RULES
FOR THE CLASSIFICATION OF SHIPS

Part 1 – GENERAL REQUIREMENTS
Chapter 6 – Requirements for additional class notations
January 2022

Amendments No. 1
July 2022

CROATIAN REGISTER OF SHIPPING

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By the decision of the General Committee of Croatian Register of Shipping,

Amendments No. 1 to the

RULES FOR THE CLASSIFICATION OF SHIPS

Part 1 – GENERAL REQUIREMENTS

Chapter 6 – Requirements for additional class notations

have been adopted on 27th June 2022 and shall enter into force on 1st July 2022

INTRODUCTORY NOTES

These amendments shall be read together with the requirements in the Rules for the Classification of Ships, Part 1 – General requirements, Chapter 6 – Requirements for additional class notations, edition January 2022.

Table 1 contains review of amendments, where items changed or added in relating to previous edition are given, with short description of each modification or addition. All major changes throughout the text are shaded.

The subject Chapter of the Rules includes the requirements of the following international Organisations:

International Maritime Organization (IMO)

Resolutions: Res. A.446(XI), as amended by Res. A.497(XII) and as further amended by Res. A.897(21)
A.1156(32) (Survey Guidelines Under the Harmonized System of Survey and Certification (HSSC), 2021)

International Association of Classification Societies (IACS):

Unified Requirements (UR):
E10 (Rev.8 Corr.1 2022)

TABLE 1 – REVIEW OF AMENDMENTS

This review comprises amendments in relation to Rules for the Classification of Ships, Part 1 – General requirements, Chapter 6 – Requirements for additional class notations, edition January 2022.

ITEM	*DESCRIPTION OF THE AMENDMENTS*
SECTION 2 – BATTERY SYSTEM (BAT)	
Head 2.3 Risk assessment, battery location, ventilation, gas detection and fire safety	Minor changes within the text due to introduction of the requirements of the new revision of IACS UR E10

Chapter 6 REQUIREMENTS FOR ADDITIONAL CLASS NOTATIONS

Contents:

1 ADDITIONAL CLASS NOTATIONS

1.1 GENERAL

1.1.1 This section of this Chapter of the *Rules for the classification of ships* (hereafter referred to as: the Rules) of ***CROATIAN REGISTER OF SHIPPING*** (hereinafter referred to as: the *Register*) is prescribing technical requirements for some of additional characters of class or descriptive class notations, as referenced to in the *Rules for the classification of ships, Part 1 – General requirements, Chapter 1 – General information, 4*.

1.1.2 The assignment of additional characters of class or descriptive class notations to a new ship is subject to compliance with the general rule requirements laid down in the *Rules for the classification of ships, Part 1 – General requirements, Chapter 1 – General information*, and with the additional requirements laid down in the corresponding Section of this Chapter.

2 BATTERY SYSTEM (BAT)

2.1 GENERAL

2.1.1 The additional character of class **BAT** - BATTERY SYSTEM may be assigned to ships using battery systems complying to below specified requirements.

Technical documentation to be submitted to the *Register* for the purpose of the first assignment of subject character of class is listed in the *Rules for the classification of ships, Part 1 – General requirements, Chapter 2 – Survey during construction and initial survey*.

Requirements for periodical class surveys, for the purpose of maintaining subject character of class are included in the *Rules, Part 1 – General requirements, Chapter 5 – Surveys of ships in service*.

2.2 TECHNICAL REQUIREMENTS

2.2.1 Requirements in this item applies to the lithium-ion, lithium metal and lithium polymer battery types. Requirements concerning conventional types of batteries are prescribed in the *Rules for the classification of ships, Part 12 – Electrical equipment, Section 13*.

2.2.2 Since battery technologies are under constant development, additional battery types may be considered and additional requirements, other than these stated here, may be required.

Alternative battery designs, other than stated here, may be considered on case to case basis by the *Register* provided that the safety and reliability of such design will be at least at equivalent level to those specified here.

2.2.3 Definitions and explanations:

.1 **Battery cell** – smallest unit of a battery.

.2 **Battery cell block** – group of battery cells connected together in parallel configuration with or without protective devices and monitoring circuitry.

.3 **Battery module** – group of battery cells connected together in series and/or parallel configuration with or without protective devices and monitoring circuitry.

.4 **Battery pack** – energy storage device, which is comprised of one or more battery cells or battery modules electrically connected. Battery pack has a monitoring circuitry which provides information to a battery system. Battery pack may incorporate a protective housing and be provided with terminals or other interconnection arrangement.

.5 **Battery system** – system which comprises of one or more battery cells, battery modules or battery packs. Battery system has a Battery Management System and may also have cooling or heating units.

.6 **Battery Management System (BMS)** – electronic system associated with a battery which has functions to cut off in case of overcharge, overcurrent, over discharge and overheating. It monitors and/or manages its state, calculates secondary data, reports that data and/or controls its environment to influence the battery's safety, performance and/or service life. The function of the BMS can be assigned to the battery pack or to equipment that uses the battery.

.7 **Energy Management System (EMS)** – system providing monitoring and control of energy capacities.

.8 **Battery string** – a number of battery cells or modules connected in series with the same voltage level as the battery system.

.9 **Battery space (Compartment)** – The space in which the battery system is physically located.

.10 **State of Charge (SOC)** – available capacity in a battery expressed as a percentage of rated capacity.

.11 **State of Health (SOH)** – an indication of the general condition of a battery compared to its ideal conditions (e.g. a new battery). The unit of SOH are percent points (100% means battery's condition matches the battery's specifications).

.12 **Thermal Runaway** – uncontrolled intensive increase in the temperature of a cell driven by exothermic reaction.

.13 **Rated capacity** – capacity value of a cell or battery determined under specified conditions and declared by the manufacturer.

2.2.4 Apart from the list of documentation to be submitted for the purpose of the assignment of subject additional character of class stated in the *Rules for the classification of ships, Part 1 – General requirements, Chapter 2 – Survey during construction and initial survey, 1.2.17*, the *Register* may request additional documentation to be submitted, where it proves necessary.

