



INTLREG
INTERNATIONAL REGISTER OF SHIPPING

RULES FOR CLASSIFICATION OF FRP VESSELS

PART 5 Machinery and Piping

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CHANGES HISTORY

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CHAPTER 1 GENERAL

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SECTION 1 REQUIREMENTS

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1.1 Application

- 1.1.1. This Part applicable to the main propulsion machinery and piping system. Deck machinery and power transmission system, shafting systems, propellers, waterjet propulsion systems, prime movers.
- 1.1.2. Machinery installations, which are unusual and considered impracticable to meet the requirements of this Part shall be accepted provided they are deemed by the Society to be equivalent to those specified in this Part.
- 1.1.3. Passenger Ships or with special service limitations or restrictions Ships intended for classification shall be constructed in accordance with the requirements of INTLREG as well as Governmental Regulations.
- 1.1.4.
 - 1.1.4.1. Unit and formulae including in the Rules are in SI units.
 - 1.1.4.2. Pressure gauges shall be calibrated in bar. where: 1 bar = 0.1 MPa
- 1.1.5. Ambient conditions.

Ambient conditions shall be in accordance as specified in INTLREG Part 5A Rules and Regulations for Classification of Steel Vessels, Ch 2, sect 1[1.1.4]
- 1.1.6. Power rating.

Power rating shall be in accordance with the requirements specified in INTLREG Part 5A Rules and Regulations for Classification of Steel Vessels, Ch 2, sect 1[1.1.2.2]
- 1.1.7. Documents
 - 1.1.7.1. Machineries built under special survey during construction, drawings of the proposed arrangements of machinery compartments and such drawings of the machineries as stated in the subsequent Chapters of this Part shall be submitted for approval before proceeding with the work.
 - 1.1.7.2. The proposed dimensions and quality of materials as well as all important arrangements and details shall be clear in the drawings.
 - 1.1.7.3. For any novel design of machinery, detailed drawings of parts and necessary data shall be submitted for consideration

1.2 Materials

- 1.2.1. Material intended for machinery installations shall be selected considering the purpose and condition of their service. Materials intended for principal components shall be of those tested and inspected in accordance with the requirements specified in this Part and INTLREG Part 2 Rules and Regulations for Classification of Steel Vessels
- 1.2.2. Materials used for machinery installations which are not specified in [1.2.1] of this Chapter shall be submitted for consideration

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2.1 General considerations

- 2.1.1. The machinery installations shall be properly fixed and shall be of construction and arrangement to facilitate operation, inspection and maintenance.
- 2.1.2. The machinery installations shall be of a design and construction adequate for the service for which they are intended and shall be so installed and protected as to reduce to a minimum any danger to persons on board, due regard being paid to moving parts, hot surface and other hazards.
- 2.1.3. Machinery installations shall be fitted with adequate safety monitoring and control devices such as speed, temperature, pressure and other operation parameters.
- 2.1.4. Special consideration shall be mentioned to the design, construction and installation of the machinery installations so that any mode of vibrations, accelerations, shocks, etc., shall not cause undue stresses in normal operating ranges.

2.2 Inclination of ships.

- 2.2.1. The designs and constructions of machinery installations shall be in compliance with accepted marine engineering practices and the machineries shall be operable with complete reliability in all positions and motions with the ship under the conditions as shown in INTLREG Part 5A Rules and Regulations for Classification of Steel Vessels, Chapter 1, Sect 4, Table 1.4.2
- 2.2.2. Astern power.
 - 2.2.2.1. Sufficient power for going astern shall be provided to secure proper control of the ship in all normal circumstances.
 - 2.2.2.2. For the main propulsion system with reversing gear, controllable pitch propellers, waterjet propulsion systems, or electric propulsion systems, running astern is not to lead to the overload of propulsion machinery.
- 2.2.3. Welded construction.

The welded construction shall be in compliance with as specified in INTLREG Part 2 Rules and Regulations for Classification of Steel Vessels
- 2.2.4. Safety devices on moving parts
 - 2.2.4.1. Efficient means shall be provided to prevent the loosening of nuts and screws of moving parts.
 - 2.2.4.2. The moving parts of machinery and shafting shall be of efficiently protected by means of safety handrails, safety screens, grills etc.

