are to be in accordance with international recognized standards.

Materials which according to EN 13480-2 may be used up to -270°C are allowed, subject to having 60 J impact energy of base material and 40 J for welding material at -196°C.

Other alternative proposals to demonstrate the suitability of selected material (e.g. use of test data for samples of base material alloys and welding material impact tested at -269°C with liquefied helium) will be evaluated case by case basis by the Society.

It is to be ensured that deterioration (ageing) of material will not affect its resistance capacity to hydrogen embrittlement.

7.4.3 *(1/10/2021)*

Materials of construction and ancillary equipment such as insulation are to be resistant to the effects of high oxygen concentrations caused by condensation and enrichment at the low temperatures attained in parts of the hydrogen containment system and piping working at cryogenic temperature. Due consideration is to be given to ventilation in areas where condensation might occur, to avoid the stratification of oxygen-enriched atmosphere.

8 Bunkering

IGF CODE REFERENCE: Ch. 8

8.1 Goal

8.1.1 *(1/10/2021)*

The goal of this paragraph [8] is to provide for suitable systems on board the ship to ensure that bunkering can be conducted without causing danger to persons, the environment or the ship.

8.2 Functional requirements

8.2.1 *(1/10/2021)*

This paragraph [8] relates to functional requirements in IGF Code 3.2.1 to 3.2.11 and 3.2.13 to 3.2.17. In particular the following apply.

The piping system for transfer of fuel to the storage tank is to be designed such that any leakage from the piping system *cannot cause danger to personnel, the environment or the ship.*

8.3 Regulations for bunkering station

8.3.1 General *(1/10/2021)*

The requirements in IGF Code 8.3 apply, with the following additions:

a) The bunkering station is to be under direct view from a bunkering control station, if any, or from the bridge; as an alternative a CCTV system may be considered.

b) For bunkering of hydrogen, a risk assessment is to be carried out, following the steps outlined below:

1) The team of experts is to conduct a Hazard Identification (HAZID) to agree on the scenarios to be subjected to the risk assessment, and on the assumptions regarding the most critical events (typically, connection failures causing an hydrogen spill). The effects in the bunker station and above and below it are to be simulated by means of the tools mentioned in [5.10.2].

2) As a minimum, a scenario to be assumed is the failure of the presentation flange on the bunkering line. The simulation is to focus on the calculation of the amount of hydrogen released before the intervention of ESD and the stop of the bunkering pumps. After the stop of the pumps, the amount of the discharge of the residual inventory of the hose or loading arm is to be calculated according to the bunkering configuration, to estimate whether it is significant; in this case, it is to be taken into account in the simulation.

3) Reasonable assumptions on the extent of connection failures or other selected events and the parameters of the hydrogen process are to be made by the team of experts, preferably on the basis of statistics available in the public domain or provided and documented by stakeholders or using industry safety standards.

4) Reasonable assumptions on the operation of ventilation system are to be made according to layout and procedures of the bunker station.

5) For the case of liquified hydrogen, in order to verify the release cloud and drip tray capacity, a specific simulation is to be set up, aimed at evaluating the maximum amount of hydrogen released and spilled onto the drip tray, the evaporation rate, and the possibility to fully accommodate the hydrogen in the drip tray avoiding any over-board disposal.

6) In particular, the dispersion of hydrogen resulting from leakage and/or evaporation in the bunker station and from the bunker station to the upper decks, if realistically possible, is to be simulated.

7) In case a double walled bayonet coupling is used instead of a single presentation flange, the hydrogen release scenario is to be adapted accordingly.

c) Low temperature steel shielding is to be considered if the escape of cold jets impinging on surrounding hull structure is possible.

8.4 Regulations for manifold

8.4.1 *(1/10/2021)*

The requirements in IGF Code 8.4 apply.

8.5 Regulations for bunkering system

8.5.1 *(1/10/2021)*

An arrangement for purging fuel bunkering lines with inert gas is to be provided.

8.5.2 *(1/10/2021)*

A manually operated stop valve and a remote operated shut-down valve in series, or a combined manually operated and remote valve is to be fitted in every bunkering line close to the connecting point. It is to be possible to operate the remote valve in the control location for bunkering operations and/or from another safe location.