2.2.5 Following documentation is to be kept onboard:

.1 Operation manual and maintenance manual.

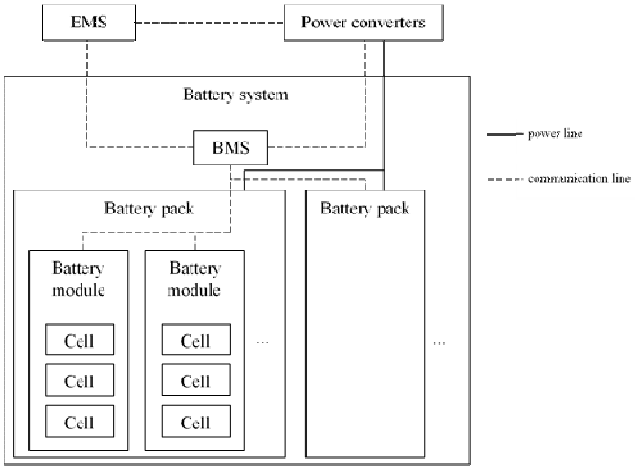
.2 Battery system firefighting procedure.

.3 Battery system operation and maintenance logs.

Battery system

2.2.6 Typical battery system configuration is shown in the Figure 2.2.6-1. Battery system configuration may vary from manufacturer to manufacturer.

Figure 2.2.6-1
Typical battery system configuration



2.2.7 Battery system is to be designed so that the capacity of the system is sufficient for the intended use of the vessel, taking into account aging deterioration of the battery capacity.

2.2.8 Exposed battery casing shall be constructed of durable, flame-retardant, materials that are suitable for use in the marine environment and resistant to electrolyte spillage.

2.2.9 Minimum degree of protection (IP) of batteries depends on the location of installation but shall be no less than IP 44.

2.2.10 Battery system is to be provided with Battery Management System (BMS) and external emergency shutdown arrangement.

2.2.11 If the battery system is used as a main source of power, then two independent battery systems shall be provided. If the battery system is used as emergency source of power, then it is not to be installed in the same space as the emergency switchboard.

2.2.12 Battery cells of different physical characteristics, chemistry composition and electrical parameters are not to be used in the same electrical circuit.

2.2.13 Battery system's outgoing circuits are to be protected against overload and short-circuit.

2.2.14 If batteries are used for supplying power to propulsion and steering, then the system is to be arranged so that the power to these services is maintained or immediately restored in case of supply failure.

2.2.15 Arrangements shall be provided to disconnect the less essential consumers automatically and gradually in the event of the battery system overload. This load shedding may be carried out in one or several steps.

2.2.16 Battery system is to be provided with means for local operation, independent of remote operation and with disconnecting switch for maintenance purposes.

Power converters

2.2.17 Power converters are to be certified and fulfil the requirements set in the *Rules for the classification of ships, Part 12 – Electrical equipment, Sections 2 and 12*.

2.2.18 Power converters are to be able to communicate to and be able to operate within limits set by BMS and EMS.

2.2.19 Power converters shall be provided with overvoltage and undervoltage protection.

2.2.20 Power converters exceeding 50 kVA shall be provided with an independent emergency stop function.

2.2.21 Power converters shall alarm charging/discharging failure on continuously manned station.

2.2.22 In the case of charging of battery system via shore-connection, means shall be provided to cut off the shore power automatically or manually. Shore-connection is to be executed in such manner so that the human operator cannot come in contact with any live connection.

Control, monitoring, alarm, and safety systems

2.2.23 Control, monitoring, alarm, and safety systems are to have self-check functions. In the event of failure, an alarm is to be activated.

2.2.24 Safety system is to be designed to minimize the impact of failures and shall be constructed on fail-safe principle.

2.2.25 Safety system sensors are to be independent from other sensors.

2.2.26 Sensors are to be designed to withstand the local environment. The enclosure of the sensor and the cable entry are to be appropriate to the space in which they are located. Any malfunction in the sensors is to be detectable.

2.2.27 Energy Management System (EMS) is to be installed that shall provide reliable measure of available energy and power taking into consideration the SOH and SOC. EMS is responsible for load reduction to prevent battery system overload.

2.2.28 EMS is to be certified. EMS is considered to be a computer system of category III and is to comply with requirements from the *Rules for the classification of ships*, *Part 12 – Electrical equipment, Chapter 2.10*. EMS may be a part of vessel's Power Management System (PMS).

Battery management system (BMS)

2.2.29 Battery Management System (BMS) is to be certified. BMS is considered to be a computer system of category II or III (exact categorization depends on the intended use of the battery system) and is to comply with requirements from the *Rules for the classification of ships, Part 12 – Electrical equipment, Chapter 2.10*.

2.2.30 BMS is to have following functions:
- Provide limits to the power converters for charging and discharging.
- Provide protection of the battery system in case of overcurrent, overvoltage, undervoltage and overtemperature.
- Provide battery cell and module balancing.

2.2.31 BMS is to be continuously powered by a source of power other than battery monitored by it, and an alarm shall be provided in the event of power supply failure.

2.2.32 BMS is to monitor the battery cell voltage, temperature, and battery string current. BMS shall provide following information on local control panel and on continuously manned station:

- Battery system voltage.
- Battery cell voltage (including minimum, maximum, and average).
- Battery cell temperature (including minimum, maximum, and average).
- Battery string current.
- Ambient and/or battery space temperature.
- State of Charge (SOC) of the batteries (also to be provided to EMS).
- State of Health (SOH) of the batteries (also to be provided to EMS).
- Battery charging/discharging status.

Alarms

2.2.33 Any abnormal condition of the battery system is to initiate an audible and visual alarm at continuously manned station and/or navigation bridge. For vessels without centralized alarm system, battery alarms are to be presented on the navigation bridge.

2.2.34 Battery alarms shall consist of following alarms:

- Battery shutdown.
- Other safety/protection functions.
- Failure of safety/protection functions.
- Battery cell high temperature.
- Ambient or battery space low/high temperature.
- Battery cell overvoltage/undervoltage.
- Battery cell voltage imbalance.
- Battery string overcurrent.
- Ventilation status alarms.
- Minimum SOC.
- Gas detection.
- Charging/discharging fault.

