22-420

RULES FOR THE SURVEY AND CONSTRUCTION OF STEEL SHIPS

GUIDANCE FOR THE SURVEY AND CONSTRUCTION OF STEEL SHIPS

Part H Electrical Installations

Rules for the Survey and Construction of Steel Ships
Part H 2022 AMENDMENT NO.2
Guidance for the Survey and Construction of Steel Ships
Part H 2022 AMENDMENT NO.2

Rule No.89 / Notice No.64 27 December 2022
Resolved by Technical Committee on 27 July 2022

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NIPPON KAIJI KYOKAI

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

RULES FOR THE SURVEY AND CONSTRUCTION OF STEEL SHIPS

RULES

Part H Electrical Installations

2022 AMENDMENT NO.2

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Rule No.89 27 December 2022
AMENDMENT TO THE RULES FOR THE SURVEY AND CONSTRUCTION OF STEEL SHIPS

"Rules for the survey and construction of steel ships" has been partly amended as follows:

Part H ELECTRICAL INSTALLATIONS

Chapter 2 ELECTRICAL INSTALLATIONS AND SYSTEM DESIGN

2.11 Accumulator Batteries

Paragraph 2.11.1 has been amended as follows.

2.11.1 General*

1 The requirements given in this **2.11** apply to all permanently installed vented types of secondary batteries. However, the requirements specified in **2.11.5-4** are also applicable to valve-regulated sealed types of batteries.

2 Accumulator battery systems consisting of lithium-ion batteries with total capacities of 20 *kWh* or more and associated equipment are to be in accordance with **Annex 2.11.1-2**.

~~**2**~~**3** Any usage of types of secondary batteries other than vented types of secondary batteries and the secondary batteries specified in **-2** above is required to be as deemed appropriate by the Society.

~~**3**~~**4** Accumulator batteries are to be able to suitably perform with respect to their intended service.

Annex 2.11.1-2 has been added as follows.

Annex 2.11.1-2 Accumulator Battery Systems

1.1 General

1.1.1 Scope

1 This annex applies to accumulator battery systems consisting of lithium-ion batteries with total capacities of 20 *kWh* or more, and associated equipment.

2 Accumulator battery systems consisting of lithium-ion batteries with total capacities of 20 *kWh* or more are used as emergency power sources are to comply with other relevant requirements in addition to this annex.

3 Accumulator battery systems and related equipment shall be based on relevant international standards.

1.1.2 Terminology

1 The terms used in this chapter mean as follows.

(1) "Cell" means a battery that produces electrical energy by means of an electrochemical reaction occurring between a pair of positive and negative electrodes. A cell is the smallest unit that constitutes a cell block (a group of cells connected in parallel), module or string.

(2) "Module" means a group of cells connected in parallel, or in a series.

(3) "String" means a group of modules connected in a series.

(4) "Battery management system" (hereinafter referred to as "*BMS*") means a system with functions for monitoring and protecting accumulator battery systems, battery packs, or modules.

(5) "Energy management system" (hereinafter referred to as "*EMS*") is a system that is independent from *BMS*, and has functions such as monitoring the capacity of the accumulator battery system, controlling charge and discharge, and managing the operation mode.

(6) "Battery pack" means a combination of one or more cells or modules and a *BMS*, which itself can be charged and discharged by combining it with electrical power converter.

(7) "Accumulator battery system" means a system, as shown in **Fig. 1**, that includes modules, electrical connections, *BMS* and other related devices (protection devices, cooling units, etc.).

(8) "Electrical power converter" means a device, as shown in **Fig. 2**, that converts the power stored in the accumulator battery system into the appropriate power for each case, such as when feeding (discharging) power to the distribution board or propulsion motor, or when charging the accumulator battery system from the distribution board or power generating equipment.

(9) "Accumulator battery system compartment" means a compartment where an accumulator battery system is installed.

(10) "State of Charge" (hereinafter referred to as "*SOC*") means the ratio of the available capacity at given time to the fully charged capacity at given time.

(11) "State of Health" means the ratio of the fully charged capacity of the accumulator battery system at a given time to the fully charged capacity of the latest accumulator battery system which has just been manufactured.

Fig. 1 Example of Accumulator Battery System and Associated Equipment

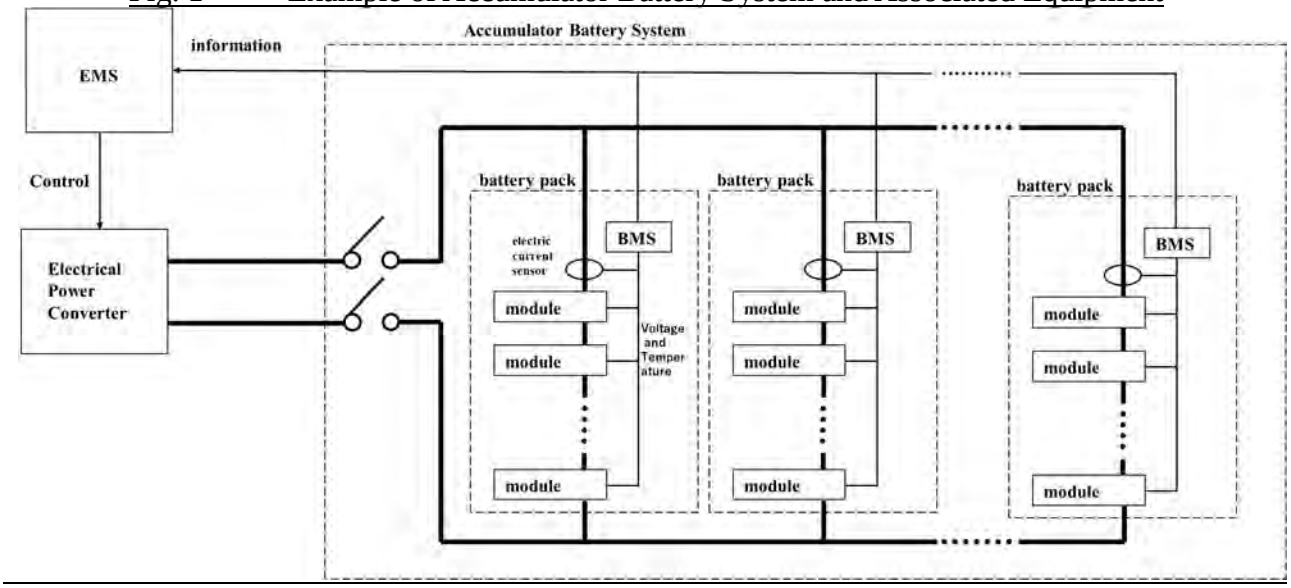
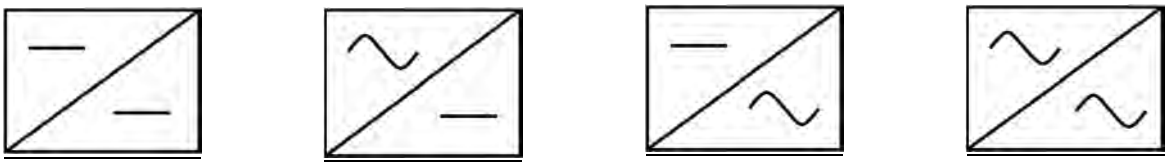


