RULES
FOR THE CLASSIFICATION OF SHIPS

Part 9 – MACHINES
January 2020

Amendments No. 1
July 2020

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 9 – MACHINES

have been adopted on 30th June 2020 and shall enter into force on 1st July 2020

INTRODUCTORY NOTES

These amendments shall be read together with the requirements in the Rules for the Classification of Ships, Part 9 – Machines, edition January 2020.

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.

This Part of the Rules includes the requirements of the following international Organisations:

International Maritime Organization (IMO)

Conventions: International Convention for the Safety of Life at Sea 1974 (SOLAS 1974) and all subsequent amendments up to and including the 2014 amendments (MSC.365/93).
Protocol of 1988 relating to the International Convention for the Safety of Life at Sea 1974, as amended (SOLAS PROT 1988).

Circulars: MSC.1/Circ.1425

International Association of Classification Societies (IACS)

Unified Requirements (UR):
A3 (Rev.1 2019), F29 (Rev. 6, 2005), M2 (1971), M3 (Rev. 6, 2018), M9 (Corr. 2, 2007), M10 (Rev. 4, 2013), M11 (1972), M12 (1972), M16 (Rev. 1, 2005), M26 (Corr. 1, 2005), M28 (1978), M42 (Rev. 4, 2011), M44 (Corr.2, Nov 2016), M51 (Corr. 1, Oct 2018), M53 (Rev. 3, 2017), M56 (Rev. 3, 2015), M60 (1997), M61 (2003), M63 (2005), M66 (Rev. 3, 2008), M67 (Rev. 2, 2015), M71 (Corr.1, 2016), M72 (Rev.2, 2019), M73 (Corr.1, 2016), Z26 (2015), M77 (Sep 2016), M79 (Oct 2018), M80 (2019)

Unified Interpretations:
SC76 (1985), SC94 (Rev. 2, 2016), SC133 (1998), SC189 (2004), SC228 (2008), SC242 (Rev.2, 2020), SC246 (Rev.1, 2015)

International standards

International Organisation for Standardisation:
ISO 1122-1:1998 Corr. 1:1999 Corr. 2:2009, ISO 6336-1:2006 Corr. 2008, ISO 6336-2:2006 Corr. 2008, ISO 6336-3:2006 Corr. 2008, ISO 6336-5:2003, ISO 19019:2005

TABLE 1 – REVIEW OF AMENDMENTS

This review comprises amendments in relation to the Rules for the Classification of Ships, Part 9 – Machines, edition January 2020.

ITEM	*DESCRIPTION OF THE AMENDMENTS*
SECTION 6 – DECK MACHINERY	
Head 6.2 - Steering gear	Existing paragraph 6.2.14 - Arrangements for steering capability and function on ships fitted with propulsion and steering systems other than traditional arrangements for a ship's directional control has been amended
Head 6.3 - Anchor machinery	Existing items 6.3.1.2, 6.3.2.2 and 6.3.6 have been amended
SECTION 9 - REQUIREMENTS FOR AC GENERATING SETS	
Section 9	New Section has been added

6 DECK MACHINERY

■ In Head **6.2 – STEERING GEAR**, existing paragraph **6.2.14 - Arrangements for steering capability and function on ships fitted with propulsion and steering systems other than traditional arrangements for a ship's directional control** has been amended and should be read as follows:

6.2.14.1 The requirements of this item are applicable for ships fitted with alternative propulsion and steering arrangements, such as but not limited to, azimuthing propulsors or water jet propulsion systems.

6.2.14.2 The stopping times, ship headings and distances recorded on trials, together with the results of trials to determine the ability of ships having multiple propulsion/steering arrangements to navigate and manoeuvre with one or more of these devices inoperative, shall be available on board for the use of the master or designated personnel.

6.2.14.3 For a ship fitted with multiple steering propulsion units, such as but not limited to azimuthing propulsors or water jet propulsion systems each of the steering-propulsion units shall be provided with a main steering gear and an auxiliary steering gear or with two or more identical steering actuating systems in compliance with 6.2.14.7. The main steering gear and the auxiliary steering gear shall be so arranged that the failure of one of them will not render the other one inoperative.