2.2.35 Battery system warnings that can develop into safety hazards are to be alarmed before reaching hazardous levels (e.g. high ambient temperature).

2.2.36 Minimum level of SOC is to be determined with regards to vessels operation purpose.

Safety system

2.2.37 Activation of safety system is to give an alarm. Safety system is to be executed in the fail-safe principle. Failure of the safety system's protection functions is to give an alarm.

2.2.38 Thermal protection device, independent of the BMS, that shall disconnect the battery in case of high temperature is to be provided for battery modules.

2.2.39 Battery cell or battery module/pack case is to be provided with a pressure relief mechanism to prevent rupture or explosion.

2.2.40 External emergency shutdown arrangement mentioned in 4.2.1.6 is to be located outside battery space. If the battery system is used for propulsion, then an additional emergency shutdown arrangement from navigation bridge is to be provided.

2.2.41 Other safety functions shall be implemented if battery design comprises additional safety hazards.

2.2.42 Safety mechanism is to be provided that will not allow manual override of safety functions.

2.3 RISK ASSESSMENT, BATTERY LOCATION, VENTILATION, GAS DETECTION AND FIRE SAFETY

Risk assessment

2.3.1 Risk assessment is to be carried out in the design phase in order to identify all potential hazards and uncertainties of the proposed battery system design and installation on the vessel. Risk assessment should include measures to avoid and/or mitigate risks.

2.3.2 Risk assessment shall be used to determine:

- Development of dangerous (toxic and corrosive) gases.
- Electrolyte spillage.
- Electric shock.
- Fire and water hazards.
- Explosion hazards.
- Battery room entry hazards and procedures.
- Battery thermal runaway, short-circuit, overcurrent, overvoltage.
- External heat hazards.
- Battery space ventilation rate and loss of ventilation.
- Charging facilities.
- Loss of propulsion.
- Gas detection system.
- Fire detection system.
- Fire-fighting methods.

2.3.3 Battery system fire-fighting procedure is to be provided which shall cover all the necessary steps for successful fire suppression and extinguishment and will include all necessary precautions to avoid any personnel injuries.

2.3.4 Risk assessment is part of documentation that is subject to approval.

2.3.5 Identified risks and means to mitigate risks are to be included in the operating manual.

Battery spaces, ventilation, gas detection

2.3.6 Risk assessment is to be carried to determine whether the battery system needs to be installed in designated battery room, sufficient ventilation capacities, selection of gas detection and fire safety systems.

2.3.7 Batteries > 25 kWh are to be installed inside battery rooms or inside battery boxes on open deck, provided that the battery boxes can ensure battery's service environment.

2.3.8 Batteries < 25 kWh may be installed inside battery boxes located in engine room, provided that the battery boxes can ensure battery's service environment.

2.3.9 Battery boxes' mechanical degree of protection shall correspond to the requirements of the installed location (the *Rules for the classification of ships, Part 12 – Electrical equipment, Chapter 2.4*).

2.3.10 Battery boxes, as well as battery rooms shall be fitted with temperature sensor(s).

2.3.11 Battery spaces are not to be located forward of the collision bulkhead, nor in the accommodation spaces.

2.3.12 Battery rooms are not to contain any equipment supporting essential services with the exemption of cables of the battery system itself.

2.3.13 Battery rooms are not to contain any other equipment that are not part of battery system with the exemption of safety and fire protection equipment used for the battery system itself.

2.3.14 Battery rooms are not to contain any heat sources.

2.3.15 Batteries are to be installed in locations where they will not be exposed to excessive temperatures, liquid splashing or spraying, shocks and vibrations.

2.3.16 Battery rooms and battery boxes are to be mechanically ventilated. Ventilation ducts are to be made of steel or equivalent material. Ventilation ducts used for battery system ventilation cannot be used to ventilate other spaces. Ventilation shall have capacity for at least two air changes per hour.

2.3.17 Battery rooms and battery boxes are to be equipped with appropriate emergency exhaust ventilation that shall vent the gases that may occur during an abnormal situation. Ventilation fan is to be of non-sparking type and provide six air changes per hour. Intake and exhaust ventilation ducts are to be from/to a safe location on the open deck.

2.3.18 Emergency exhaust ventilation is to be activated automatically upon detection of dangerous gases from the batteries. Facilities for local and remote (from continuously manned station) operation of this ventilation are to be provided.

2.3.19 Battery spaces are to be provided with gas detection system of approved type which will be appropriately suited for the used battery chemistry. Gas detection system is to provide an alarm to continuously manned station in case of 30% LEL and emergency exhaust ventilation is to be started automatically. In the case of 60% LEL, all unprotected electrical circuits in the battery space must be de-energized.

2.3.20 Battery spaces are to be provided with a gas-tight door with alarm to the continuously manned station, or self-closing gas-tight door without hold-back arrangement.

2.3.21 Means to disconnect the battery system outside of the protected space are to be provided in case of fire in battery space or machinery space of category A.

Fire safety

2.3.22 Fixed fire detection and alarm system is to be provided for battery system. This system is to be according to the *Rules for the classification of ships, Part 12 – Electrical equipment*, and the *Rules for the classification of ships, Part 17 – Fire protection*.

2.3.23 Battery spaces are categorized as auxiliary machinery spaces and are subject to fire protection requirements for those spaces.

2.3.24 Battery spaces are to be fitted with fixed fire extinguishing system that is appropriate to be used with regards to battery chemistry. Battery manufacturer's recommendations shall be taken into account. This system is to be according to the *Rules for the classification of ships, Part 17 – Fire protection*.

2.3.25 In addition to fixed fire extinguishing system, portable fire extinguishers are to be used – at least two dry powder or CO_2 extinguishers, with capacity of not less than 5 kg, near every battery system installation.