Fig. 2 Electrical Power Converter



(a) DC－DC converter (b) AC－DC converter (c) DC－AC converter (d) AC－AC converter

Fig. 3 Examples of Distribution Systems Which Use Accumulator Battery Systems

Accumulator battery system

Electrical power converter (and connected electrical loads on board the ship)

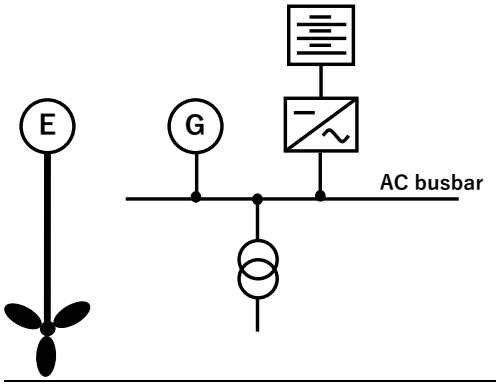
Main engine

Propeller

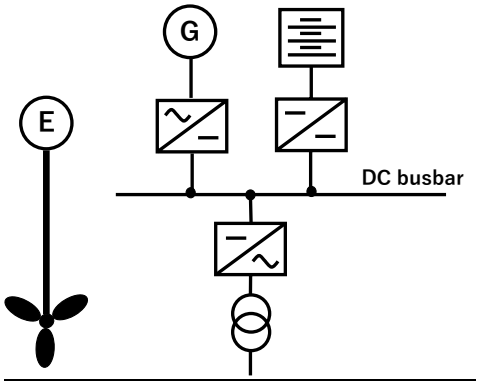
Electric generator

Clutch

Electric motor for propulsion

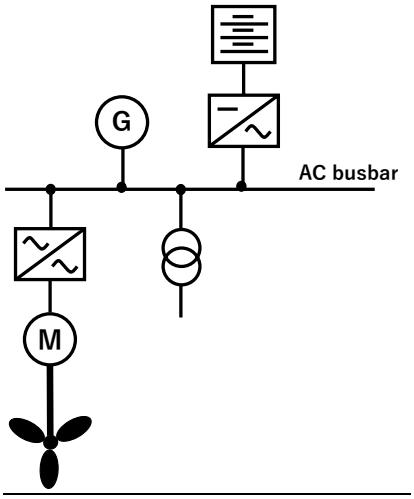


(i) AC distribution system

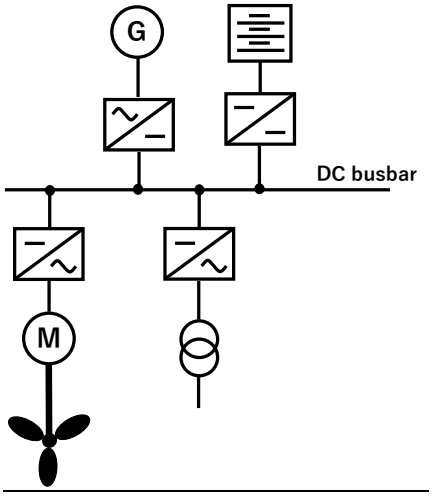


(ii) DC distribution system

(a) Cases where power sources other than electrical power is used for propulsion and where accumulator battery systems and electric generators can be used as main sources of electrical power



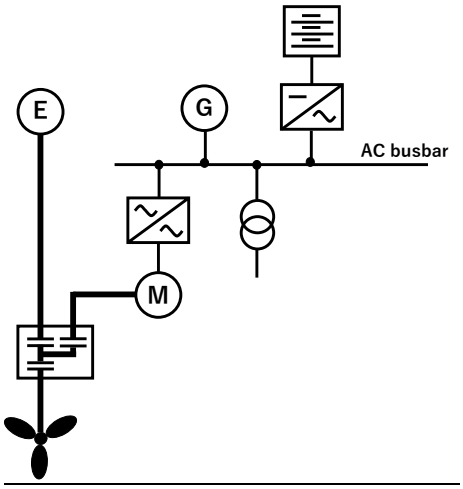
(i) AC distribution system



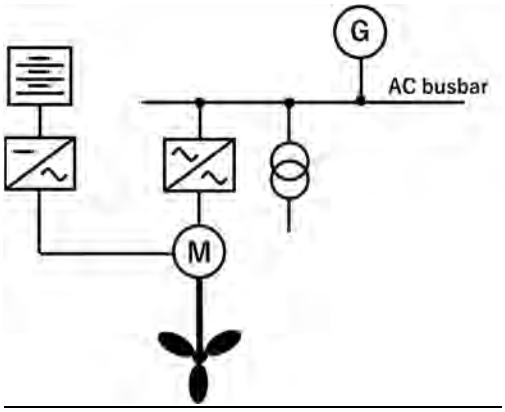
(ii) DC distribution system

(b) Cases where accumulation battery systems and electric generators for electric propulsion ships can be used as power sources for electric motors used for propulsion or as main sources of electrical power

