Guidance for Fuel Cell Systems on Board of Ships

2022. 02.



Machinery Rule Development Team

- Main Amendments -

(1) Effective date : 1 Jul. 2022 (Date of the application for approval)

- Guidance fuel cell system on bard of ships have been updated.
 - Added type approval for fuel cell module.
 - Amended to increase or decrease the requirements of type test in consideration of the various technologies and types of fuel cells and operating conditions in the ship environment.
 - Add the requirements for composite material pressure vessels for fuel containment of compressed hydrogen gas

Present	Amendment	Note
CHAPTER 1 GENERAL	CHAPTER 1 GENERAL	〈Guidance for Fuel Cell Systems on Board of Ships〉
Section 1 General	Section 1 General	(Amendment) Guidance fuel cell system on bard
101. Application <i>(2020)</i>	101. Application <i>(2020)</i>	of ships have been updated. (effective date:
1. This Guidance is to apply to with fuel cell power installations of board of ships used as auxiliary or main source of power.	 This Guidance is to apply to with fuel cell power installations on board of ships used as auxiliary or main source of power. 	the date of contract for construction on or after
 2. The scope of this Guidance covers the requirements for the arrangement and design of fuel cell power installations in 102. 3 (4) and the spaces containing such installations. Regulations such as storage preparation, distribution, etc. of fuel <u>outside the above scope</u> are to be covered by the relevant regulations of Rules for Ships using Low-flashpoint Fuels depending on the fuel used. Additional safet considerations may be required when using rich hydrogen reformed fuel as fuel in fuel cells. 3. ~ 6. (omitted) 	 2. The scope of this Guidance <u>mainly</u> covers the requirements for the arrangement and design of fuel cell power installations in 102. 3 (4) and the spaces containing such installations. Regulations such as storage, preparation, distribution, etc. of fuel <u>other than this guidance</u> are to be covered by the relevant regulations of Rules for Ships using Low-flashpoint Fuels depending on the fuel used. Additional safety considerations may be required when using rich hydrogen reformed fuel as fuel in fuel cells. (2022) 3. ~ 6. (same as the present) 	 O1.Jul.2022> Addition of requirements for composite material pressure vessels for fuel containment of compressed hydrogen gas other than fuel cell power installations.

Present	Amendment	Note
Present 102. General (2020) 1. ~ 2. (omitted) 3. Definitions For the purpose of these Guidances, the terms used have the meanings defined in the following paragraphs. Terms not defined have the same meaning as in SOLAS chapter II-2 and Rules for Ships using Low-flashpoint Fuels. (1) Fuel cell is a source of electrical power in which the chemical energy of a fuel cell fuel is converted directly into electrical and thermal energy by electrochemical oxidation.	 Amendment 102. General (2020) 1. ~ 2. (same as the present) 3. Definitions For the purpose of these Guidances, the terms used have the meanings defined in the following paragraphs. Terms not defined have the same meaning as in SOLAS chapter II-2 and Rules for Ships using Low-flashpoint Fuels. (1) Fuel cell is a source of electrical power in which the chemical energy of a fuel cell fuel is converted directly into electrical and thermal energy by electrochemical oxidation. (2) Fuel cell stack is an assembly of cells, separators, cooling plates, manifolds and a supporting structure that electrochemically converts, typically, hydrogen-rich gas and air reactants to DC power, heat and other reaction products. (2022) (3) Fuel cell module is an assembly incorporating one or more fuel cell stacks and, if applicable, additional components, which is in- 	Note - IEC 62282-2-100 3.8 - IEC 62282-2-100 3.1
<u>(2) ~ (11)</u> ⟨omitted⟩ (hereafter, omitted)	 cell stacks and, if applicable, additional components, which is intended to be integrated into a power system or a vehicle. A fuel cell module comprises the following main components: one or more fuel cell stack(s), a piping system for conveying fuels, oxidants and exhausts, electric connections for the power delivered by the stack(s) and means for monitoring, control or both. Additionally, a fuel cell module can comprise: means for conveying additional fluids (e.g. cooling media, inert gas), means for detecting normal and abnormal operating conditions, enclosures or pressure vessels and module ventilation systems, and the required electronic components for module operation and power conditioning. (2022) (4) ~ (13) (same as the present) 	- Number changed