2.3.26 Depending on battery chemistry and design used, flammable gases may be produced in the battery space. In this case the battery space is to be classified as a hazardous area as per IEC 60079 series and additional precautions shall be taken accordingly.

2.3.27 Additional firefighting equipment or cooling means may be required with regard to characteristics of battery fire.

2.4 CERTIFICATION, TESTING AND INSPECTION

Certification and testing

2.4.1 The battery system ≥ 25 kWh shall be type approved, with testing carried out according to requirements from IEC 61619:2017, IEC 61620:2017 and Electrical and electronic equipment type testing (refer to IACS UR E10, also). Type testing is to be witnessed by the surveyor of the *Register*. For type testing information see Table 2.4.1-1.

2.4.2 For battery system < 25 kWh, manufacturer test certificates are required.

2.4.3 Batteries that have failed propagation test are not allowed for use.

2.4.4 Electrical equipment is to be suitable for use in the marine environment and fulfil the requirement of the *Rules for the classification of ships, Part 12 – Electrical Equipment, Section 2*.

Table 2.4.1-1
Battery system type testing

No.	Test	Test unit	Type test	Routine test	Reference
1.	External short-circuit test	Cell	x	-	IEC 62619, 7.2.1
2.	Impact test	Cell	x	-	IEC 62619, 7.2.2
3.	Drop test	Cell	x	-	IEC 62619, 7.2.3
4.	Thermal abuse test	Cell	x	-	IEC 62619, 7.2.4
5.	Overcharge test	Cell	x	-	IEC 62619, 7.2.5
6.	Forced discharge test	Cell	x	-	IEC 62619, 7.2.6
7.	Internal short-circuit test	Battery system	x	-	IEC 62619, 7.3.2
8.	Propagation test	Battery system	x	-	IEC 62619, 7.3.3
9.	Overcharge control of voltage	Battery system	x	-	IEC 62619, 8.2.2
10.	Overcharge control of current	Battery system	x	-	IEC 62619, 8.2.3
11.	Overheating control	Battery system	x	-	IEC 62619, 8.2.4
12.	Capacity validation	Battery system	x	-	IEC 62620, 6.3.1
13.	Battery system type testing	Battery system	x	-	IACS UR E10
14.	Battery system unit testing	Battery system	-	x	IACS UR E10, 1, 2, 3, 9, 10
15.	Battery system safety function tests	Battery system	x	x	Specification

2.4.5 Performance tests of the battery system are to be carried out according to the Testing program that is to be submitted for approval.

2.4.6 Additional tests may be required if hazards are recognized by the Risk assessment or if seemed necessary by the *Register*.

Inspection

2.4.7 Battery system is to be inspected during manufacturing, during installation onboard and after installation onboard.

2.4.8 Inspection during installation of battery system onboard is to include:

- Inspection of battery boxes or battery rooms.
- Inspection of cable routing.
- Inspection of fire division.
- Inspection of ventilation system.
- Inspection of gas detection system.
- Inspection of fire detection system.
- Inspection of fire-extinguishing system.
- Inspection of temperature sensors.
- Inspection of safe type of electrical equipment.

2.4.9 Inspection after installation of battery system onboard is to include:

- Interface testing of battery system.
- Insulation resistance test.
- Test of battery system's protection and safety functions.
- Testing of alarms and indication.
- Testing of fire detection, gas detection, ventilation, etc. as far as applicable.
- Charging and discharging capacities.

2.4.10 Battery system is to be periodically surveyed to ensure that the system is in satisfactory condition.

2.4.11 At each annual survey of the vessel with additional character of class **BAT** assigned, items listed in the *Rules for the classification of ships, Part 1 – General requirements, Chapter 5 – Surveys of ships in service*, must be checked.

2.4.12 Any modification or alteration of installed battery system, besides replacing spare parts and batteries, is not allowed prior to the approval of the *Register*.

3 CRUDE OIL WASHING (COW)

3.1 GENERAL

3.1.1 The additional character of class **COW** – CRUDE OIL WASHING may be assigned to with installed Crude oil washing system and complying to below specified requirements.

Technical documentation to be submitted to the *Register* for the purpose of the first assignment of subject character of class is listed in the *Rules for the classification of ships, Part 1 – General requirements, Chapter 2 – Surveys during construction and initial survey*.

Requirements for periodical class surveys, for the purpose of maintaining subject character of class are included in the *Rules for the classification of ships, Part 1 – General requirements, Chapter 5 – Surveys of ships in service*.

3.1.2 Ships carrying crude oil having 20,000 tons deadweight and above are to be fitted with cargo tank cleaning system using crude oil washing arrangement complying with MARPOL 73/78, Annex I, Reg. 33 and Reg. 35, which refers to "Revised Specifications for the Design, Operation and Control of Crude Oil Washing Systems", adopted by IMO Res. A.446(XI), as amended by A.497(XII) and as further amended by A.897(21).

3.1.3 The crude oil washing system shall fully comply with the requirements of IMO Resolution A.446(XI), as amended by IMO Resolution A.497(XII) and as further amended by IMO Resolution A.897(21) within one year after the tanker was first engaged in the trade of carrying crude oil or by the end of the third voyage carrying crude oil suitable for crude oil washing, whichever occurs later (see 5.2).

3.1.4 Every oil tanker operating with crude oil washing system shall be provided with an Operations and Equipment Manual detailing the system and equipment and specifying operational procedures, to the satisfaction of the *Register*.

3.1.5 Every oil tanker fitted with a cargo tank cleaning system using crude oil washing shall be provided with an inert gas system, according to the *Rules for the classification of ships, Part 17 - Fire protection*.

3.2 PIPING

3.2.1 The crude oil washing pipes and all valves incorporated in the supply piping system shall be of steel or other equivalent material and shall be of adequate strength having regard to the pressure to which they may be subjected, and shall be properly jointed and supported. Piping is to comply with the requirements of the *Rules for the classification of ships, Part 8 - Piping*.

3.2.2 The crude oil washing system shall consist of permanent piping and shall be independent of the fire mains and of any system other than for tank washing. A sections of the ship's cargo system may be incorporated in the crude oil washing system provided that they meet the requirements applicable to crude oil piping.