For a ship fitted with a single steering-propulsion unit, the requirement in 6.2.1.2 is considered satisfied if the steering gear is provided with two or more steering actuating systems and is in compliance with 6.2.14.8. A detailed risk assessment is to be submitted in order to demonstrate that in the case of any single failure in the steering gear, control system and power supply the ship steering is maintained.

6.2.14.4 All components used in steering arrangements for ship directional control are to be of sound reliable construction to the satisfaction of the *Register*. Special consideration shall be given to the suitability of any essential component which is not duplicated. Any such essential component shall, where appropriate, utilize anti-friction bearings such as ball bearings, roller bearings or sleeve bearings which shall be permanently lubricated or provided with lubrication fittings.

6.2.14.5 The main steering arrangements for ship directional control shall be:

.1 of adequate strength and capable of steering the ship at maximum ahead service speed which shall be demonstrated;

.2 capable of changing direction of the steering-propulsion unit from one side to the other at declared steering angle limits at an average turning speed of not less than 2.3°/s with the ship running ahead at maximum ahead service speed;

.3 for all ships, operated by power; and

.4 so designed that they will not be damaged at maximum astern speed; this design requirement need not be proved by trials at maximum astern speed and declared steering angle limits. Ship manoeuvrability tests, such as according to Resolution MSC.137(76) on Standards for ship manoeuvrability, are to be carried out with steering angles not exceeding the declared steering angle limits.

Note: **Declared steering angle limits** – limits are the operational limits in terms of maximum steering angle, or equivalent, according to manufacturers' guidelines for safe operation, also taking into account the ship's speed or propeller torque/speed or other limitation; the "declared steering angle limits" are to be declared by the directional control system manufacturer for each ship specific non-traditional steering mean; ship manoeuvrability tests, such as those in the Standards for ship manoeuvrability (resolution MSC.137(76)) are to be carried out with steering angles not exceeding the declared steering angle limits.

6.2.14.6 The auxiliary steering arrangements for ship directional control shall be:

.1 of adequate strength and capable of steering the ship at navigable speed and of being brought speedily into action in an emergency;

.2 capable of changing direction of the ship's directional control system from one side to the other at declared steering angle limits at an average turning speed of not less than 0.5 °/s with the ship running ahead at one half of the maximum ahead service speed or 7 knots, whichever is the greater; and

.3 for all ships, operated by power where necessary to meet the requirements of 6.2.2.2.2 and in any ship having power of more than 2,500 kW propulsion power per steering-propulsion unit.

Ship manoeuvrability tests, such as according to Resolution MSC.137(76), are to be carried out with steering angles not exceeding the declared steering angle limits.

Note: **Declared steering angle limits** – limits are the operational limits in terms of maximum steering angle, or equivalent, according to manufacturers' guidelines for safe operation, also taking into account the ship's speed or propeller torque/speed or other limitation; the "declared steering angle limits" are to be declared by the directional control system manufacturer for each ship specific non-traditional steering mean; ship manoeuvrability tests, such as those in the Standards for ship manoeuvrability (Resolution MSC.137(76)) are to be carried out with steering angles not exceeding the declared steering angle limits.

6.2.14.7 For a ship fitted with a single steering-propulsion unit where the main steering gear comprises two or more identical power units and two or more identical steering actuators, an auxiliary steering gear need not be fitted provided that the steering gear:

.1 in a passenger ship is capable of satisfying the requirements in 6.2.14.5 while any one of the power units is out of operation;
.2 in a cargo ship, is capable of satisfying the requirements in 6.2.14.5 while operating with all power units; and
.3 is arranged so that after a single failure in its piping system or in one of the power units' steering capability can be maintained or speedily regained.

6.2.14.8 For a ship fitted with multiple steering propulsion units, where each main steering system comprises two or more identical steering actuating systems, an auxiliary steering gear need not be fitted provided that each steering gear:
.1 in a passenger ship, is capable of satisfying the requirements in 6.2.14.5 while any one of the steering gear steering actuating systems is out of operation;
.2 in a cargo ship, is capable of satisfying the requirements in 6.2.14.5 while operating with all steering gear steering actuating systems;
.3 is arranged so that after a single failure in its piping or in one of the steering actuating systems, steering capability can be maintained or speedily regained the above capacity requirements apply regardless whether the steering systems are arranged with common or dedicated power units.