2.3 Installation of machinery.

- 2.3.1. Propulsion machinery, except for those of small output, shall be installed on the bottom girders through the steel engine seatings of sufficient strength and rigidity.

- 2.3.2. Machinery with large unbalanced inertia force or large unbalanced moment of inertia or subjected to large exciting force due to piston side thrust are installed, it is recommended that the steel engine seatings are of sufficient length for the engines and the steel engine seatings on both sides are connected each other or the steel engine seatings of solid construction
- 2.3.3. If the temperature of the bedplates for propulsion machinery or engine seatings in contact with the FRP girders become the value to give bad influence on the creeping property of FRP in a normal operating condition, an effective insulation shall be provided between the bedplates or seatings and FRP girders.
- 2.3.4. Considering installation of all machinery on to the FRP girders such that an excessive creep deformation does not occur due to the weights and clamping forces of bolts.
- 2.3.5. The machinery accessories and heavy spare parts shall be well secured so that they cannot move or become loose under the movements of the ship.

2.4 Ventilating systems for machinery spaces.

- 2.4.1. Machinery spaces shall be well ventilated such that when machineries operating at full power in all weather conditions, sufficient supply of air is circulated to the spaces for the safety and comfort of personnel, for the operation of the machinery and for the prevention of accumulation of flammable gases.

- 2.4.2. Dead ship start.

Means shall be provided such that the machinery shall be recovered into operation from a dead ship condition (e.g. a condition under which the main propulsion machinery, and auxiliaries are not in operation due to power failure and normal starting energy sources exhausted).

- 2.4.3. Noise protection safety.

Measures shall be taken to minimize machinery noise in machinery spaces to acceptable levels as determined by the National Regulations of the country in which the ship is registered. If this noise cannot be sufficiently reduced the source of excessive noise shall be suitably insulated or isolated or a refuge from noise shall be provided if the space is required to be manned. Ear protectors shall be provided for personnel required to enter such spaces, if necessary.

- 2.4.4. Limitation in the use of fuel oil.

Except for cases as specified in (a) to (c) below, no fuel oil with a flash point (to be determined by means of closed-cup test) of less than 60°C shall be used.

(a) In emergency generators, fuel oil with a flash point of not less than 43°C shall be used.

(b) Subject to such additional precautions as shall consider necessary and on condition that the ambient temperature of space in which such fuel oil is stored or used shall not be allowed to rise to within 10°C below the flashpoint of the fuel oil, the general use of fuel oil having a flashpoint of less than 60°C but not less than 43°C shall be permitted.

(c) The use of fuel oil having a flashpoint of less than 43°C shall be permitted provided that such fuel oil is not stored in any machinery space and subject to the approval by this Society.

2.4.5. Automatic trips.

A description of all automatic trips that shall affect the vessels propulsion system shall be submitted for review.

2.4.6. Boilers, pressure vessels and turbines.

If fitted , boilers and pressure vessels shall be designed and constructed in accordance with INTLREG ,Part 5A Rules and Regulations for Classification of Steel Vessels

2.5 Tests

2.5.1. Shop tests and inspections.

The machinery for ships classed or intended to be classed, built under the special survey during construction, normally shall be tested and inspected in the presence of the surveyor in accordance with the requirement of Rules and the approved drawing

(a) Material approval and material tests for component parts of machinery set out in the relevant Chapters of this Part.

(b) Workmanship for machining from the commencement of work until the finish inspections for component parts of machinery.

(c) Tightness, balancing and non-destructive tests etc. for component parts of machinery set out in the relevant Chapters of this Part.

(d) Trial testing of machinery.

2.5.2. Tests and inspections after installation on board.

The following tests and inspections shall be carried out after installation on board,:

(a) Verification inspection of installation or fixing condition of machinery.

(b) On-board tests and inspection of machinery and essential systems shall be carried out in accordance with the requirements of the relevant Chapters of this Part.

(c) Other test and inspections not included in this Part shall be required if deemed necessary by the society.

2.5.3. The society shall be prepared on application to adopt the alternative methods of inspection for the production line machinery and component parts subject to approval of manufacturer's production procedure and quality control.