8.5.3 *(1/10/2021)*

Means are to be provided for draining any fuel from the bunkering pipes upon completion of operation, unless these are arranged for a permanent containment of hydrogen.

8.5.4 *(1/10/2021)*

Bunkering lines are to be arranged for inerting and gas freeing. When not engaged in bunkering, the bunkering pipes are to be free of gas, unless these are arranged for a permanent containment of hydrogen and the consequences of not gas freeing are evaluated in the risk assessment according to [4.2].

8.5.5 *(1/10/2021)*

In case bunkering lines are arranged with a cross-over it is to be ensured by suitable isolation arrangements that no fuel is transferred inadvertently to the ship side not in use for bunkering, unless the lines are arranged for a permanent containment of hydrogen.

8.5.6 *(1/10/2021)*

A ship-shore link (SSL) or an equivalent means for automatic and manual ESD communication to the bunkering source is to be fitted.

8.5.7 *(1/10/2021)*

If not demonstrated to be required at a higher value due to pressure surge considerations a default time as calculated in accordance with IGF Code 16.7.3.7 from the trigger of the alarm to full closure of the remote operated valve required by [8.5.3] is to be adjusted.

8.5.8 *(1/10/2021)*

Means are to be provided to manage the vapors generated during the bunkering, either by vapor return to the bunkering manifold or by one of the systems required in [6.9.2].

9 Fuel supply to consumers

IGF CODE REFERENCE: Ch. 9

9.1 Goal

9.1.1 *(1/10/2021)*

The goal of this paragraph [9] *is to ensure safe and reliable distribution of fuel to the consumers.*

9.2 Functional requirements

9.2.1 (1/10/2021)

This paragraph [9] is related to functional requirements in IGF Code 3.2.1 to 3.2.6, 3.2.8 to 3.2.11 and 3.2.13 to 3.2.17. In particular the following apply:

a) *the fuel supply system is to be so arranged that the consequences of any release of fuel will be minimized, while providing safe access for operation and inspection;*

b) *the piping system for fuel transfer to the consumers is to be designed in a way that a failure of one barrier cannot lead to a leak from the piping system into the surrounding area causing danger to the persons on board, the environment or the ship; and*

c) *fuel lines outside the machinery spaces are to be installed and protected so as to minimize the risk of injury to personnel and damage to the ship in case of leakage.*

9.3 Regulations on redundancy of fuel supply

9.3.1 (1/10/2021)

The requirements in IGF Code 9.3 apply.

9.4 Regulations on safety functions of gas supply system

9.4.1 (1/10/2021)

The requirements in IGF Code 9.4 apply with the following deviations from IGF Code 9.4.7.

9.4.2 (1/10/2021)

In cases where the master gas fuel valve is automatically shut down, the complete gas supply branch downstream of the double block and bleed valve is to be automatically vented to the vent mast; the requirements in [6.7.2] i) apply.

9.5 Regulations for fuel distribution outside of machinery space

9.5.1 (1/10/2021)

Fuel pipes are to be protected by a secondary enclosure. *This enclosure can be a ventilated duct or a double wall piping system. The duct or double wall piping system is to be mechanically under pressure ventilated with 30 air changes per hour, and gas detection as required in IGF Code 15.8 is to be provided.* In case of low temperatures in the annular space of piping, the ventilation is to be made by dry air. *Other solutions providing an equivalent safety level may also be accepted by the Society* (e.g. use of pressurized inert gas in the double wall annular space).

9.5.2 (1/10/2021)

The requirement in [9.5.1] *need not be applied for fully welded* open ended *fuel gas vent pipes led through mechanically ventilated spaces* nor for fully welded fuel gas pipes on the open deck.

9.6 Regulations for fuel supply to consumers in gas-safe machinery spaces

9.6.1 (1/10/2021)

The requirements in IGF Code 9.6 apply.

9.6.2 (1/10/2021)

The fuel is to be supplied to machinery spaces at a temperature higher than -183°C (90 K), to prevent oxygen condensation on the pipes.