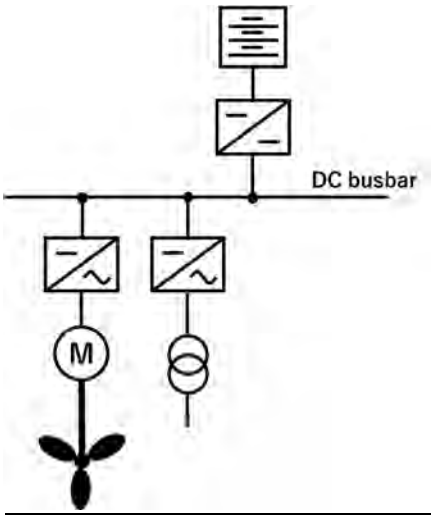
Fig. 3 Examples of Distribution Systems Which Use Accumulator Battery Systems (continued)



(c) Cases where use power sources other than electrical power are used for propulsion or main sources of electrical power, and where accumulator battery systems and electric generators can be used as main sources of electrical power



(d) Cases where accumulator battery systems for electric propulsion ships can feed only electric motors used for propulsion



(e) Cases where accumulator battery systems can be used as main sources of electrical power for electric propulsion ships

1.1.3 Submission of Drawings and Documents

1 The drawings for approval and documents for reference to be submitted to the Society for the design of systems using accumulator battery systems are as follows. However, other drawings and documents may be required if deemed necessary by the Society. As for the operation manuals specified in **(2)(a)**, it is acceptable to submit all such manuals after all the designs of the accumulator battery system have been completed.

(1) Drawings for approval (the following, if already approved under other relevant provisions, are required to be submitted as reference)
  (a) Arrangements for accumulator battery systems and other associated equipment (ventilation equipment, gas detection equipment, etc.) in accumulator battery system compartments.
  (b) Arrangements for accumulator battery system compartments (with adjacent compartments identified)
  (c) Fire protection construction plans for accumulator battery system compartments (as specified in **1.2.3-1** and **-2**)
  (d) Fire control plans (as specified in **15.2.2, Part R**).
  (e) Documents related to fire extinguishing systems (documents stating arrangements, types, extinguishing media, number of extinguishing media, etc. as specified in **1.2.3-4** and **-5**)
  (f) Arrangements of fixed fire detection and alarm systems (as specified in **1.2.3-3**)
  (g) System diagrams for the fixed fire detection and alarm systems (as specified in **1.2.3-3**)
  (h) Plans showing ventilation systems related to **1.2.2** (including detailed arrangements of pipes and ducts as well as arrangements of ventilation inlets, ventilation outlets, etc.)
  (i) System diagrams of the gas detection systems (as specified in **1.2.2-10**)
  (j) Wiring system diagrams (including ratings of circuit breakers, contactors and fuses as well as types of cables, cable sizes, etc.)
  (k) Documents related to risk assessment (as specified in **1.2.4**)
  (l) Onboard testing plans (as specified in **1.2.7** and **1.3.8**)
  (m) Layouts inside accumulator battery system panels
  (n) Arrangements outside accumulator battery system panels
(2) Documents for reference
  (a) Operation manuals
  (b) Maintenance manuals

2 The drawings for approval and documents for reference to be submitted to the Society for the designs of accumulator battery systems and their components (e.g. cells and modules) are as follows. However, other drawings and documents may be required when deemed necessary by the Society.

(1) Drawings for approval
  (a) Specifications for accumulator battery systems
  (b) System diagrams for accumulator battery systems (including descriptions of cable sizes, types, materials, etc.)
  (c) Instruction manuals for the control functions of accumulator battery systems
  (d) List of items monitored and protected by *BMS*
  (e) Testing plans for conducting the tests specified in **1.4.3**
(2) Documents for reference
  (a) Test reports for cells or modules (not required for cells or modules of types used in accumulator battery systems which have already received approval of use)
  (b) Test reports for accumulator battery systems (not required for accumulator battery systems of a type which has received approval of use)
  (c) Environmental conditions for *BMS* (temperature, vibration, humidity, *EMC*, and

protection type)

1.2 Safety Requirements

1.2.1 Installation Compartments

1 Accumulator battery system compartments are to be located aft of collision bulkheads. Accumulator battery system compartments are to not be located in accommodation areas. In cases where accumulator battery system compartments are adjacent to accommodation areas, the entrances and exits of accumulator battery system compartments are to be fitted at locations which faces areas other than accommodation areas.

2 Only equipment related to accumulator battery systems (excluding electrical power converters and *EMS*) are to be installed in accumulator battery system compartments.

3 Ambient conditions of accumulator battery systems are to be in accordance with **1.1.7, Part H**. In addition, such conditions are to be suitable for the environmental conditions (temperature, humidity, etc.) recommend for accumulator battery systems by manufacturers.

4 Ambient temperatures in accumulator battery system compartments are to be indicated in engine control rooms or at accumulator battery system control stations. In cases where ambient temperatures reach limit values recommended by accumulator battery manufacturers, alarms are to be issued in engine control rooms or at accumulator battery system control stations.

5 Electrical equipment installed at locations 450 *mm* or closer to the ceilings of accumulator battery system compartments are to be explosion-protected electrical equipment suitable for use in explosive mixtures classified as apparatus group *IIC* and temperature class *T*2 as specified in *IEC* 60079, be equivalent thereto, or be of a higher standard (explosion-protected type is not limited). However, this does not apply in cases where it is judged that explosion-protected electrical equipment is not needed per the results of the risk assessments specified in **1.2.4-1(13)**. In addition, mechanical ventilators do not need to be explosion-protected electrical equipment in cases where the ventilator is of the external motor driven type.

6 Cables installed at locations 450 *mm* or closer to the ceilings of accumulator battery system compartments are to be suitably protected in accordance with the following **(1)** and **(2)** items in cases where there are risks of fire or explosion in the event of electrical accidents at such locations.

(1) Cables are, in principle, to be protected by metal sheaths.

(2) Means for preventing mechanical damage to cables are to be provided as necessary.

1.2.2 Ventilation

1 Mechanical ventilation systems capable of ventilating at least 6 *times per hour* are to be installed in accumulator battery system compartments in order to exhaust gases generated from accumulator batteries in the event of an emergency.

2 In principle, ventilation outlets for accumulator battery system compartments are to be located near the ceiling and ventilation inlets are to be located near the floor.

3 Exhaust gases from accumulator battery system compartments are to be led to areas on open decks where there are no dangers of fire, explosion, or which may have adverse effects on human health.