2.5.4. In case the machinery or component part of machinery possess appropriate certificates, the tests and inspections shall be wholly or partially dispensed with subject to further considerations and special approval by the Society

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SECTION 1 GENERAL

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1.1 General

1.1.1. The construction and installation of diesel engines for main propelling and essential service shall be carried out in accordance with the following requirements under the supervision and to the satisfaction of the surveyor.

1.1.2. Diesel engines which drive electric propulsion generators shall be constructed and installed in accordance with the following requirements as well as the requirements stated INTLREG ,Part 6 Rules and Regulations for Classification of Steel Vessels, Electrical Installation & Control Systems, Chapter 2 Sect 2[2.3]

1.2 Documents

1.2.1. Documents submission for approval are generally to comply with the requirements specified in INTLREG ,Part 5A ,Rules and Regulations for Classification of Steel Vessels , Chapter 2,Sect 1[1.1.5]

1.3 Materials

1.3.1. Materials intended for the component parts of diesel engines shall be tested and inspected in the presence of the Surveyor in accordance with the requirements of INTLREG ,Part 5A Rules and Regulations for Classification of Steel Vessels ,Chapter 2,Sect 1[1.2] or with the requirements of the specification approved in connection with the design.

1.3.2. Engine parts subject to stress shall be made of sound materials, and cylinders, cylinder liners, cylinder covers, pistons, etc. under high temperature or pressure shall be made of materials suitable for the stress and temperature to which they are exposed.

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2.1 Construction

2.1.1. General

- a) Diesel engines shall be designed to have construction and strength adequate for the service for which they are intended, the working conditions to which they are subjected and the environmental conditions on board.
- b) Frames and bed plates shall be of rigid and oil tight construction. Crank cases shall be strongly built and doors or covers securely fastened and made air and oil tight so that they can withstand a considerable excessive pressure within the crankcases without any risk of damage.
- c) Passages for cooling water and lubricating oil shall be carefully cleaned of sand and scale.
- d) Clutches or reversing gear built in engines shall be in accordance with the requirements stated in Chapter 4 of this Part.

2.1.2. Cylinder relief valves.

Each cylinder of a diesel engine having a bore exceeding 230mm shall be provided with a relief valve adjusted to be activated at not more than 40% above the maximum combustion pressure at the maximum continuous output, and so arranged that when discharged no damage to operators can occur.

2.1.3. Protection against crankcase explosion.

Engines shall comply with the following requirements to protect from crankcase explosion:

2.2 Starting Arrangements

2.2.1.

- (a) 2.1.1 (b) of this Chapter.
- (b) INTLREG ,Part 5A Rules and Regulations for Classification of Steel Vessels ,Chapter 2,Sect 1[1.8.3.1]
- (c) 2.2.3 and 2.2.4 of this Chapter.

2.2.2. Crankcase ventilation

- a) Provision shall be made for ventilation of an enclosed crankcase by means of a small breather or by means of slight suction not exceeding 25 mm of water. Crankcase shall not to be ventilated by a blast of air. Otherwise, the general arrangements and installation shall be such as to preclude the possibility of free entry of air to the crankcase.
- b) Crankcase ventilation piping is not to be directly connected with any other piping system. Crankcase ventilation pipes from each engine are normally to be led independently to the weather and fitted with corrosion resistant flame screens.
- c) Crankcase ventilation pipes from two or more engines shall lead to a common oil mist manifold. Where a Common oil mist manifold is employed, the vent pipes from each engine shall be led independently to the manifold and fitted with a corrosion resistant flame screen within the manifold. The arrangement is not to violate the engine manufacturer's recommendations for crankcase ventilation. The common oil mist manifold shall be accessible at all times under normal

conditions and effectively vented to the weather. where venting of the manifold to the weather is accomplished by means of a common vent pipe, the clear open area of the common vent pipe is not to be less than the aggregate cross-sectional area of the individual vent pipes entering the manifold, and the outlet to the weather shall be fitted with a corrosion resistant flame screen. The manifold shall also fitted with an appropriate draining arrangement.

2.2.3. Warning notice.

Suitable warning notices shall be attached in a conspicuous place on each engine and shall caution against the opening of a hot crankcase for a specified period of time after shutdown based upon the size of the engine, but not less than 10 minutes in any case. Such notice is also to warn against restarting an overheated engine until the cause of overheated has been identified and rectified.