9.7 Regulations for gas fuel supply to consumers in ESD-protected machinery spaces

9.7.1 (1/10/2021)

ESD protected Machinery spaces are generally not acceptable and [5.4.1] applies.

9.8 Regulations for the design of ventilated duct, outer pipe against inner pipe gas leakage

9.8.1 (1/10/2021)

The design pressure of the outer pipe or duct of fuel systems is not to be less than the maximum working pressure of the inner pipe.

Alternatively for fuel piping systems with a working pressure greater than 1.0 MPa, the design pressure of the outer pipe or duct is not to be less than the maximum built-up pressure arising in the annular space considering the higher between:

- maximum built-up pressure as the static pressure in way of the rupture resulting from the gas flowing in the annular space.
- the local instantaneous peak pressure in way of any rupture considering the ventilation arrangements.

The tangential membrane stress of a straight pipe is not to exceed the tensile strength divided by 1,5 (Rm/1,5) when subjected to the above pressures. The pressure ratings of all other piping components are to reflect the same level of strength as straight pipes.

9.8.2 (1/10/2021)

Verification of the strength is to be based on calculations demonstrating the duct or pipe integrity. As an alternative to calculations, the strength can be verified by representative tests.

9.8.3 (1/10/2021)

The duct is to be pressure tested to show that it can withstand the expected maximum pressure at fuel pipe rupture.

9.9 Regulations for compressors and pumps

9.9.1 (1/10/2021)

The requirements in IGF Code 9.9 apply.

9.9.2 (1/10/2021)

Motors driving hydrogen compressors and pumps are to be of a type certified as suitable for operation in an explosive atmosphere (Hazardous area Zone 1) due to the presence of hydrogen, even when placed in a motor room separated from the compressors by a gastight bulkhead or deck, unless the motor room is equipped with a ventilation system having a capacity of 30 air changes per hour being continuously operated when the motors are energized. Suitable interlocks and alarms are to be provided to stop and prevent the start of the motors in case of loss of ventilation. Avoidance of unacceptable loss of power as defined in IGF Code 2.2.40 is anyway to be ensured by automatically starting a stand-by motor.

10 Power generation including propulsion and other gas consumers

IGF CODE REFERENCE: Ch. 10

10.1 Goal

10.1.1 *(1/10/2021)*

The goal of this paragraph [10] is to provide safe and reliable delivery of mechanical, electrical or thermal energy.

10.2 Functional requirements

10.2.1 *(1/10/2021)*

This paragraph [10] is related to functional requirements in IGF Code 3.2.1, 3.2.11, 3.2.13, 3.2.16 and 3.2.17. In particular the following apply:

a) *the exhaust systems are to be configured to prevent any accumulation of unburnt gaseous fuel;*

b) *unless designed with the strength to withstand the worst case over pressure due to ignited gas leaks, engine components or systems containing or likely to contain an ignitable gas and air mixture are to be fitted with suitable pressure relief systems. Dependent on the particular engine design this may include the air inlet manifolds and scavenge spaces;*

c) *the explosion venting is to be led away from where personnel may normally be present; and*

d) *all gas consumers are to have a separate exhaust system.*

10.3 Regulations for internal combustion engines of piston type

10.3.1 **General** *(1/10/2021)*

The requirements in IGF Code 10.3 apply with the following additions to IGF Code 10.3.1.2 and 10.3.1.4:

a) for hydrogen fuelled engines where the space below the piston is in direct communication with the crankcase, a crankcase forced ventilation is required, having the inlet from open areas that, in the absence of the considered inlet, would be non-hazardous and going to a dedicated duct having a hydrogen detection system;

b) *the gas extracted from auxiliary systems media is to be vented to a safe location in the atmosphere.* In the vent line a gas detection is to be installed for monitoring/alarm function.

10.4 Regulations for main and auxiliary boilers

10.4.1 *(1/10/2021)*

The requirements in IGF Code 10.4 apply.

10.5 Regulations for gas turbines

10.5.1 *(1/10/2021)*

The requirements in IGF Code 10.5 apply.

10.6 Regulations for Fuel cells

10.6.1 *(1/10/2021)*

The requirements available in Tasneef Rules for fuel cell installation in ships (FC-Ships) apply to the installation of fuel cells.