Note: **Steering gear power unit** – For the purposes of alternative steering arrangements, the steering gear power unit is to be considered as defined in SOLAS regulation II-1/3. For electric steering gears, refer to SOLAS regulation II-1/3; electric steering motors are to be considered as part of the power unit and actuator.

6.2.14.9 Where the propulsion power exceeds 2500 kW per thruster unit, an alternative power supply, sufficient at least to supply the steering arrangements which complies with the requirements of 6.2.2.2.-.2 and also its associated control system and the steering gear response indicator, shall be provided automatically, within 45 s, either from the emergency source of electrical power or from an independent source of power located in the steering gear compartment. This independent source of power shall be used only for this purpose. In every ship of 10,000 gross tonnage and upwards, the alternative power supply shall have a capacity for at least 30 min of continuous operation and in any other ship for at least 10 min.

The above is also valid to the steering propulsion units having a certain proven steering capability due to ship speed also in case propulsion power has failed.

6.2.14.10 Each electric or electrohydraulic steering gear comprising one or more power units shall be served by at least two exclusive circuits fed directly from the main switchboard; however, one of the circuits may be supplied through the emergency switchboard. An auxiliary electric or electrohydraulic steering gear associated with a main electric or electrohydraulic steering gear may be connected to one of the circuits supplying this main steering gear. The circuits supplying an electric or electro hydraulic steering gear shall have adequate rating for supplying all motors which can be simultaneously connected to them and may be required to operate simultaneously.

For a ship fitted with multiple steering systems, this requirements are to be applied to each of the steering systems.

6.2.14.11 For ships having multiple propulsion/steering arrangements to navigate and manoeuvre with one or more of these devices inoperative see the *Rules, Part 7 - Machinery Installation*, item 1.4.3.

■ In Head **6.3 – ANCHOR MACHINERY**, has been amended and should be read as follows:

6.3.1 General

6.3.1.1 Application

A windlass used for handling anchors, suitable for the size of chain cable and complying with the following criteria is to be fitted to the ship.

6.3.1.2 Standards of Compliance

The design, construction and testing of windlasses are to conform to an acceptable standard or code of practice. To be considered acceptable, the standard or code of practice is to specify criteria for stresses, performance and testing.

The following are examples of standards recognized:
- SNAME T & R Bulletin 3-15:2018 - Guide to the Design and Testing of Anchor Windlasses for
- Merchant Ships
- ISO 7825:2017 Deck machinery general requirements
- ISO 4568:2006 Shipbuilding - Sea-going vessels - Windlasses and anchor capstans
- JIS F6714:1995 Windlasses

6.3.1.3 Plans and Particulars to be Submitted

The following plans showing the design specifications, the standard of compliance, engineering analyses and details of construction, as applicable, are to be submitted for evaluation:

.1 Windlass design specifications; anchor and chain cable particulars; anchorage depth; performance criteria; standard of compliance.
.2 Windlass arrangement plan showing all of the components of the anchoring/mooring system such as the prime mover, shafting, cable lifter, anchors and chain cables; mooring winches, wires and fairleads, if they form part of the windlass machinery; brakes; controls; etc.
.3 Dimensions, materials, welding details, as applicable, of all torque-transmitting (shafts, gears, clutches, couplings, coupling bolts, etc.) and all load bearing (shaft bearings, cable lifter, sheaves, drums, bed-frames, etc.) components of the windlass and of the winch, where applicable, including brakes, chain stopper (if fitted) and foundation.
.4 Hydraulic system, to include:
- piping diagram along with system design pressure,
- safety valves arrangement and settings,
- material specifications for pipes and equipment,
- typical pipe joints, as applicable, and
- technical data and details for hydraulic motors.