3.2.3 Notwithstanding the requirements of 3.2.2, in combination carriers the arrangement of crude oil washing system may allow:

.1 The removal of the equipment, if necessary, when carrying cargoes other than crude oil, provided that, when reinstated, the system is as originally fitted and tested for oil tightness.

.2 The use of flexible hose pipes to connect the crude oil washing system to tank washing machines if it is necessary to locate these machines in a cargo tank hatch cover. Such flexible hose pipes must be provided with flanged connections and be manufactured and tested in accordance with the *Rules for the classification of ships, Part 8 - Piping*. The length of these hoses shall be no greater than necessary to connect the tank washing machines to an adjacent point just outside the hatch coaming. These hoses shall be removed to suitably prepared and protected stowage when not in use and be pressure tested by an authority acceptable to the *Register* at intervals of not more than two and a half years.

3.2.4 Provision shall be made to prevent overpressure in the tank washing supply piping. Any relief device fitted to prevent overpressure shall discharge into the suction side of the supply pump. Alternative methods to the satisfaction of the *Register* may be accepted provided an equivalent degree of safety and environmental protection is provided.

One such alternative is that where the system is served only by centrifugal pumps so designed that the pressure derived cannot exceed that for which the piping is designed, a temperature sensing device located in the pump casing is required to stop the pump in the case of overheating.

3.2.5 Where hydrant valves are fitted for water washing purposes on tank washing lines, all such valves shall comply with 2.1 and provision shall be made for such connections to be blanked off by blank flanges when washing lines may contain crude oil. Alternatively, hydrant valves shall be isolated from the crude oil washing system by spade blanks.

3.2.6 All connections for pressure gauges or other instrumentation shall be provided with isolating valves adjacent to the lines unless the fitting is of the sealed type.

3.2.7 No part of the crude oil washing system shall enter the machinery spaces. Where the tank washing system is fitted with a steam heater for use when water washing, the heater must be effectively isolated during crude oil washing by double shut-off valves or by clearly identifiable blanks.

The steam heater referred to shall be located outside the machinery spaces.

3.2.8 Where a combined crude oil-water washing supply piping is provided the piping shall be so designed that it can be drained so far as is practicable of crude oil, before water washing is commenced, into spaces designated in the Operations and Equipment Manual. These spaces may be the slop tank or other cargo spaces.

3.2.9 The piping system shall be of such diameter that the greatest number of tank cleaning machines required, as

specified in 3.2.8, can be operated simultaneously at the designed pressure and throughput. The arrangement of the piping shall be such that the required number of tank cleaning machines to each cargo compartment, can be operated simultaneously.

3.2.10 The piping system shall be tested to 1.5 times the working pressure after it has been installed on the ship.

3.2.11 The crude oil washing supply piping shall be anchored (firmly attached) to the ship's structure at appropriate locations, and means shall be provided to permit freedom of movement elsewhere to accommodate thermal expansion and flexing of the ship. The anchoring shall be such that any hydraulic shock can be absorbed without undue movement of the supply piping.

The anchors should normally be situated at the ends furthest from the entry of the crude oil supply to the supply piping. If tank washing machines are used to anchor the ends of branch pipes, then special arrangements are necessary to anchor these sections when the machines are removed for any reason.

3.3 TANK WASHING MACHINES

3.3.1 The tank washing machines for crude oil washing shall be permanently mounted and shall be of a design acceptable to the *Register*.

3.3.2 The performance characteristic of a tank washing machine is governed by nozzle diameter, working pressure and the movement pattern and timing. Each tank cleaning machine fitted shall have a characteristic such that the sections of the cargo tank covered by that machine will be effectively cleaned within the time specified in the Operations and Equipment Manual.

3.3.3 Tank washing machines shall be mounted in each cargo tank and the method of support shall be to the satisfaction of the *Register*. Where the tank washing machines are positioned well below the deck level to cater for protuberances in the tank, consideration may need to be given to additional support for the machines and their supply piping.

3.3.4 Each machine shall be capable of being isolated by means of stop valves in the supply line. If a deck mounted tank washing machine is removed for any reason, provision shall be made to blank off the oil supply line to the machine for the period the machine is removed. Similarly, provision shall be made to close the tank opening with a plate or equivalent means.

Where more than one submerged machine is connected to the same supply line a single isolating stop valve in the supply line may be acceptable provided the rotation of the submerged machines can be verified in accordance with 3.3.11.1 or 3.3.11.3.

3.3.5 The drive units for the tank cleaning machines are to be an integral with the tank cleaning machine.

3.3.6 The number and location of the tank washing machines shall be to the satisfaction of the *Register*.

3.3.7 The location of the machines is dependent upon the characteristics detailed in 3.3.2 and upon the configuration of the internal structure of the tank.

3.3.8 The number and location of the machines in each cargo tank and oily mixture (slop) tank shall be such that all horizontal and vertical areas are washed by direct impingement or effectively by deflection or splashing of the impinging jet. In assessing an acceptable degree of jet deflection and splashing, particular attention shall be paid to the washing of upward facing horizontal areas and the following parameters shall be used:

.1 For horizontal areas of a tank bottom and the upper surfaces of a tank's stringers and other large primary structural members, the total area shielded from direct impingement by deck or bottom transverses, main girders, stringers or similar large primary structural members shall not exceed 10 % of the total horizontal area of tank bottom, the upper surface of stringers, and other large primary structural members.

.2 For vertical areas of the sides of a tank, the total area of the tank's sides shielded from direct impingement by deck or bottom transverses, main girders, stringers or similar large primary structural members shall not exceed 15% of the total area of the tank’s sides.

In some installations it may be necessary to consider the fitting of more than one type of tank washing machine in order to effect adequate coverage.

3.3.9 At the design stage the following minimum procedures shall be used to determine the area of the tank surface covered by direct impingement:

.1 Using suitable structural plans, lines are set out from the tips of each machine to those parts of the tank within the range of the jets.