11 Fire safety

11.1

11.1.1 *(1/10/2021)*

This paragraph is void, as the provisions of IGF Code Ch 11 are not within the scope of classification.

These provisions are applied by the Society when acting on behalf of the flag Administration, within the scope of delegation (see [1.1.6]).

12 Explosion prevention

IGF CODE REFERENCE: Ch. 12

12.1 Goal

12.1.1 *(1/10/2021)*

The goal of this paragraph [12] *is to provide for the prevention of explosions and for the limitation of effects from explosion.*

12.2 Functional requirements

12.2.1 *(1/10/2021)*

This paragraph [12] is related to functional requirements in IGF Code 3.2.2 to 3.2.5, 3.2.7, 3.2.8, 3.2.12 to 3.2.14 and 3.2.17. In particular the following apply.

The probability of explosions is to be reduced to a minimum by:

a) *reducing number of sources of ignition; and*

b) *reducing the probability of formation of ignitable mixtures.*

12.3 Regulations - General

12.3.1 *(1/10/2021)*

The requirements in IGF Code 12.3 apply.

12.4 Regulations on area classification

12.4.1 *(1/10/2021)*

The requirements in IGF Code 12.4 apply.

12.5 Hazardous area zones

12.5.1 *(1/10/2021)*

The requirements in IGF Code 12.5 apply, with the following deviations.

12.5.2 *(1/10/2021)*

The extensions and types (Zone 0, Zone 1, Zone 2) of hazardous areas in way of outlet from the pressure relief valves are to be evaluated in the context of the risk assessment required in [4.2].

12.5.3 Fuel storage hold space categorization *(1/10/2021)*

a) Fuel storage hold spaces containing Type C tanks with all potential leakage sources in a tank connection space and having no access to any hazardous area, are to be considered as non-hazardous.

b) Where the fuel storage hold spaces include potential leak sources, e.g. tank connections, they are to be considered hazardous area zone 1.

c) Where the fuel storage hold spaces included bolted access to the tank connection space, they are to be considered hazardous are zone 2.

13 Ventilation

IGF CODE REFERENCE: Ch. 13

13.1 Goal

13.1.1 *(1/10/2021)*

The goal of this paragraph [13] is to provide for the ventilation required for safe operation of gas-fuelled machinery and equipment.

13.2 Functional requirements

13.2.1 *(1/10/2021)*

This paragraph [13] is related to functional requirements in IGF Code 3.2.2, 3.2.5, 3.2.8, 3.2.10, 3.2.12 to 3.2.14 and 3.2.17.

13.3 Regulations - General

13.3.1 *(1/10/2021)*

The requirements in IGF Code 13.3 apply.

13.3.2 *(1/10/2021)*

Areas where fuel covered by this Appendix can be present are to be provided with suction points of the mechanical exhaust system fitted in the high part of the space, where hydrogen is likely to accumulate.

13.4 Regulations for tank connection space

13.4.1 *(1/10/2021)*

The requirements in IGF Code 13.4 apply.

13.5 Regulations for machinery spaces

13.5.1 *(1/10/2021)*

The requirements in IGF Code 13.5 apply.

13.6 Regulations for fuel preparation room

13.6.1 *(1/10/2021)*

The requirements in IGF Code 13.6 apply.

13.7 Regulations for bunkering station

13.7.1 *(1/10/2021)*

Bunkering station are to be suitably ventilated to ensure that any vapour being released during bunkering operations will be removed. *If the natural ventilation is not sufficient, mechanical ventilation is to be provided in accordance with the risk assessment required by [4.2].*

13.8 Regulations for ducts and double pipes

13.8.1 *(1/10/2021)*

The requirements in IGF Code 13.8 apply with the following deviations from IGF Code 13.8.2 and 13.8.3.

13.8.2 *(1/10/2021)*

The ventilation system for double piping and for gas valve unit spaces in gas safe engine-rooms is to be independent of all other ventilation systems except other fuel supply ventilation systems.