2.2.4. Speed governors and overspeed protective devices of main diesel engines and generator prime movers.

The speed governors and overspeed protective devices of main diesel engines and generator prime movers shall be in compliance with the requirements specified INTLREG ,Part 5A Rules and Regulations for Classification of Steel Vessels ,Chapter 2,Sect 1[1.4.3]

2.3 Starting Arrangements

2.3.1. Air starting.

Compressed air starting arrangements shall be in compliance with the requirements specified in INTLREG ,Part 5A Rules and Regulations for Classification of Steel Vessels ,Chapter 8,Sect 4[4.5]

2.3.2. Electric starting.

- a) Where main propelling and auxiliary engines are fitted with electric starters, at least 2 starting batteries shall be installed sufficient in their combined capacity without recharging to provide the consecutive starts, as required in INTLREG ,Part 6 Rules and Regulations for Classification of Steel Vessels, Electrical Installation & Control Systems, Chapter 2 Sect 2[2.2]
- b) The connections to the starting batteries shall be such that the batteries shall be used alternately. Two charging facilities are required for the starting batteries, one automatic device supplied from a charging dynamo on the engine, and another device shall be of manually, supplied from the ship's electric system. Each of the charging devices shall be able to recharge one battery completely within 6 hours.
- c) The starting battery shall not to be used for any purpose other than starting and running the engine. If it is also used for other purposes, the battery capacity shall be increased accordingly and the circuits shall be completely separated from the starting system

2.4 Air Intake and Exhaust Arrangements

2.4.1. Exhaust gas turbo-superchargers.

If the Engines are fitted with exhaust gas turbo-supercharger , then in case of failure of the turbo-supercharger. it shall be so arranged that the ship shall proceed the safe voyage

2.4.2. Exhaust arrangements.

- a) The exhaust pipes shall be water jacketed or effectively insulated. Engine exhaust systems shall be so installed that the vessels structure cannot be damaged by heat from the systems. Exhaust pipes of several engines not to be interconnected. Where these pipes are connected to a common silencer, effective means shall be provided to prevent the exhaust gas from return to cylinders of non-operating engines.
- b) Exhaust lines which are led overboard near the waterline shall be protected against the possibility of the water finding its way inboard.
- c) Where necessary, the exhaust pipe shall be fitted with suitable draining arrangement and means to allow for expansion.

2.5 Fuel system , Lubrication system and Cooling systems

2.5.1. Fuel oil system.

Fuel oil arrangements shall be in accordance with the requirements of INTLREG ,Part 5A Rules and Regulations for Classification of Steel Vessels ,Chapter 8, Sect 4[4.2] in addition to the following:

- a) The high pressure fuel oil injection pipes shall be effectively shielded and secured to prevent the fuel or fuel mist from reaching a source of ignition on the engine or its surroundings. And fuel oil leakage within the sheath shall be drained through drainage system of engine. Where flexible hoses are used for shielding purposes, they shall be of an approved type.
- b) The surfaces of FRP fuel oil tank facing the spaces such as main engine room, etc. where there shall be the source of fire shall be provided with the application of covering with non-combustible material or application of not less than 3 mm thickness of laminates impregnated with fire-reguardent resins. The final total thickness of FRP laminated plating for fuel oil tank, whichever is chosen as mentioned above, shall be not less than 6 mm.

2.5.2. Lubricating oil systems.

Lubricating oil systems shall be in accordance with the requirements of INTLREG ,Part 5A Rules and Regulations for Classification of Steel Vessels ,Chapter 8, Sect 4[4.3] in addition to the following:

- a) If enclosed crankcase are used as lubricating oil sumps, they shall be so arranged that the contained oil be drained at any time and that purifiers or suitable filters for lubricating oil are provided.
- b) Lubricating oil lines shall be provided with pressure gauges or other adequate means at suitable positions to indicate that proper circulation is being maintained.
- c) The lubricating oil arrangements for rotor shafts of exhaust gas turbochargers shall be designed so that the lubricating oil shall not be drawn into charging air.
- d) Main engines and auxiliary engines with maximum continuous output exceeding 37 kw shall be provided with alarm devices which give visible and audible alarming in the event of failure of supply of lubricating oil or appreciable reduction in lubricating oil pressure, and also with devices to stop the operation of the engine automatically by lower pressure after the function of alarms.