.2 Where the configuration of the tanks is considered by the *Register* to be complicated, a pinpoint of light simulating the tip of the tank washing machine in a scale model of the tank shall be used.

.3 Shadow diagrams must be on drawings the scale of which must be at least:

.1 1:100 for tankers of less than 100,000 tons deadweight,

.2 1:200 for tankers of 100,000 tons deadweight and above.

.4 The drawings must provide at least a plan view, a profile view and an end elevation for each tank, or for tanks considered to be similar.

.5 Sufficient detailed drawings of the vessel must be provided to check that all large primary structural members have been included.

.6 Guidelines for the assessment of shadow diagrams are given in 4.2.9 of Appendix III to IMO Resolution A.446(XI), as amended.

3.3.10 The design of the deck mounted tank washing machines shall be such that means are provided, external to the cargo tanks, which, when crude oil washing is in progress,

would indicate the rotation and arc of the movement of the machine. Where the deck mounted machine is of the non-programmable, dual nozzle type, alternative methods to the satisfaction of the *Register* may be accepted provided an equivalent degree of verification is attained.

3.3.11 Where submerged machines are required, they should be non-programmable and, in order to comply with the requirements of 3.3.8, it must be possible to verify their rotation by one of the following methods:

.1 By indicators external to the tank.

.2 By checking the characteristic sound pattern of the machine, in which case the operation of the machine shall be verified towards the end of each wash cycle.
Where two or more submerged machines are installed on the same supply line, valves shall be provided and arranged so that operation of each machine can be verified independently of the other machines on the same supply line.

.3 By gas freeing the tank and checking the operation of the machine with water during ballast voyages.
The method of verification shall be stated in the Operations and Equipment Manual.

3.3.12 Fixed washing machines shall comply with the following:

.1 Stresses in piping or deck supports which arise during washing operation or when immersed into liquid shall not exceed allowable stresses.

.2 Machines shall be made of steel or other material which does not initiate sparking due to friction more than steel.

.3 Machines shall be earthed through hull.

3.4 PUMPS FOR CRUDE OIL WASHING SYSTEM

3.4.1 The pumps supplying crude oil to the tank cleaning machines shall be either the cargo pumps or pumps specifically provided for the purpose.

3.4.2 The capacity of the pumps shall be sufficient to provide the necessary throughput at the required pressure for the maximum number of tank cleaning machines required to be operated simultaneously as specified in the Operations and Equipment Manual. In addition to the above requirement, the pumps shall, if an eductor system is fitted for tank stripping, be capable of supplying the eductor driving fluid to meet the requirements of 3.5.2.

3.4.3 The capacity of the pumps shall be such that the requirements of 3.4.2 can be met with any one pump inoperative. The pumping and piping arrangements shall be such that the crude oil washing system can be effectively operated with any one pump out of use.

3.4.4 The carriage of more than one grade of cargo shall not prevent crude oil washing of tanks.

3.4.5 To permit crude oil washing to be effectively carried out where the back pressure presented by the shore terminal is below the pressure required for crude oil washing, provision shall be made that such an adequate pressure to the washing machines can be maintained in accordance with 3.4.2. This requirement shall be met with any one cargo pump out of action. The minimum supply pressure required for crude oil washing shall be specified in the Operations and Equipment Manual. Should this minimum supply pressure not be obtainable, crude oil washing operations shall not be carried out.

3.4.6 Pumps shall be in accordance with the *Rules for the classification of ships, Part 8 - Piping* and the *Rules for the classification of ships, Part 9 - Machines*.

3.5 STRIPPING SYSTEM

3.5.1 The design of the system for stripping crude oil from the bottom of every cargo tank shall be to the satisfaction of the *Register*.

3.5.2 The design and capacity of the tank stripping system shall be such that the bottom of the tank being cleaned is kept free of accumulations of oil and sediment towards completion of the tank washing process.

3.5.3 The stripping system shall be capable of removing oil at a rate of 1.25 times the total throughput of all the tank cleaning machines to be operated simultaneously when washing the bottom of the cargo tanks or during any stage of the bottom washing as specified in the Operations and Equipment Manual.

3.5.4 Means such as level gauges, hand dipping and stripping system performance gauges as referred to in 3.5.9 shall be provided for checking that the bottom of every cargo tank is dry after crude oil washing. Suitable arrangements for hand dipping must be provided at the aftermost portion of a cargo tank and in three other suitable locations unless other approved means are fitted for efficiently ascertaining that the bottom of every cargo tank is dry. The cargo tank bottom shall be considered dry if there is no more than a small quantity of oil near the stripping suction with no accumulation of oil elsewhere in the tank. Level indicators system shall be of closed type (water-gas tight).

3.5.5 Every oil tanker required to be provided with segregated ballast tanks or fitted with a crude oil washing system, shall comply with the following requirements:

.1 Oil piping is to be so designed and installed that oil retention in the lines is minimised.

.2 Means shall be provided to drain all cargo pumps and all oil lines at the completion of cargo discharge, where necessary, by connection to a stripping device. The line and pump draining shall be capable of being discharged both to a cargo tank or a slop tank and ashore. For discharge ashore a special small diameter line shall be provided and shall be connected outboard of the ship's manifold valves. The cross-sectional area of this line shall not exceed 10 % of that of a main cargo discharge line.

3.5.6 In crude oil tankers having individual cargo pumps in each tank, each pump having an individual piping system, dispensation from the required special small diameter

line may be given in cases where the combined amount of oil left in the tank after stripping and the volume of oil in the piping system from the manifold to the tank is less than 0.00085 times the volume of the cargo tank. If a deep well cargo pump system is provided with an evacuating system for retained oil, the above consideration should also apply.

3.5.7 The means for stripping oil from the cargo tanks shall be by positive displacement pump, self-priming centrifugal pump or eductor or other methods to the satisfaction of the *Register*. Where a stripping line is connected to a number of tanks, means shall be provided for isolating each tank not being stripped at that particular time.

3.5.8 The internal structure of the tank shall be such that drainage of oil to the tank suctions of the stripping system is adequate to meet the requirements of 3.5.2 and 3.5.4. Care shall be taken that both longitudinal and transverse drainage are satisfactory and shall be verified during the inspection.