.5 Electric one line diagram along with cable specification and size; motor controller; protective device rating or setting, as applicable.
.6 Control, monitoring and instrumentation arrangements.
.7 Engineering analyses for torque-transmitting and load-bearing components demonstrating their compliance with recognized standards or codes of practice. Analyses for gears are to be in accordance with a recognized standard.
.8 Plans and data for windlass electric motors including associated gears rated 100 kW and over.
.9 Calculations demonstrating that the windlass prime mover is capable of attaining the hoisting speed, the required continuous duty pull, and the overload capacity are to be submitted if the “load testing” including “overload” capacity of the entire windlass unit is not carried out at the shop (see 6.3.4).
.10 Operation and maintenance procedures for the anchor windlass are to be incorporated in the vessel operations manual.

6.3.2. Materials and Fabrication

6.3.2.1 Materials

Materials used in the construction of torque-transmitting and load-bearing parts of windlasses are to comply with the Rules of acting class society or of a national or international material standard. The proposed materials are to be indicated in the construction plans and are to be approved in connection with the design. All such materials are to be certified by the material manufacturers and are to be traceable to the manufacturers’ certificates.

6.3.2.2 Welded Fabrication

Weld joint designs are to be shown in the construction plans and are to be approved in association with the approval of the windlass design. Welding procedures and welders are to be qualified in accordance with the requirements of the class society. Welding consumables are to be approved by the class society in the case their type and grade fall within the scope of IACS UR W17 and UR W23; when their type and grade fall outside the scope of IACS UR W17 and UR W23, the welding consumables are to comply with the applicable Rules of acting class society, if any, or to national or international standards. The degree of non-destructive examination of welds and post-weld heat treatment, if any, are to be specified and submitted for consideration.

6.3.3 Design

Along with and notwithstanding the requirements of the chosen standard of compliance, the following requirements are also to be complied with. In lieu of conducting engineering analyses and submitting them for review, approval of the windlass mechanical design may be based on a type test, in which case the testing procedure is to be submitted for consideration.

6.3.3.1 Mechanical Design

.1 Design Loads
(a) Holding Loads; Calculations are to be made to show that, in the holding condition (single anchor, brake fully applied and chain cable lifter declutched), and under a load equal to 80% of the specified minimum breaking strength of the chain cable, the maximum stress in each load bearing component will not exceed yield strength (or 0.2% proof stress) of the material. For installations fitted with a chain cable stopper, 45% of the specified minimum breaking strength of the chain cable may instead be used for the calculation.
(b) Inertia Loads; The design of the drive train, including prime mover, reduction gears, bearings, clutches, shafts, cable lifter and bolting is to consider the dynamic effects of sudden stopping and starting of the prime mover or chain cable so as to limit inertial load.
.2 Continuous Duty Pull; The windlass prime mover is to be able to exert for at least 30 minutes a continuous duty pull (e.g., 30-minute short time rating corresponding to S2-30 min. of IEC 60034-1), Z_{cont1}, corresponding to the grade and diameter, d, of the chain cables as follows:

Grade of chain	Z_{cont1}	
	N	*kgf*
1	$37.5d^2$	$3.82d^2$
2	$42.5d^2$	$4.33d^2$
3	$47.5d^2$	$4.84d^2$
Unit of d	*mm*	*mm*

The values of the above table are applicable when using ordinary stockless anchors for anchorage depth down to 82.5 m.
For anchorage depth deeper than 82.5 m, a continuous duty pull Z_{cont2} is:
$Z_{cont2}[N] = Z_{cont1}[N] + (D – 82.5) \times 0.27d_2$
or
$Z_{cont2}[kgf] = Z_{cont1}[kgf] + (D – 82.5) \times 0.0275d_2$
Where D is the anchor depth, in metres.
The anchor masses are assumed to be the masses as given in the *Rules, Part 3 – Hull equipment, 3.3*. Also, the value of Z_{cont} is based on the hoisting of one anchor at a time, and that the effects of buoyancy and hawse pipe efficiency (assumed to be 70%) have been accounted for. In general, stresses in each torque-transmitting component are not to exceed 40% of yield strength (or 0.2% proof stress) of the material under these loading conditions.

.3 Overload Capability; The windlass prime mover is to be able to provide the necessary temporary overload capacity for breaking out the anchor. This temporary overload capacity or “short term pull” is to be at least 1.5 times the continuous duty pull applied for at least 2 minutes. The speed in this period may be lower than normal.