4 Areas within spheres with a 1.5 *m* radius from ventilation outlets on open decks for ducts used for ventilation are classified as hazardous areas of Zone 2.

5 Operating indicators for mechanical ventilation systems, as specified in **-1** above, are to be provided at engine control rooms or accumulator battery system control stations. Visible and audible alarms are to be issued in engine control rooms or at accumulator battery system control stations in the event of mechanical ventilator malfunction or power supply loss.

6 Mechanical ventilators are to be fed by electrical power sources independent of accumulator

battery systems in the accumulator battery system compartments in which such ventilators are installed. Mechanical ventilator fans are to be of a non-sparking construction as specified in **4.5.4-1(1), Part R**.

7 Pipes and ducts used for ventilation of accumulator battery system compartments are to be leakproof and are to be separated from the pipes and ducts used for ventilation of other compartments.

8 Pipes and ducts used for ventilation of accumulator battery system compartments are to be provided with closing appliances. However, in cases where all the conditions specified in **(1)** to **(3)** of **R5.2.1-1, Part R** are satisfied, closing appliances may be omitted.

9 In cases where the closing appliances specified in **-8** above are installed, notices stating "This closing device is to be kept open and only closed in the event of fire or other emergency - Explosive Gas", are to be provided near such closing appliances to mitigate the possibility of inadvertent closing.

10 Gas detection systems are to be installed in accumulator battery system compartments to detect flammable gases that may be emitted in the event of accumulator battery malfunctions. Such gas detection systems are to be fed by electrical power sources independent of the accumulator battery systems in the accumulator battery system compartments where the gas detection systems are installed. In addition, such gas detection systems are to comply with *IEC* 60079-29-1.

11 In cases where gas concentrations of 30 *% LEL* are detected by the gas detection systems specified in **-10** above, visible audible alarms are be issued at navigation bridges as well as in engine control rooms or at accumulator battery control stations

12 In cases where gas concentrations of 30 *% LEL* are detected by the gas detection systems specified in **-10** above, all electrical equipment installed in accumulator battery system compartments, except for the following **(1)** to **(4)** items, is to be automatically shut off in an emergency. In addition, mechanical ventilation systems are to automatically operate in cases where gas concentrations of 30 *% LEL* are detected.

(1) Explosion-protected electrical equipment
(2) Gas detection systems
(3) Fire detection and alarm systems
(4) Mechanical ventilation systems

1.2.3 Fire Considerations

1 Accumulator battery system compartments are to be classified as either **(1)** or **(2)** below and **Chapter 9, Part R** is to be applied.

(1) In cases where accumulator battery systems fall under **1.3.1-1(1)** or **(2)**: Machinery Spaces of category *A*
(2) Other than **(1)** above: Other machinery spaces

2 In cases where accumulator battery system compartments are adjacent to either **(1)** or **(2)** below, fire integrity of in-between bulkheads is to be *A*-60.

(1) Machinery Spaces of category *A*
(2) Cargo spaces in which dangerous goods are intended to be carried

3 Accumulator battery system compartments are to be equipped with fixed fire detection and alarm systems complying with **Chapter 29, Part R**.

4 Compartments in which cells of accumulator battery systems are located are to be provided with either of the fixed fire-extinguishing systems specified in **10.5.1-1(1)** to **(3)**, **Part R** in accordance with the manufacturer recommendations or the characteristics of cells of accumulator battery systems.

5 In addition to the fixed fire-extinguishing systems specified in **-4** above, at least one portable fire extinguisher is to be provided in accumulator battery system compartments near entrances. Such fire extinguishers are to comply with **Chapter 24, Part R**, and the fire extinguishing media

are to be in accordance with manufacturer recommendations or the characteristics of the cells of accumulator battery systems.

1.2.4 Risk Assessments

1 Risk assessments are to be carried out to verify the risks to the safety of personnel and the ship arising from the use of accumulator battery systems. The following **(1)** through **(13)** items are to be included in such risk assessments.

(1) Risk of gas leakages that may occur during normal operations or abnormal conditions and countermeasures
(2) Risk of fire and countermeasures
(3) Risk of explosions (composition, volume and release rate of gas emitted from cells during thermal runaway, etc.) and countermeasures
(4) Appropriate detection, monitoring, and alarm methods for gas emitted from cells (e.g. numbers and locations of gas detectors and fire detectors)
(5) Appropriate ventilation methods in accumulator battery system compartments
(6) Appropriate fire extinguishing methods (kind of fire extinguishing medium, numbers and locations of fire extinguishing systems, etc.)
(7) Risk of thermal runaway of cells and countermeasures
(8) Risk of internal and external short circuits and earth faults, and countermeasures
(9) Electrical protection (appropriate protection against overcurrent, overcharge, overdischarge, etc.)
(10) Appropriate protection against electrical faults due to external leakage or pollution
(11) Risk of flooding of modules due to cooling liquid leakage and countermeasures
(12) Risk of external factors (flooding, heat, etc.) and countermeasures
(13) Necessity of making electrical equipment in accumulator battery system compartments explosion-protected types.

2 Measures are to be taken based on the results of the risk assessments described in **-1** above.

1.2.5 System Design

1 Accumulator battery systems are to be arranged so that they are easily accessible for replacement, inspection, testing and cleaning. Accumulator battery system compartments are to be equipped with locks to prevent access by unauthorised personnel.

2 Accumulator battery systems are to be fixed to ships by methods specified by manufacturers so that they cannot be rendered inoperable by the vibration, upsetting, etc. of ships.

3 Emergency disconnection to battery systems is to be available from the following **(1)** to **(3)** locations. Such disconnections are to be carried out by circuits independent of the circuits for control, monitoring and alarms (e.g. the *BMS* functions specified in **1.4.2**). Note that it is not necessary to provide such disconnections in cases where accumulator battery systems fall under **1.3.1-1(3)**. In cases where accumulator battery systems fall under **1.3.1-1(2)**, there is no need to provide such disconnections at **(3)**.

(1) Outside accumulator battery system compartments (e.g. in adjacent compartments, corridors, near doors)
(2) Engine control rooms or accumulator battery system control stations
(3) Navigation bridges

4 Earth insulation levels for accumulator battery system output terminals are to be continuously monitored insulation and audible or visual indications of abnormally low insulation values are to be provided at engine control rooms or accumulator battery system control stations. “Abnormally low insulation values” means insulation resistance values corresponding, as a standard, to 1/10 of those under normal conditions of electric circuits which are to be monitored.