13.8.3 *(1/10/2021)*

The ventilation inlet for the double wall piping or duct is always to be located in a non-hazardous area in open air *away from ignition sources. The inlet opening is to be fitted with a suitable wire mesh guard and protected from ingress of water.*

14 Electrical installations

IGF CODE REFERENCE: Ch. 14

14.1 Goal

14.1.1 *(1/10/2021)*

The goal of this paragraph [14] *is to provide for electrical installations that minimize the risk of ignition in the presence of a flammable atmosphere.*

14.2 Functional requirements

14.2.1 *(1/10/2021)*

This paragraph [14] is related to functional requirements in IGF Code 3.2.1, 3.2.2, 3.2.4, 3.2.7, 3.2.8, 3.2.11, 3.2.13 and 3.2.16 to 3.2.18. In particular the following apply.

Electrical generation and distribution systems, and associated control systems, are to be designed such that a single fault will not result in the loss of ability to maintain fuel tank pressures and hull structure temperature within normal operating limits.

14.3 Regulations - General

14.3.1 *(1/10/2021)*

The requirements in IGF Code 14.3 apply.

15 Control monitoring and safety systems

IGF CODE REFERENCE: Ch. 15

15.1 Goal

15.1.1 *(1/10/2021)*

The goal of this paragraph [15] *is to provide for the arrangement of control, monitoring and safety systems that support an efficient and safe operation of the gas-fuelled installation as covered in the other paragraphs of this Appendix.*

15.2 Functional requirements

15.2.1 *(1/10/2021)*

This paragraph [15] *is related to functional requirements in IGF Code 3.2.1, 3.2.2, 3.2.11, 3.2.13 to 3.2.15, 3.2.17 and 3.2.18. In particular the following apply:*

a) *the control, monitoring and safety systems of the gas-fuelled installation are to be so arranged that the remaining power for propulsion and power generation is in accordance with IGF Code 9.3.1 in the event of single failure;*

b) *a gas safety system is to be arranged to close down the gas supply system automatically, upon failure in systems as described in IGF Code Table 1 and upon other fault conditions which may develop too fast for manual intervention;*

c) *the safety functions are to be arranged in a dedicated gas safety system that is independent of the gas control system in order to avoid possible common cause failures. This includes power supplies and input and output signal;*

d) *the safety systems including the field instrumentation are to be arranged to avoid spurious shutdown, e.g. as a result of a faulty gas detector or a wire break in a sensor loop; and*

e) *where two or more gas supply systems are required to meet the regulations, each system is to be fitted with its own set of independent gas control and gas safety systems.*

15.3 Regulations - General

15.3.1 *(1/10/2021)*

The requirements in IGF Code 15.3 apply.

15.4 Regulations for bunkering and liquefied gas fuel tank monitoring

15.4.1 *(1/10/2021)*

The requirements in IGF Code 15.4 apply.

15.5 Regulations for bunkering control

15.5.1 *(1/10/2021)*

The requirements in IGF Code 15.5 apply.

15.6 Regulations for gas compressor monitoring

15.6.1 *(1/10/2021)*

The requirements in IGF Code 15.6 apply.

15.7 Regulations for gas engine monitoring

15.7.1 *(1/10/2021)*

The requirements in IGF Code 15.7 apply.

15.8 Regulations for gas detection

15.8.1 *(1/10/2021)*

The requirements in IGF Code 15.8 apply, with the following deviations.

15.8.2 *(1/10/2021)*

Permanently installed gas detectors are also to be fitted:

a) at ventilation inlets to service spaces, ro-ro spaces, special category spaces and other machinery spaces if required based on the risk assessment required in [4.2];

b) in bunker stations.

15.8.3 *(1/10/2021)*

Gas detection equipment is to be designed, installed and tested in accordance with IEC 60079-29-1 or an equivalent recognized standard acceptable to the Society.

15.8.4 (1/10/2021)

Audible and visible alarms from the gas detection equipment are to be located on the navigation bridge or in the continuously manned central control station or safety centre.

15.9 Regulations for fire detection

15.9.1 *(1/10/2021)*

The requirements in IGF Code 15.9 apply.

15.10 Regulations for ventilation

15.10.1 *(1/10/2021)*

The requirements in IGF Code 15.10 apply.