2.5.3. Cooling arrangements.

Cooling arrangements shall be in accordance with the requirements of INTLREG ,Part 5A Rules and Regulations for Classification of Steel Vessels ,Chapter 8, Sect 4[4.4] in addition to the following:

- a) Discharge pipes for cooling water or cooling oil shall be provided with thermometer and preferably be fitted with adequate means to indicate the proper circulation.
- b) Drain arrangements shall be provided on water jackets and cooling water lines at their lowest positions. Relief valves shall be fitted in the main lines to the jackets to release excessive pressure.

2.6 Tests and Inspections

2.6.1. Hydraulic pressure tests on diesel engine parts shall be carried out under the conditions specified in INTLREG ,Part 5A Rules and Regulations for Classification of Steel Vessels ,Chapter 8, Sect 1[1.8]

2.6.2. Material and non-destructive tests required on diesel engine parts.

- a) Material intended for the principal components of diesel engines and their non-destructive test shall conform to the requirements mentioned in INTLREG ,Part 5A Rules and Regulations for Classification of Steel Vessels ,Chapter 2, Sect 1. The manufacturer's certificates of material tests shall be acceptable in each case if considered satisfactory by the Surveyor.
- b) For important structural parts of diesel engines, examination of welded seams by approval methods of inspection shall be required if deemed necessary by this Class Society.

2.6.3. For diesel engine with novel design features or those with no service records, in case of deemed necessary by this Society, tests shall be carried out to verify their endurance by the procedure as deemed appropriate by this Class Society.

2.6.4. For diesel engines, shop trials shall be carried out by the test procedure as deemed appropriate by this society.

2.6.5. For diesel engines, a final sea trial shall be carried out by the sea trial procedure as deemed appropriate by this class society.

CHAPTER 3 AUXILIARY AND DECK MACHINERIES

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SECTION 1 STEERING GEAR, WINDLASS, COMPRESSOR

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1.1 General

1.1.1. This Chapter applicable to the steering gear, windlass, mooring winch, capstan, reciprocating compressor and essential service pumps, etc.

1.1.2. The requirements in [1.5] of this Section shall be complied with, as far as they are applicable, for the mooring winch and capstan.

1.2 Documents

Documents submitted are generally comply with the requirements specified in INTLREG ,Part 5A Rules and Regulations for Classification of Steel Vessels ,Chapter 1, Sect 3

1.3 Materials

Material intended for the component parts of deck machinery and essential auxiliaries shall comply with requirements specified in INTLREG ,Part 5A Rules and Regulations for Classification of Steel Vessels ,and INTLREG ,Part 4 Rules and Regulations for Classification of Steel Vessels Hull outfitting and Equipment

1.4 Steering Gear

1.4.1. General

- a) Every ship shall be provided with a main steering gear and an auxiliary steering gear in accordance with the requirements of the Rules. The main steering gear shall be so arranged that the failure of one of them shall not render the other one inoperative.
- b) Consideration shall be given to other cases, or to arrangements, which are equivalent to those required by the Rules.

1.4.2. Main steering gear.

Main steering gear shall comply with the requirements specified in INTLREG ,Part 5A Rules and Regulations for Classification of Steel Vessels ,Chapter 6

1.4.3. Auxiliary steering gear

- a) Auxiliary steering gear shall comply with the requirements specified in INTLREG ,Part 5A Rules and Regulations for Classification of Steel Vessels ,Chapter 6, and INTLREG ,Part 6 Rules and Regulations for Classification of Steel Vessels, Electrical Installation & Control Systems, Chapter 5 Sect 3
- b) Auxiliary steering gear need not be fitted when the ship is provided with:
 - i. two rudders, each with its own steering gear and capable of steering the vessel with any one of the rudders out of operation, or
 - ii. fitted with an approved alternative means of steering capable of steering the vessel with the rudder out of operation and provided with approved remote control from the bridge.

1.5 Windlass

1.5.1. General

A windlass of sufficient power and suitable for the size of chain shall be fitted to the ship to operate the anchors.