1.2.6 Electrical Power Converters

1 Electrical power converters are to comply with requirements for semiconductor power converters in **2.12, Part H**.

2 Electrical power converters are to be tested at manufacturing plants or other locations as is required for the semiconductor power converters in **2.12.4, Part H**.

3 Electrical power converters for charging and discharging accumulator battery systems are to comply with the specifications specified by accumulator battery system manufacturers.

4 Electrical power converters for charging and discharging accumulator battery systems are to be capable of maintaining proper charging voltages according to the characteristics of accumulator battery systems.

1.2.7 Tests After Installation On Board

1 After installation on board, accumulator battery systems and associated equipment are to be subjected to the following **(1)** through **(3)** verification tests.

(1) Accumulator battery system operation tests
The entire system (including the accumulator battery systems, electrical power converters, *EMS*, etc.) is to be checked for normal operation.

(2) Operation tests of the protective functions provided for accumulator battery systems

(3) Operation tests of devices installed in accumulator battery system compartments (ventilation systems, gas detection systems, fire extinguishing systems, fire detection and alarm systems, etc.)

1.2.8 Maintenance, Management, etc.

1 Maintenance and management methods for accumulator battery systems, replacement times, etc. designated by accumulator battery system manufacturers are to be followed.

1.3 Additional Requirements for Electrical Propulsion, Main Electrical Power Source or Emergency Electrical Power Source Purposes

1.3.1 General

1 This **1.3** applies to accumulator battery systems that fall under any of the following **(1)** through **(3)** types.

(1) Accumulator battery systems for electrical power propulsion purposes, partial or total.

(2) Accumulator battery systems for main electrical power source purposes, partial or total.

(3) Accumulator battery systems for emergency electrical power source purposes

2 At least one or more other independent accumulator battery system is to be provided in cases where either the following **(1)** or **(2)** applies. Such accumulator battery systems are to be located in separate compartments and are to feed by independent circuits.

(1) In cases where ships are equipped with accumulator battery systems corresponding to **-1(1)** above are provided and ships are unable to maintain navigable speeds by other power supply units when the accumulator battery systems fail or stop. In such cases, “navigable speed” means those speeds at which ships are capable of being steered and kept navigable for extended periods of time. Speeds regarded as “navigable speeds” are normally 7 *knots* or speeds corresponding to 1/2 of the speed specified in **2.1.8, Part A** at full loaded draught.

(2) In cases where ships are equipped with accumulator battery systems that fall under **-1(2)** above and other main electrical power sources cannot satisfy **3.2.1-2** and **-3, Part H** when accumulator battery systems fail or stop.

3 Ships of less than 500 *gross tonnage* not engaged in international voyages need not satisfy **-2** above, subject to the approval by the Administration.

4 **Chapter 18, Part D** applies to the equipment specified in **1.3.7-1(1)** and **(2)**.

1.3.2 Accumulator Battery System Capacity

1 In cases where either **1.3.1-2(1)** or **(2)** above applies, accumulator battery systems are to have sufficient capacities, taking into account system aging, expected sailing time, etc.

1.3.3 Monitoring

1 The following **(1)** through **(4)** items are to be indicated at navigation bridges.

(1) Available accumulator battery system electrical energy (*kWh*)

(2) Available accumulator battery system electrical power (*kW*)

(3) State of Charge (*SOC*)

(4) State of Health

1.3.4 Capacity Monitoring Functions

1 *EMS* or other means are to have functions for monitoring accumulator battery system capacities as well as controlling recharge and discharge.

2 The parameters in **1.3.3-1(1)** and **(2)** are to be calculated by either *EMS* or other means.

1.3.5 Electrical Power Converters

1 Electrical power converters for feeding power from accumulator battery systems to main switchboards are to comply with the following **(1)** to **(5)** items. For DC distribution systems (e.g. **Fig. 3(a)(ii)**, **Fig. 3(b)(ii)**, **Fig. 3(e)**), only **(3)** through **(5)** apply; however, in cases where electric propulsion ships (such as shown in **Fig. 3(e)**) depend entirely on accumulator battery system power for their power requirements, **(3)** and **(4)** need not be satisfied as long as there are no problems supplying power to each load.

(1) In cases where electric power converters are driven at rated frequencies, giving rated voltages and rated symmetrical loads, the total harmonic distortion (*THD*) of distribution systems connected to such electrical power converters are not to exceed values of 5 %; this, however, does not apply if the safe operation of other electric devices connected to such distribution systems is maintained by the adoption of suitable methods for decreasing harmonic content effects such as harmonic filters, and total harmonic distortion (*THD*) values do not exceed 8 %.

(2) The following frequency characteristics are to be provided.

(a) Accumulator battery systems that fall under **1.3.1-1(2)**

i) Momentary frequency variations are, in principle, to be 10 % or less of maximum rated frequency when rated loads of electrical power converters are suddenly thrown off. However, in cases where momentary frequency variations are 10 % or less of the rated frequency when the maximum load on board is suddenly thrown off and the frequency is returned to within 1 % of the final steady frequency in not more than 5 *seconds*, momentary frequency variations in excess of 10 % of rated frequencies may be acceptable in cases where rated loads of such electric power converters are suddenly thrown off.

ii) Momentary frequency variations are, in principle, to be 10 % or less of maximum rated frequency when 50 % of the rated loads of electrical power converters are suddenly thrown on followed by the remaining 50 % of such loads suddenly being thrown on after an interval to restore the steady state. On the other hand, momentary frequency variations are to be 10 % or less of maximum rated frequency when 100 % of the rated loads of electrical power converters are suddenly thrown on, and frequencies are to return to within 1 % of final steady frequencies in not more than 5 *seconds*. In cases where such throwing-on methods are difficult according to the above requirements, and where a three-stage or more throwing-on method is adopted, throw-on power calculation sheets which take into consideration the following **1)** to

4) are to be submitted to the Society for approval.