3.5.9 Equipment shall be provided for monitoring the efficiency of the stripping system. All such equipment shall have remote read-out facilities in the cargo control room or in some other safe and convenient place easily accessible to the officer in charge of cargo and crude oil washing operations. Where a stripping pump is provided, the monitoring equipment shall include, as appropriate, a flow indicator, or a stroke counter or a revolution counter, and pressure gauges at the inlet and discharge connections of the pump or equivalent. Where eductors are provided, the monitoring equipment shall include pressure gauges at the driving fluid intake and at the discharge and a pressure/vacuum gauge at the suction intake.

3.5.10 The trim conditions for crude oil washing given in the Operations and Equipment Manual shall be adhered to.

4 IN-WATER SURVEY (IWS)

4.1 GENERAL

4.1.1 The additional class notation **IWS** – IN-WATER SURVEY may be assigned to ships with a hull specially marked and equipped for in-water surveys and complying with below specified requirements.

Technical documentation to be submitted to the *Register* for the purpose of the first assignment of subject character of class is listed in the *Rules for the classification of ships, Part 1 – General requirements, Chapter 2 – Surveys during construction and initial survey*.

Requirements for periodical class surveys, for the purpose of maintaining subject character of class are included in the *Rules for the classification of ships, Part 1 – General requirements, Chapter 5 – Surveys of ships in service*.

NOTE: When performing in-water examination of the outside of ship's bottom statutory requirements as stated in IMO Res. A.1156(32) (Survey Guidelines Under the Harmonized System of Survey and Certification (HSSC), 2021), as may be amended and IMO MSC.1/Circ.1348 (Guidelines for the assessment of technical provisions for the performance of an in-water survey in lieu of bottom inspection in dry-dock to permit one dry-dock examination in any five-year period for passenger ships other than ro-ro passenger ships), should be appropriately taken into account also.

4.2 TECHNICAL REQUIREMENTS

4.2.1 The underwater part of the hull is to be protected against corrosion, either by an appropriate coating system, and/or external cathodic protection.

4.2.2 The underwater part of the hull is to be provided, where necessary, with permanent markings at selected points on the plating that would enable determining the diver's position on the plating and localization of any damage.

Identification marks and systems are to be supplied on the outer surface of the immersed shell to facilitate the in-water survey by showing clearly the positions of watertight bulkheads.

Every tank and bulkhead are to be clearly identified on the full immersed shell (side shells and bottom) by:

- at least one marking every five ordinary stiffeners spacing, distributed along the bulkhead length, without exceeding 5 meters between two markings;
- a segmented marking at every angle formed by a bulkhead;
- a cross shaped marking at every bulkhead intersection;
- the abbreviated name of each tank, to be painted beside one of the boundaries markings.

4.2.3 Means are to be provided for ascertaining the clearance in the propeller shaft aft bearing (or wear down by poker gauge), as well as the rudder pintle and bush clearances with the ship afloat.

4.2.4 Liners of rudder stocks and pintles as well as bushes in rudders are to be marked in such a way that the diver will notice any shifting or turning.

4.2.5 Sea chests must be capable of being cleaned under water, where necessary. Means should be provided to enable the diver to confirm that the sea suction openings are clear.

4.2.6 For other equipment, such as bow thrusters, or stabilizers, requirements will be specified separately in each particular case.

4.2.7 Plans and information facilitating the performance of the In-water Surveys, as approved by the *Register*, are to be placed onboard and are to indicate the location and/or the general arrangement of:

- all shell openings;
- the stem;
- rudder and fittings;
- the sternpost;
- the propeller, including the means used for identifying each blade;
- anodes, including securing arrangements;
- bilge keels;
- welded seams and butts;
- marking with type, position, size, paint, tank abbreviation table.

The plans are also to include the necessary instructions to facilitate the divers' work, especially for taking clearance measurements.

Moreover, a specific detailed plan showing the systems to be adopted when the ship is floating in order to assess the slack between pintles and gudgeons is to be submitted to the *Register* for approval.

5 ASPHALT CARRIERS

5.1 GENERAL

5.1.1 As stated in the *Rules for the classification of ships, Part 1 – general requirements, Chapter 1 – General information, 4*, tanker for oil intended for carriage of cargo having temperature above 60 [ºC] may be assigned to ships with installed may be assigned with the descriptive class notation **Asphalt carrier**, when complying with below specified requirements.

Technical documentation to be submitted to the *Register* for the purpose of the first assignment of subject character of class is listed in the *Rules for the classification of ships, Part 1 – General requirements, Chapter 2 – Surveys during construction and initial survey*.

Requirements for periodical class surveys, for the purpose of maintaining subject descriptive class notation are included in the *Rules for the classification of ships, Part 1 – General requirements, Chapter 5 – Surveys of ships in service*.

5.2.2 Below stated requirements are related asphalt carriers intended to carry asphalt (or bitumen) as heated cargo in independent tanks.

5.2.3 In cases of asphalt carrier intended only to carry asphalt (or bitumen) as heated cargo, but in integral cargo tanks and having GT ≥ 500, requirements of Enhanced Survey Programme should to be applied, as stated in the *Rules for the classification of ships, Part 1 – General requirements, Ch. 5 – Surveys of ships in service*, 3.1.

In the case of double hull asphalt carriers hull survey requirements for double-hull oil tankers should apply (*Rules for the classification of ships, Part 1 – General requirements, Chapter 5 – Surveys of ships in service*, Annex B).

In the case of single hull asphalt carrier hull survey requirements for single hull tankers should apply (*Rules for the classification of ships, Part 1 – General requirements, Chapter 5 – Surveys of ships in service*, 4.5, 5.4 and 7.7).

5.2 GENERAL REQUIREMENTS

5.2.1 Generally, asphalt carriers should comply with the requirements in Annex I of MARPOL 1973, as amended with regard to oil fuel tank protection (Reg. 12A), pump-room bottom protection (Reg. 22) and accidental oil outflow performance (Reg. 23).