15.11 Regulations on safety functions of fuel supply systems

15.11.1 *(1/10/2021)*

The requirements in IGF Code 15.11 apply.

16 Manufacture workmanship and testing

IGF CODE REFERENCE: Ch. 16

16.1 General

16.1.1 *(1/10/2021)*

The manufacture, testing, inspection and documentation are to be in accordance with recognized standards and the regulations given in this Appendix.

16.1.2 *(1/10/2021)*

Where post-weld heat treatment is specified or required, the properties of the base material are to be determined in the heat treated condition, in accordance with the applicable

Tables of IGF Code Ch 7 and the weld properties are to be determined in the heat treated condition in accordance with IGF Code 16.3. In cases where a post-weld heat treatment is applied, the test regulations may be modified at the discretion of the Society.

16.2 General test regulations and specifications

16.2.1 Tensile test *(1/10/2021)*

The requirements in IGF Code 16.2 apply.

16.3 Welding of metallic materials and non-destructive testing for the fuel containment system

16.3.1 General *(1/10/2021)*

The requirements in IGF Code 16.3 apply.

16.4 Other regulations for construction in metallic materials

16.4.1 General *(1/10/2021)*

The requirements in IGF Code 16.4 apply.

16.5 Testing

16.5.1 General *(1/10/2021)*

The requirements in IGF Code 16.5 apply.

16.5.2 Testing and inspections during construction *(1/10/2021)*

a) Process pressure vessels containing hydrogen are categorized as class 1 for the application of the requirements in Sec 3, irrespective of their design pressure and design temperature.

b) The fuel containment system for low temperature hydrogen is to be inspected for cold spots during or immediately following the first hydrogen bunkering, when steady thermal conditions are reached. Inspection of the integrity of thermal insulation surfaces that cannot be visually checked is to be carried out in accordance with the requirements of the Society.

16.6 Welding, post-weld heat treatment and non-destructive testing

16.6.1 General *(1/10/2021)*

The requirements in IGF Code 16.6 apply.

16.7 Testing regulations

16.7.1 *(1/10/2021)*

The requirements in IGF Code 16.7 apply.

SECTION 38 H2 FUELLED READY (X1, X2, X3…)

1 General

1.1 Application

1.1.1 *(1/10/2021)*

The additional class notation **H2 FUELLED READY (X1, X2, X3…)** is assigned, in accordance with Pt A, Ch 1, Sec 2, [6.14.58], to ships fulfilling the requirements of this section.

A Statement of Compliance may be issued to ships not classed with the Society, fulfilling the requirements of this section.

2 Assignment criteria

2.1

2.1.1 *(1/10/2021)*

The additional class notation **H2 FUELLED READY (X1, X2, X3…)** is assigned:

a) to new buildings that are in accordance with the Tasneef Rules in force at the date when the contract for construction between the Owner and the shipbuilder is signed;

b) to existing ships that are in accordance with the Tasneef Rules in force at the date of request of notation assignment

having the following characteristics:

- Design (X1); and
- One of the following:
  - Structure (X2);
  - Tank (X3);
  - Piping (X4);
  - Users (X5).

The notation characteristics **(X1, X2, X3…)** are defined in Tab 1.

Irrespective of previous assignment of the **H2 FUELLED READY** notation, when the ship will be converted to use hydrogen as fuel, approval for compliance with Tasneef requirements in force at the time of conversion, followed by testing and commissioning under survey, will be required.

Table 1 : Description of the notation characteristics *(1/10/2021)*

Xi	Characteristic	Description
1	Design	The complete design of the ship with hydrogen fuelled system is found to be in compliance with the rules applicable to new buildings, including those in Pt C, Ch 1, App 14.
2	Structure	Structural reinforcements to support the fuel containment system (hydrogen fuel tank(s)) are installed and materials to support the relevant temperatures are used.
3	Tank	Hydrogen storage tank, tank isolation valve, fuel venting arrangements and, where applicable, the fuel storage hold space, structural fire protection and ventilation arrangements for under deck tank locations are built under survey and installed in accordance with approved drawings and certified fit for hydrogen fuel operations.
4	Piping	All piping equipment associated with the hydrogen fuelled system, e.g. pipes, pumps, valves, etc. including all bunkering arrangements and associated access arrangements including structural fire protection as applicable, are built and installed in accordance with approved drawings and certified fit for hydrogen fuel operations.