1) Power restoration after blackout
2) Sequential starting
3) Starting with large start-up loads
4) Instantaneous load transfers in cases where one set of generators fails (during parallel running)

(b) Accumulator battery systems that fall under **1.3.1-1(3)**

i) Momentary frequency variations are not to exceed the values specified in **(a)i)** in cases where total emergency consumer loads are suddenly thrown off.

ii) Momentary frequency variations are, in principle, not to exceed the values specified in **(a)ii)** and frequencies to return to within 1 % of final steady frequencies in not more than 5 *seconds* in cases where total emergency consumer loads are suddenly thrown on. However, if it is difficult to meet the above requirements and in cases where the following **1)** through **3)** are adopted, throwing-on in steps methods may be used.

1) Total emergency consumer loads are to be thrown on within 45 *seconds* after blackout.
2) Electric power converters are to be designed so that the maximum step loads in emergency consumer loads are to be thrown on at one time.
3) Documents such as thrown on power calculations specifying the adoption of throwing on in steps are to be submitted.

iii) At all loads in ranges between no loads and total emergency consumer loads, all permanent frequency variations are not to exceed the values specified in **(a)iii)** above.

(3) Overall voltage regulation of electrical power converters is to be such that rated voltages at all loads from zero to full loads at rated power factors are maintained under steady conditions within ± 2.5 %. However, for accumulator battery systems that fall under **1.3.1-1(3)**, such voltage limits may be within ± 3.5 %.

(4) In cases where electrical power converters operating at rated voltages and rated frequencies are subjected to sudden changes in symmetrical loads within the limits of specified currents and power factors, voltages are not to fall below 85 % nor exceed 120 % of rated voltage. Voltages of such electrical power converters are then to be restored to within ± 3 % of their rated voltage in a period of not more than 1.5 *seconds*. However, for accumulator battery systems that fall under **1.3.1-1(3)**, such voltage values may be increased to ± 4 % in a period of not more than 5 *seconds*.

(5) Electrical power converters are to be capable of maintaining currents of at least three times their rated full-load currents for durations of at least 2 *seconds* or for those durations of any time delays which may be fitted in tripping devices for selective tripping. In addition, depending on the distribution systems on ships, test conditions may be relaxed in cases where there are no effects on selective trip operations of protective devices. In such case, the documents listed in **(a)** through **(d)** are to be submitted to the Society for approval beforehand.

(a) Short circuit current calculations in cases where accumulator batteries operate independently
(b) List of circuit breakers used (including breaking capacities, operation setting values, etc.)
(c) Proposal for short circuit withstand tests
(d) Declaration stating that the present selective coordination of trips is effective under short-circuit conditions

2 Electrical power converters for supplying power from accumulator battery systems to main

switchboards are to be tested at manufacturing plants or other locations in accordance with the following **(1)** and **(2)**.

(1) Tests of AC power distribution systems are to be carried out to verify that the voltage total harmonic distortion (*THD*) specified in **-1(1)** above does not exceed 5 % under no load conditions.

(2) In cases where accumulator battery systems may be operated alone, steady short-circuit tests are to be conducted to verify that **-1(5)** above is satisfied. Power sources used in such tests do not have to be accumulator battery systems. Manufacturer simulation models for electrical power converters may be used in cases where such simulations have been validated through tests of identical types of the same model.

3 Electrical power converters used to feed electric motors for propulsion are to comply with **5.2.5, Part H**.

1.3.6 Load Sharing

1 In cases where two or more accumulator battery systems are operated in parallel or in cases where accumulator battery systems and AC generators are operated in parallel, each system and generator operating in parallel is to be capable of stable operation between of 20 % and 100 % of the total combined loads of all such systems and generators. Furthermore, the *kW* loads for each system or generator operating in parallel is not to differ from its proportionate share of the total combined loads of all such systems and generators by more than 15 % of the rated output of the largest system or generator, or 25 % of the rating of the individual system or generator.

2 In cases where two or more accumulator battery systems are operated in parallel or in cases where accumulator battery systems and AC generators are operated in parallel, each system and generator operating in parallel is to be capable of stable operation and the reactive loads for each system or generator are not to differ from its proportionate share of the total combined reactive loads of all such systems and generators by more than 10 % of the rated reactive output of the largest system or generator, or 25 % of the smallest system or generator (whichever value is smaller).

1.3.7 Shop Tests

1 The electrical equipment specified below is to be tested in accordance with **18.7.1, Part D** at manufacturing plants or other locations. However, with respect to equipment which has been already received approval of use from the Society, some or all of the environmental tests specified in **18.7.1(1), Part D** may be omitted.

(1) Equipment related to the charging and discharging control of accumulator battery systems (e.g. the *EMS* referred to in **1.1.2-1(5)**)

(2) Electrical power converters used in accumulator battery systems

1.3.8 Tests After Installation On Board

1 In addition to **1.2.7**, tests to verify that **1.3.5-1(2)** to **(4)** and **1.3.6** are satisfied are to be carried out.

1.4 Accumulator Battery Systems

1.4.1 General

1 This **1.4** applies accumulator battery systems and their components (e.g. cells and modules).

2 Accumulator battery systems are to be equipped with *BMS*.

3 Accumulator battery systems are to be capable of disconnecting both output poles by means of contactors or circuit breakers.

4 Accumulator battery systems are to be equipped with fuses to protect the accumulator

batteries.

5 Suitable measures are to be taken as far as possible to prevent salt damage and moisture condensation on accumulator battery system enclosures as well as associated modules, *BMS* and cables, etc.

6 Accumulator battery systems are to comply with **Chapter 18, Part D**.

1.4.2 *BMS*

1 *BMS* are to measure the following **(1)** to **(3)**

(1) Cell voltage

(2) Cell or module temperature

(3) Current flowing in strings (or battery packs)

2 *BMS* are to be capable of electrically disconnecting at points where any of the following **(1)** through **(4)** abnormal conditions are detected.

(1) Overcurrent

(2) Voltages exceeding upper limit voltages

(3) Voltages below lower limit voltages

(4) Overheating

3 *BMS* are to be capable of automatically correcting charge imbalances (cell balance).

4 The parameters listed in **(1)** to **(4)** below are to be indicated in engine control rooms or at accumulator battery control stations.

(1) System output voltage

(2) Maximum and minimum cell voltages for all cells

(3) Maximum and minimum cell temperatures (or module temperatures) for all cells (or modules)

(4) Current flowing in strings (or battery packs)

5 Visible and audible alarms are to be issued at navigation bridges as well as in engine control rooms or at accumulator battery system control stations in cases where anomalies concerning the following **(1)** to **(7)** items are detected.