Present	Amendment	Note
CHAPTER 2 CONSTRUCTION AND INSTALLATION (2020)	CHAPTER 2 CONSTRUCTION AND INSTALLATION <i>(2020)</i>	
Section 6 Fuel Cells and Associated Components	Section 6 Fuel Cells Associated Auxiliaries	
601. General The For the fuel cell module, the requirements in KS C IEC 62282-2 <u>"Fuel cell technology-Sec.2:fuel cell module" or equivalent standards</u> may be complied with, but will also have to take the environmental and operating conditions in a ship into account. 	 601. General 1. The For the fuel cell module, the requirements in KS C IEC 62282-2 "Fuel cell technology Sec.2:fuel cell module" or equivalent standards may be complied with, but will also have to take the environmental and operating conditions in a ship into account. 	- Move to 701. 1
<u>602.</u> Fuel Reformer Systems	<u>601.</u> Fuel Reformer Systems	- Number changed
Section 7 Manufacture, Workmanship and Testing	Section 7 Manufacture, Workmanship and Testing	
701. General	701. General	
 Valves containing reformed fuel are to be tightness tested with hy- drogen or an appropriate test gas to show that there is no leakage. After assembly, piping systems containing reformed fuel are to be tightness tested with hydrogen or an appropriate test gas to show that there is no leakage. 	1. Fuel cell module is to be type approved in accordance with IEC 62282-2-100 "Fuel cell technologies - Fuel cell modules - Safety" or standards recognized by the Society. The type test requirements may be reduced or added in consideration of various technologies and types of fuel cells and operating conditions in the ship environment.	 Added type approval for fuel cell module.
 Expansion bellows for fuel cell fuel system are subject to type approval. 	(2022) 2. Fuel cell power installation is be type approved in accordance with	- Amended to increase or decrease the re-
3. The fuel cell power systems are to be subjected to type approval, and the type tests are to be in accordance with the IEC 62282-3-100 "Stationary fuel cell power systems-Safety", but will also have to take the environmental and operating conditions in a ship into account.	IEC 62282-3-100 "Fuel cell technologies - Stationary fuel cell power systems - Safety" or standards recognized by the Society. The type test requirements may be reduced or added in consideration of vari- ous technologies and types of fuel cells and operating conditions in the ship environment. (2022)	quirements of type test in consideration of the various technologies and types of fuel cells and operating con-
	3. Valves containing reformed fuel are to be tightness tested with hy- drogen or an appropriate test gas to show that there is no leakage. After assembly, piping systems containing reformed fuel are to be tightness tested with hydrogen or an appropriate test gas to show that there is no leakage.	ditions in the ship environment.
	4. Expansion bellows for fuel cell fuel system are subject to type approval.	

Present	Amendment	Note
702. ~ 703. {omitted}	 702. ~ 703. (same as the present) 704. Composite material pressure vessels for fuel containment of compressed hydrogen gas (2022) 1. Composite material pressure vessels for fuel containment of compressed hydrogen gas with an internal volume of 450L or less that supply hydrogen fuel to fuel cells (hereinafter referred to as "vessels") are to obtain type approval from the Society. 2. Tests and inspections The composition, quality, etc. of the vessel materials are verified through test reports signed by the material manufacturer. The vessel manufacturers verify that the construction of all finished vessels is consistent with the design. In addition, it is to be verified and recorded that the main dimensions and weight of vessels satisfy the design tolerances set by the manufacturers. The vessel manufacturers are to measure and record the dimensions of the threads of the attachment ports of all vessels valves with a plug gauge, etc That the maximum defect size of the metal liner does not exceed the allowable defects are to be confirmed by ultrasonic tests or non-destructive testing method used for verification is to be capable of detecting the maximum allowable defect size. Whether the defects present in the non-metallic liner exceed the limit value of the allowable defects suggested by the vessel manufacturers is to be checked through visual inspection or non-destructive tests. The vessel manufacturers are to measure and record the hardness according to ISO 6506-1 after heat treatment for all manufactured Type 3 metal liners, check whether the value determined in the design conditions is obtained. The hardness for the liner is measured at the center of the vessel and at the end of the hemisphere. 	 Add the type approval requirements for com- posite material pres- sure vessels for fuel containment of com- pressed hydrogen gas

Present	Amendment	Note
	 (6) All vessels of Type 4 are to be subjected to a tightness test in accordance with the following. (A) Vessels are to be dried so that it is free of moisture. (B) Nitrogen is to be filled with containing a detectable gas such as hydrogen or helium and hold the pressure for at least 3 minutes to working pressure. (C) No gas leakage through cracks or defects is to be identified. (7) All vessels are subjected to pressure test according to the following. (A) The pressure test is to be carried out at pressure of 1.5 times or more of working pressure. However, in any case, the autofrettage pressure is not to be exceeded. In the case of Type 3 vessels, before autofrettage and pressure test, the internal pressure is not to exceed 90% of the pressure test pressure is not to exceed 90% of the pressure cannot be maintained due to a problem with the test equipment, the test is to be retested at an increased pressure of 0.7 MPa. The retest is not to be repeated more than two times. (C) The leakage through cracks or defects is not to be occur, and for Type 3 vessels, the permanent expansion rate is not to exceed 5%, and for Type 4 vessels, the elastic expansion rate. 	
(hereafter, omitted)	(hereafter, same as the present)	