.4 Hoisting Speed; The mean speed of the chain cable during hoisting of the anchor and cable is to be at least 9 m/min. For testing purposes, the speed is to be measured over two shots of chain cable and initially with at least three shots of chain (82.5 m or 45 fathoms in length) and the anchor submerged and hanging free.

.5 Brake Capacity; The capacity of the windlass brake is to be sufficient to stop the anchor and chain cable when paying out the chain cable. Where a chain cable stopper is not fitted, the brake is to produce a torque capable of withstanding a pull equal to 80% of the specified minimum breaking strength of the chain cable without any permanent deformation of strength members and without brake slip. Where a chain cable stopper is fitted, 45% of the breaking strength may instead be applied.

.6 Chain Cable Stopper; Chain cable stopper, if fitted, along with its attachments is to be designed to withstand, without any permanent deformation, 80% of the specified minimum breaking strength of the chain cable.

.7 Support Structure; For hull supporting structures of windlass and chain cable stoppers, refer to the *Rules, Part 3 – Hull equipment,* 3.5.8.

6.3.3.2 Hydraulic Systems

Hydraulic systems where employed for driving windlasses are to comply with the provisions of the requirements stated in the Section 7 and the *Rules, Part 8 – Piping*, 14.

6.3.3.3 Electrical Systems

.1 Electric Motors; Electric motors are to meet the requirements of the *Register* and those rated 100 kW and over are to be certified. Motors exposed to weather are to have enclosures suitable for their location as provided for in the requirements of the *Register*. Where gears are fitted, they are to meet the requirements of the class society and those rated 100 kW and over are to be certified.

.2 Electrical Circuits; Motor branch circuits are to be protected in accordance with the provisions of the *Register* and cable sizing is to be in accordance with the requirements of the *Register*. Electrical cables installed in locations subjected to the sea are to be provided with effective mechanical protection.

6.3.3.4 Protection of Mechanical Components

To protect mechanical parts including component housings, a suitable protection system is to be fitted to limit the speed and torque at the prime mover. Consideration is to be given to a means to contain debris consequent to a severe damage of the prime mover due to over speed in the event of uncontrolled rendering of the cable, particularly when an axial piston type hydraulic motor forms the prime mover.

6.3.3.5 Couplings

Windlasses are to be fitted with couplings which are capable of disengaging between the cable lifter and the drive shaft. Hydraulically or electrically operated couplings are to be capable of being disengaged manually.

6.3.4 Shop Inspection and Testing

Windlasses are to be inspected during fabrication at the manufacturers' facilities by a Surveyor for conformance with the approved plans. Acceptance tests, as specified in the specified standard of compliance, are to be witnessed by the Surveyor and include the following tests, as a minimum.

.1 No-load test. The windlass is to be run without load at nominal speed in each direction for a total of 30 minutes. If the windlass is provided with a gear change, additional run in each direction for 5 minutes at each gear change is required.

.2 Load test. The windlass is to be tested to verify that the continuous duty pull, overload capacity and hoisting speed as specified in 6.3.3.1 can be attained. Where the manufacturing works does not have adequate facilities, these tests, including the adjustment of the overload protection, can be carried out on board ship. In these cases, functional testing in the manufacturer's works is to be performed under no-load conditions.

.3 Brake capacity test. The holding power of the brake is to be verified either through testing or by calculation.

6.3.5 On-board Tests

Each windlass is to be tested under working conditions after installation onboard to demonstrate satisfactory operation. Each unit is to be independently tested for braking, clutch functioning, lowering and hoisting of chain cable and anchor, proper riding of the chain over the cable lifter, proper transit of the chain through the hawse pipe and the chain pipe, and effecting proper stowage of the chain and the anchor. It is to be confirmed that anchors properly seat in the stored position and that chain stoppers function as designed if fitted. The mean hoisting speed, as specified in 6.3.3.1.4, is to be measured and verified. The braking capacity is to be tested by intermittently paying out and holding the chain cable by means of the application of the brake. Where the available water depth is insufficient, the proposed test method will be specially considered.