All new asphalt carriers and existing tankers undergoing conversion to asphalt carriers under supervision of the *Register* are to comply with Annex I of MARPOL 1973 regarding to double hull and double bottom requirements (Reg. 19).

The requirements of Annex I of MARPOL, Regs. 29, 31 and 32 should not apply to oil tankers carrying asphalt or other products subject to the provisions of this Annex, which through their physical properties inhibit effective product / water separation and monitoring, for which the control of discharge under Reg. 34 of Annex I of MARPOL should be effected by the retention of residues on board with discharge of all contaminated washings to reception facilities.

Asphalt carriers of 30,000 tonnes dwt and above are also to comply with the requirements for segregated ballast tanks (Reg. 18) in Annex I of MARPOL 1973, as amended.

According to MARPOL 1973, Annex I, Reg. 19, as amended, independent cargo tanks are to be so located that the distance from the moulded line of the bottom shell and side shell is to be not less than the limits as required by the aforementioned MARPOL regulation.

5.2.2 Generally, carriage of asphalt cargoes at temperatures exceeding 300 [ºC] is not permitted. Carriage of cargoes exceeding such temperatures will be specially considered.

The above should be considered in conjunction with the requirement that the maximum allowable temperature of the surrounding steel structure should not exceed 80 [ºC].

Consequently, in the case of cargoes to be stored at temperatures above 90 [ºC], the effects of thermal stresses on the hull and the independent cargo tank due to the elevated temperatures of the asphalt cargo should be considered during the scantling assessment and direct calculations.

5.2.3 Cargo tanks are to be pre-heated when loading hot cargo in order to minimize the temperature discrepancies, with loading manual to be developed and available onboard ship as a guidance for the Master.

Additionally, when the piping lines are heated or cooled, they may put additional loads into the ship structures and therefore, sufficient expansion bends are to be provided to reduce this thermal loading.

5.2.4 Asphalt carriers are typically considered as tankers with cargo having a flashpoint exceeding 60 [ºC] (closed cup test), with the requirements of SOLAS, Reg. II-2 to be complied with.

However, if cargo is to be carried above its flashpoint, the fire safety measures are to comply with the requirements for tankers with cargo having a flashpoint below 60 [ºC] in SOLAS, Reg. II-2. The grades of asphalt cargoes to be carried and pertinent flashpoint temperatures are to be included in the loading manual.

5.2.5 The overproduce which may occur under loading / unloading operations should be considered, if any. In such a case, the diagram of the pressures in loading / unloading conditions is also to be included in the loading manual.

5.2.6 The supports of independent tanks are to be so designed that the loads from the independent tanks are effectively transmitted to the tank supports, while the independent tanks are allowed to expand in all directions without restraint to reduce thermal stresses in the structures of independent tanks. Generally, the supports of independent tanks are also to be designed to limit transmission of loads relative to global and local hull deflection from the hull structures to the independent tanks.

5.2.7 The access to space in cargo area of asphalt carriers with independent tanks, with appropriate distance between the surface to be inspected and ship structure should be provided. For the requirements related to access to space adjacent to cargo tank refer to the International Code for the Construction and Equipment of Ships Carrying Liquified Gases in Bulk (IGC Code), as far as applicable.

Asphalt carriers with independent tanks need not to comply with SOLAS Reg. II-1/3-6, which is applicable to oil tankers having integral tanks for the carriage of oil in bulk as contained in the definition of oil in Annex I of MARPOL 1973, as amended.

5.2.8 In order to allow access for inspections, cofferdams in cargo area, if fitted, should be provided with sufficient access space (generally not less than 600 mm). Sufficient access space should also be provided for pipe tunnels.

5.2.9 Additional specific requirements for asphalt carriers:

.1 Cargo tanks intended for the carriage of asphalt solutions are to be equipped with a heating system capable of preserving the asphalt solutions in their liquid state. Valves are to be fitted on the heating system inlet and outlet.

.2 Cargo piping and associated fittings outside tanks are to be provided with suitable heating devices.

.3 Each tank is to be equipped with at least two thermometers in order to ascertain the temperature of the asphalt solution.

.4 Cargo piping and associated fittings outside tanks are to be suitably insulated, where necessary.

.5 A fixed deck foam system or equivalent fixed installation should be installed (not required for ships with GT less than 2,000).

.6 Protection against tank overfilling should be provided.

.7 Cargo pump rooms are to be provided with a fixed fire-extinguishing system, except where the cargo is carried at a temperature below and not within 15 [ºC] of the cargo flash point.

.8 Spaces located within the cargo area are to be efficiently ventilated. Portable means of ventilation are permitted. Ventilation of the cargo pump room is to be provided.

.9 Generally, access doors, air inlets and openings to accommodation spaces, service spaces and control stations are not to face the cargo area.

.10 Fuel tanks located with a common boundary to cargo or tanks for retention of residues are not to be situated within, nor extend partly into, the cargo tank block. Such tanks may, however, be situated aft and/or forward of the cargo tank block. They may be accepted when located as independent tanks on open deck in the cargo area subject to spill and fire safety considerations. The arrangement of independent fuel tanks and associated fuel piping systems, including the pumps, may be as for fuel tanks and associated fuel piping systems located in the machinery spaces. For electrical equipment, requirements applicable to hazardous area classification must however be met.

.11 Tanks containing cargo or cargo residues are to be segregated from accommodation, service and machinery spaces, tanks containing drinking water and stores for human consumption by means of a cofferdam or similar space. Double bottom tanks adjacent to cargo tanks are not to be used as fuel oil tanks. Means are to be provided to keep deck spills away from accommodation and service areas.

.12 Cargo pump discharge pressure should have local indication on the pump (and next to the driving machine if located in a separate compartment), or next to the unloading control station.

.13 Cargo tanks intended for the carriage of asphalt solutions are to be equipped with a heating system capable of preserving the asphalt solutions in their liquid state. Valves are to be fitted on the heating system inlet and outlet.

.14 Cargo piping and associated fittings outside tanks are to be provided with suitable heating devices.