1.5.2. Construction

The Windlass shall comply with the requirements specified in INTLREG ,Part 4 Rules and Regulations for Classification of Steel Vessels, Hull Outfitting and Equipment Chapter 3,Section 6 and for other recognized standard deemed appropriate by this Society.

1.6 Reciprocating Compressor

The reciprocating compressor shall comply with the requirements specified in INTLREG ,Part 5A Rules and Regulations for Classification of Steel Vessels, Chapter 8,Section 4[4.5]

1.7 Pumps

The pumps shall comply with the requirements specified in INTLREG ,Part 5A Rules and Regulations for Classification of Steel Vessels Chapter 8,Section 4

1.8 Tests and Inspections

1.8.1. Hydraulic pressure test, shop trial and on-board trial shall comply with the requirements specified in Part 4 Rules and Regulations for Classification of Steel Vessels,Hull Outfitting and Equipment Chapter 3,Section 6 [6.3]

1.8.2. Alternative proposals shall be specially considered where any of tests and inspections required by [1.8]. above are considered impracticable.

CHAPTER 4 GEARS, SHAFTINGS, PROPELLERS, WATERJET PROPULSION SYSTEM

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SECTION 1 GEARS AND COUPLINGS

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1.1 Gearing

The gearing and couplings for main propelling purpose and for driving essential service auxiliaries shall be in accordance with the requirements in INTLREG ,Part 5A Rules and Regulations for Classification of Steel Vessels Chapter 3.

1.2 Flexible shaft couplings.

Details of the various components of flexible couplings for main propelling purpose and for driving essential service auxiliaries shall be submitted for approval. Flexible couplings with elastomer or spring type flexible members and which represent the sole source of transmitting propulsive power in a line shaft on a single screw vessel shall be provided with torsional limit capacity (coupling shall not operate beyond its limit) or positive means of locking the coupling. Operation of the vessel with a locked coupling shall be at reduced power provided warning notices are posted at the control station.

1.3 Alternative proposals

Alternative proposals shall be specially considered where any requirements specified in [1.1] and [1.2] above are considered impracticable.

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2.1 Shaftings

2.1.1. Application

This section apply to propulsion shafting and power transmitting from prime mover driving generators and essential service auxiliaries. The torsional vibration of shaftings shall comply with the requirements specified in Sect 5. of this Chapter.

2.2 Documents.

2.2.1. Generally documents shall be submitted as follows:

- a) Drawings for approval (including specifications of material)
 - (i) shafting arrangement
 - (ii) Thrust shaft
 - (iii) Intermediate shaft
 - (iv) Stern tube shaft
 - (v) Propeller shaft
 - (vi) Stern tube and stern tube bearing
 - (vii) Stern tube sealing device
 - (viii) Shaft bracket bearing
 - (ix) Shaft couplings and coupling bolts
 - (x) Shafts which transmit power to generators or essential service auxiliaries.
- b) Data for reference
 - (i) Data necessary for the calculations of shafting strength specified in this section.
 - (ii) Data deemed necessary by this Society.

2.2.2. Materials, construction and strength

- a) Material intended for the principal components of shafting shall conform to the requirements specified INTLREG ,Part 5A Rules and Regulations for Classification of Steel Vessels Chapter 4, in addition to the following:
 - (i) The specified minimum tensile strength of forgings for propeller shaft and other shafts shall be selected within the following general limits:
Carbon and carbon manganese steel: 400 to 600 N/mm²
Alloy steel (Age-hardened martensitic stainless steels or other high strength alloy materials): not exceeding 800 N/mm²
 - (ii) Where it is proposed to use alloy steel, details of the chemical composition, heat treatment and mechanical properties shall be submitted for approval.
 - (iii) Ultrasonic tests are only required on shaft forgings of which the diameter is 250 mm or greater.
- b) The dimensions of shafts shall comply with the requirements specified in INTLREG Part 5A Rules and Regulations for Classification of Steel Vessels Chapter 4
- c) The dimension and construction of shafting accessories shall comply with the requirements specified in INTLREG ,Part 5A Rules and Regulations for Classification of Steel Vessels Chapter 4