6.3.6 Marking

Windlass shall be permanently marked with the following information:

.1 Nominal size of the windlass (e.g. 100/3/45 is the size designation of a windlass for 100 mm diameter chain cable of IACS Grade 3, with a holding load of 45 % of the breaking load of the chain cable);

.2 Maximum anchorage depth, in metres.

6.3.7 Additional requirements

6.3.7.1 The anchor machinery intended for handling with mooring operations shall comply also with the requirements of 6.4.

6.3.7.2 If the provision is made for remote control of paying out the chain cable with the sprocket disconnected from the anchor machinery drive, a device shall be fitted ensuring an automatic braking by the band brake in order that the maximum speed of paying out will not exceed 180 m/min and the minimum speed will not be less than 80 m/min without regard to the initial acceleration. In ships with equipment number of 400 and less it is permissible not to install a device for an automatic braking by the band brake.

6.3.7.3 The chain sprocket brake shall provide for smooth stopping of the chain cable when paying it out for a period of not more than 5 s and not less than 2 s from the moment of initiation of the signal from the control station.

6.3.7.4 Provision shall be made at the remote control station for an indicator of the length of the chain cable paid out and the indicator of the paying out speed of the cable with the mark of 180 m/min of the maximum permissible speed.

6.3.7.5 Machinery and machinery elements for which the remote control is provided shall be manually operated form the local position. The failure of any element or the whole remote control system is not to affect adversely the normal operation of the anchor machinery and equipment manually operated from the local position (see also the *Rules, Part 12 - Electrical Equipment*, 5).

6.3.7.6 The hand-operated drive shall provide for a heaving speed of at least 2,5 m/min with a pull F on the sprocket complying with 6.3.3.1, the force applied to the handle being not over 150 N per operator.

■ Section **9 REQUIREMENTS FOR AC GENERATING SETS**, has been added and should be read as follows:

9 REQUIREMENTS FOR AC GENERATING SETS [1)]

9.1 GENERAL

9.1.1 This section provides requirements for AC Generating sets (i.e. Reciprocating Internal Combustion engines, alternators and couplings) in addition to requirements stated in 2.4, 2.11, 2.14.10, and IACS UR E13.

Reciprocating Internal Combustion engines are to comply with the requirements in 2.14 and 2.14.10.

The Reciprocating Internal Combustion engine speed governor and overspeed protective device are to comply with the requirements of 2.11.

Alternators are to comply with the requirements in IACS UR E13.

9.1.2 The requirements are applicable to AC generating sets subject to certification driven by reciprocating internal combustion engines irrespective of their types (i.e. diesel engine, dual fuel engine, gasfuel engine), except for those sets consisting of a propulsion engine which also drives power take off (PTO) generator(s).

9.2 GENERATING SETS - REQUIREMENTS

9.2.1 The generating set shall show torsional vibration levels which are compatible with the allowable limits for the alternator, shafts, coupling and damper.

9.2.2 The coupling selection for the generating set shall take into account the stresses and torques imposed on it by the torsional vibration of the system. The torsional vibration calculations are to be submitted to the *Register* for approval when the engine power is 110 kW or above.

9.2.3 The rated power shall be appropriate for the actual use of the generator set.

9.2.4 The entity responsible of assembling the generating set shall install a rating plate marked with at least the following information:

(i) the generating set manufacturer's name or mark;
(ii) the set serial number;
(iii) the set date of manufacture (month/year);
(iv) the rated power (both in kW and KVA) with one of the prefixes COP, PRP (or, only for emergency Generating sets, LTP) as defined in ISO 8528-1:2018;
(v) the rated power factor;
(vi) the set rated frequency (Hz);
(vii) the set rated voltage (V);
(viii) the set rated current (A);
(ix) the mass (kg).

1) 1. This requirement is to be implemented for AC generating sets:
i) when an application for certification of the generating set is dated on or after 1 July 2020; or
ii) which are installed in new ships contracted for construction on or after 1 July 2020.
2. The "contracted for construction" date means the date on which the contract to build the vessel is signed between the prospective owner and shipbuilder. For further details regarding the date of "contract for construction", refer to IACS Procedural Requirement (PR) No. 29.
3. The "date of application for certification of the generating set" is the date of whatever document the Classification Society requires/accepts as an application or request for certification of an individual generating set.