Xi	Characteristic	Description
5	Users	Engineering systems are installed in accordance with approved drawings and certified fit for using hydrogen as fuel or ready to be retrofitted: • ME_{H2r}: Main engine(s) installed can be converted to using hydrogen as fuel; • ME_{H2}: Main engine(s) installed are suitable to use hydrogen as fuel; • AE_{H2r}: Auxiliary engines installed can be converted to using hydrogen as fuel (see Note 1); • AE_{H2}: Auxiliary engines installed are suitable to use hydrogen as fuel (see Note 1); • B_{H2r}: Boilers installed can be converted to using hydrogen as fuel; • B_{H2}: Boilers installed can be operated on hydrogen as fuel.
Note 1: The capacity of the converted auxiliary engines is to be sufficient for the ship power balance. Examples: • H2 FUELLED READY (Design, Users(ME_{H2r})) means that the future hydrogen fuelled design has been examined and found in compliance with the applicable rules and the ship main engine is of a type that can be converted to use hydrogen as fuel; • H2 FUELLED READY (Design, Structure, Users(ME_{H2r}, AE_{H2r})) means that the future hydrogen fuelled design has been examined and found in compliance with the applicable rules, the ship is constructed with the necessary structural reinforcement and suitable materials around the hydrogen fuel tank(s), and the main and auxiliary engines are of types that can be converted to dual fuel engines.		

3 Documents to be submitted

3.1 Documentation requirements for characteristic "Design"

3.1.1 *(1/10/2021)*

The list of plans and documents to be submitted is given in Tab 2.

The documentation is to be marked "H2 FUELLED READY" in each drawing title.

The Society reserves the right to require additional documents in the case of non-conventional design or if it is deemed necessary for the evaluation of the systems and components.

3.2 Documentation requirements for characteristics "Structure", "Tank", "Piping", "Users"

3.2.1 *(1/10/2021)*

The design, applicable to the assigned characteristic, is to be submitted and approved for compliance with the applicable requirements of Pt C, Ch 1, App 14.

Table 2 : Documents to be submitted *(1/10/2021)*

Item n°	Documentation	Additional description
1	General arrangement	Including hydrogen tank location with distances from ship side, adjacent spaces, bunkering station location, pipe routing, engine room arrangement and location of any other spaces containing hydrogen equipment. Location of entrances (air locks as relevant) for spaces with hydrogen equipment are also to be shown.
2	Engine room arrangement	Only if not included in the general arrangement.
3	Design philosophy/ description	Including information on the hydrogen storage, machinery configuration, engine room arrangements, fuel arrangements, shut down philosophy, redundancy considerations, etc.
4	Hazardous zones drawing	General arrangement plan with the indication of the hazardous area classification according to IEC 60092-502, but including the additional areas to be regarded as hazardous in respect of oxygen depleted atmosphere.
5	Ventilation system	For hydrogen equipment spaces, including ventilation capacity, location of inlets and outlets, segregation from other ventilation systems.
6	Tank drawings and arrangement	Including arrangement of tank connection space and pump rooms/compressor rooms where relevant. The hydrogen tank design drawings are preferably to contain sufficient detail to allow for structural strength and thermal exposure calculations for surrounding structure.
7	Structural strength calculation for the hydrogen fuel tank location	

Item n°	Documentation	Additional description
8	Temperature calculations around the hydrogen fuel tanks	In case the hydrogen is not carried in a fully-pressurized status at ambient conditions.
9	P&ID for hydrogen bunkering and hydrogen fuel systems	Including details for double piping/ducts and arrangement/location of vent mast/vent outlet(s) for pressure relief valves and purging.
10	Inert gas system	
11	Bilge system	Where fitted in spaces containing hydrogen equipment.
12	Stability calculations with hydrogen tank(s) included	
13	Bunkering station arrangement	
14	Risk assessment report	