(1) Cell or module temperature

(2) Voltages exceeding upper voltage limits

(3) Voltages below lower limit voltages

(4) Electrical disconnection of accumulator battery systems

(5) Tripping of contactors or circuit breakers of accumulator battery systems

(6) Data communication

(7) Refrigerant leakage

6 If any of the items in **1.3.1-1(1)** through **(3)** applies, the following **(1)** and **(2)** items are to be calculated by the *BMS* or other means.

(1) State of Charge (“*SOC*”)

(2) State of Health

7 *BMS* are to comply with requirements for electrical equipment specified in **2.1.3, Part H**. In addition, insulating materials, wiring materials, etc. for *BMS* are to be flame retardant.

1.4.3 Shop Tests

1 Cells and modules of accumulator battery systems are to be tested as specified in **Table 1** at manufacturing plants or other locations. However, all the tests may be omitted for cells and modules of types used in accumulator battery systems that have already received approval of use from the Society in accordance with **Chapter 9, Part 7 of the Guidance for the Approval and Type Approval of Materials and Equipment for Marine Use**.

2 Control and protection functions of *BMS* for accumulator battery systems are to be tested as specified in **Table 2** at manufacturing plants or other locations. However, all the tests may be omitted for accumulator battery systems that have already received approval of use from the Society

in accordance with **Chapter 9, Part 7 of the Guidance for the Approval and Type Approval of Materials and Equipment for Marine Use**.

3 Accumulator battery systems are to be tested as specified in **Table 3** at manufacturing plants or other locations.

4 Accumulator battery systems are to be tested as specified in **18.7.1, Part D** at manufacturing plants. It is acceptable for environmental tests to use only those elements (e.g. battery packs) of accumulator battery systems installed on board ships that have the minimum functions required for verification of tests. However, some of all of the environmental tests specified in **18.7.1(1), Part D** may be omitted for accumulator battery systems which have already received approval of use from the Society.

Table 1 Testing of Cells and Modules at Manufacturing Plants and Other Locations

Test type	Corresponding standard number
External short-circuit test	*JIS C* 8715-2 7.2.1 or *IEC* 62619 7.2.1
Impact test	*JIS C* 8715-2 7.2.2 or *IEC* 62619 7.2.2
Drop test	*JIS C* 8715-2 7.2.3 or *IEC* 62619 7.2.3
Thermal abuse test	*JIS C* 8715-2 7.2.4 or *IEC* 62619 7.2.4
Overcharge test	*JIS C* 8715-2 7.2.5 or *IEC* 62619 7.2.5
Forced discharge test	*JIS C* 8715-2 7.2.6 or *IEC* 62619 7.2.6
Internal short-circuit test (1)	*JIS C* 8715-2 7.3.2 or *IEC* 62619 7.3.2

Note:

(1) Internal short-circuit tests need not be carried out in cases where the propagation tests in **1.4.3-2** are carried out.

Table 2 Testing of *BMS* Control and Protection Functions at Manufacturing Plants and Other Locations

Test type	Corresponding standard number
Propagation test (1)	*JIS C* 8715-2 7.3.3 or *IEC* 62619 7.3.3
Overcharge control of voltage	*JIS C* 8715-2 8.2.2 or *IEC* 62619 8.2.2
Overcharge control of current	*JIS C* 8715-2 8.2.3 or *IEC* 62619 8.2.3
Overheating control	*JIS C* 8715-2 8.2.4 or *IEC* 62619 8.2.4
Discharge performance	*JIS C* 8715-1 6.3.1 or *IEC* 62620 6.3.1
Sensor failures(2)	according to specification
Cell balancing(2)	according to specification
SOC validation(2)	according to specification

Notes:

(1) Internal short-circuit test need not be carried out in cases where the internal short-circuit tests for cells in **1.4.3-1** are carried out.

(2) Detailed test contents are to be included in manufacturer testing plans.

Table 3 Testing of Accumulator Battery Systems at Manufacturing Plants and Other locations

Test type	Corresponding standard number
External examination	–
High voltage test	Refer to **2.8.4-4, Part H** (1)
Insulation resistance test	Refer to **2.8.4-5, Part H**

Note:

(1) Components (cells, sensors, etc.) that may be damaged by high voltage tests are to be removed, and tests are to be carried out on the conductive parts of accumulator battery systems.

EFFECTIVE DATE AND APPLICATION

1. The effective date of the amendments is 1 January 2023.

2. Notwithstanding the amendments to the Rules, the current requirements apply to ships for which the date of contract for construction* is before the effective date.

3. Notwithstanding the provision of preceding **2.**, the amendments to the Rules may apply to the surveys for which the application is submitted to the Society before the effective date upon request by the owner.

* "contract for construction" is defined in the latest version of IACS Procedural Requirement (PR) No.29.

IACS PR No.29 (Rev.0, July 2009)

1. The date of "contract for construction" of a vessel is the date on which the contract to build the vessel is signed between the prospective owner and the shipbuilder. This date and the construction numbers (i.e. hull numbers) of all the vessels included in the contract are to be declared to the classification society by the party applying for the assignment of class to a newbuilding.

2. The date of "contract for construction" of a series of vessels, including specified optional vessels for which the option is ultimately exercised, is the date on which the contract to build the series is signed between the prospective owner and the shipbuilder.

For the purpose of this Procedural Requirement, vessels built under a single contract for construction are considered a "series of vessels" if they are built to the same approved plans for classification purposes. However, vessels within a series may have design alterations from the original design provided:

(1) such alterations do not affect matters related to classification, or

(2) If the alterations are subject to classification requirements, these alterations are to comply with the classification requirements in effect on the date on which the alterations are contracted between the prospective owner and the shipbuilder or, in the absence of the alteration contract, comply with the classification requirements in effect on the date on which the alterations are submitted to the Society for approval.

The optional vessels will be considered part of the same series of vessels if the option is exercised not later than 1 year after the contract to build the series was signed.

3. If a contract for construction is later amended to include additional vessels or additional options, the date of "contract for construction" for such vessels is the date on which the amendment to the contract, is signed between the prospective owner and the shipbuilder. The amendment to the contract is to be considered as a "new contract" to which **1.** and **2.** above apply.

4. If a contract for construction is amended to change the ship type, the date of "contract for construction" of this modified vessel, or vessels, is the date on which revised contract or new contract is signed between the Owner, or Owners, and the shipbuilder.

Note:
This Procedural Requirement applies from 1 July 2009.

GUIDANCE FOR THE SURVEY AND CONSTRUCTION OF STEEL SHIPS

GUIDANCE

Part H Electrical Installations

2022 AMENDMENT NO.2

Notice No.64 27 December 2022

Resolved by Technical Committee on 27 July 2022

Notice No.64 27 December 2022
AMENDMENT TO THE GUIDANCE FOR THE SURVEY AND CONSTRUCTION OF STEEL SHIPS

"Guidance for the survey and construction of steel ships" has been partly amended as follows:

Part H ELECTRICAL INSTALLATIONS

H1 GENERAL

H1.1 General

H1.1.6 Drawings and Data

Sub-paragraph -7 has been added as follows.

7 In applying **1.1.6(1)** and **(2),** the drawings and documents referred to in **1.1.3, Annex 2.11.1-2, Part H of the Rules** are to be submitted for ships equipped with accumulator battery systems to which **Annex 2.11.1-2, Part H of the Rules** is applied.

H1.2 Testing

Paragraph H1.2.1 has been amended as follows.

H1.2.1 Shop Tests

1 The wording "survey methods which it considers to be appropriate" in **1.2.1-1, Part H of the Rules,** and the wording "tests for any equipment with small capacities as specified in **(4)** and **(5)** are to be conducted as deemed appropriate by the Society" specified in **1.2.1-1, Part H of the Rules** ~~mean~~ means to be in accordance with the following **(1)** and **(2)** respectively:

(1) The wording "survey methods which it considers to be appropriate" means survey methods which the Society considers to be able to obtain information equivalent to that obtained through traditional ordinary surveys where the Surveyor is in attendance, notwithstanding any of the requirements in this Part.

(2) The wording "tests for any equipment with small capacities as specified in **(4)** and **(5)** are to be conducted as deemed appropriate by the Society" means those shop tests for electrical motors whose capacities at continuous ratings are less than 100 *kW* and controlgears of those motors may be substituted for by manufacturer tests. In such cases, submission or presentation of test records may be required by the Society.

2 Those "motors for essential services" specified in **1.2.1-1(4), Part H of the Rules** means those driving auxiliary machinery corresponding to auxiliary machinery essential for main propulsion, auxiliary machinery for manoeuvring and ~~the~~ safety, and auxiliary machinery for cargo handling specified in **Table D1.1.6-1, Part D ~~of the Guidance for the Survey and Construction of Steel Ships~~**.

3 In applying **1.2.1-1(7),** the tests for cells (or modules), accumulator battery systems and electrical power converters referred to in **Annex 2.11.1-2, Part H of the Rules** are to be carried out for ships equipped with accumulator battery systems to which **Annex 2.11.1-2, Part H of the Rules** is applied.

~~**3**~~**4** The wording "subject to Society approval" in **1.2.1-3, Part H of the Rules** means compliance

with the requirements given in **the Rules for Approval of Manufacturers and Service Suppliers**. Equipment and cables approved are made public ~~on~~ in **the List of Approved Materials and Equipment**.

~~4~~5 The wording "to be subjected to type tests" in **1.2.1-4, Part H of the Rules** means **Part 8 of the Guidance for the Approval and Type Approval of Materials and Equipment for Marine Use**. Equipment and cables approved are made public ~~on~~ in the **List of Approved Materials and Equipment**.

~~5~~6 Cables requiring type approval are as follows:

(1) Cables used for power feeding systems and power distribution circuits for power, lighting and internal communications and used for control circuits

(2) Flexible cords used for feeding power systems and power distribution circuits and control circuits

(3) Multicore vinyl insulated cables for 150 *V* electronic equipment

~~6~~7 Type tests may be carried out for flexible cords, vinyl sheathed cords, insulated cables for switchboards and control equipment, coaxial cables, etc., other than those specified in **-~~4~~6** above in cases where a request is made by the manufacturer.

EFFECTIVE DATE AND APPLICATION

1. The effective date of the amendments is 1 January 2023.

2. Notwithstanding the amendments to the Guidance the current requirements apply to ships for which the date of contract for construction* is before the effective date.

3. Notwithstanding the provision of preceding **2.**, the amendments to the Guidance may apply to the surveys for which the application is submitted to the Society before the effective date upon request by the owner.

* "contract for construction" is defined in the latest version of IACS Procedural Requirement (PR) No.29.

IACS PR No.29 (Rev.0, July 2009)

1. The date of "contract for construction" of a vessel is the date on which the contract to build the vessel is signed between the prospective owner and the shipbuilder. This date and the construction numbers (i.e. hull numbers) of all the vessels included in the contract are to be declared to the classification society by the party applying for the assignment of class to a newbuilding.

2. The date of "contract for construction" of a series of vessels, including specified optional vessels for which the option is ultimately exercised, is the date on which the contract to build the series is signed between the prospective owner and the shipbuilder.

For the purpose of this Procedural Requirement, vessels built under a single contract for construction are considered a "series of vessels" if they are built to the same approved plans for classification purposes. However, vessels within a series may have design alterations from the original design provided:

(1) such alterations do not affect matters related to classification, or

(2) If the alterations are subject to classification requirements, these alterations are to comply with the classification requirements in effect on the date on which the alterations are contracted between the prospective owner and the shipbuilder or, in the absence of the alteration contract, comply with the classification requirements in effect on the date on which the alterations are submitted to the Society for approval.

The optional vessels will be considered part of the same series of vessels if the option is exercised not later than 1 year after the contract to build the series was signed.

3. If a contract for construction is later amended to include additional vessels or additional options, the date of "contract for construction" for such vessels is the date on which the amendment to the contract, is signed between the prospective owner and the shipbuilder. The amendment to the contract is to be considered as a "new contract" to which **1.** and **2.** above apply.

4. If a contract for construction is amended to change the ship type, the date of "contract for construction" of this modified vessel, or vessels, is the date on which revised contract or new contract is signed between the Owner, or Owners, and the shipbuilder.

Note:
This Procedural Requirement applies from 1 July 2009.