2.3 Fitting of propellers

- a) When propellers are force fitted on the propeller shafts, the fixing part shall be of sufficient strength against torque to be transmitted. The edge at the fore end of the tapered hole of the propeller boss shall be appropriately rounded off.
- b) Where a key is designed at fixing part, ample fillets shall be provided at the corners of the keyway and the key shall fit tightly in the keyway and be of sufficient size to transmit the full torque of the shaft. The fore end of keyway on the propeller shaft shall be rounded smoothly for avoiding an excessive stress concentration.
- c) Where a propeller is force fitted on the propeller shaft without a key, the minimum and maximum limits of pull-up length shall comply with the requirements specified in INTLREG ,Part 5A Rules and Regulations for Classification of Steel Vessels Chapter 5. Calculation sheet of propeller pull -up length shall be submitted for approval.
- d) Where the propeller and propeller shaft flange are connected with bolts, the following (i) and (ii) shall comply with:
 - (i) The bolts and pins shall be of sufficient strength.
 - (ii) The thickness of the aft propeller shaft flange at the pitch circle shall be submitted for approval.
- e) The propeller hub is not to be fitted or removed by means of local heating.

2.4 Protection for propeller shaft against corrosion.

Protection for propeller shaft against corrosion shall comply with the requirements specified in INTLREG ,Part 5A Rules and Regulations for Classification of Steel Vessels Chapter 5, Section 5[5.3]

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3.1 Application

3.1.1. This Chapter shall be applicable to the screw propellers. If a design is proposed to which the following cannot be applied, special strength calculations shall be submitted for consideration.

3.2 Documents.

3.2.1. Documents shall be submitted and generally comply with the requirements specified in INTLREG, Part 5A Rules and Regulations for Classification of Steel Vessels Chapter 5, Section 1 [1.3]

3.2.2. Materials.

Materials of propeller are generally to comply with the requirements specified in INTLREG, Part 5A Rules and Regulations for Classification of Steel Vessels Chapter 5, Section 2

3.3 Strength calculations and construction.

- a) The strength calculations and construction of propeller blades and blade attaching studs are generally to comply with the requirements specified in INTLREG, Part 5A Rules and Regulations for Classification of Steel Vessels Chapter 5, Section 3
- b) Where the blade thickness for propellers fitted onto propeller shafts with a propeller blade rake of 5° or more and for rudder propellers shall be reduced to the value given by the following formula:

Where :

$$t = K \sqrt{\frac{K_1 H}{K_2 N B Z}}$$

t = Required propeller blade thickness (excluding the fillet of blade root), in mm.

H = Maximum continuous output of the engine driving the propeller, in kW.

N = Revolution of the propeller, in rpm.

Z = Number of blades.

B = Width of blade at radius in consideration, in mm.

K = 447.5

K1 = Coefficient given by the following formula at radius in consideration:

$$K_1 = \frac{30.3}{\sqrt{1 + a \left(\frac{P'}{D}\right)^2}} \left(b \frac{D}{P} + c \frac{P'}{D} \right)$$

D = Diameter of propeller, in mm.

P = Pitch at radius of 0.7R, in mm.

(R = Radius of propeller, in mm)

P' = Pitch at radius in consideration, in mm.

a.b.c = Values mentioned in Table 4-3-1

K2 = Coefficient given by the following formula:

$$K_2 = K_3 - \left(d \frac{E}{t_0} + e\right) \frac{(0.001D)^2 (0.01N)^2}{1000}$$

K3 = Value mentioned in Table 4-3-2

d,e = Values mentioned in Table 4-3-1

E = Blade rake of aft, measured as the distance between the tip of the blade and a perpendicular where the line of the blade face intersects with the axis of the propeller, in mm.

t₀ = Imaginary thickness of blade at propeller shaft centre line, in mm.

Note: t₀ is projection thickness obtained by connecting from the blade tip thickness via 0.25R (or 0.35R for controllable pitch propeller) maximum thickness then intersecting the propeller shaft centerline

Table 4-3-1
Values of a, b, c, d and e

Radial position	a	b	c	d	e
0.25R	1.62	0.386	0.239	1.92	1.71
0.35R	0.827	0.308	0.131	1.79	1.56
0.6R	0.281	0.113	0.022	1.24	1.09

Table 4-3-2 Values of K3

Material	K3	
Copper alloy casting	NF1A	1.15
	NF1B	1.15
	NF2A	1.3
	NF2B	1.15

Notes:

1. For the materials of blades different from those specified in the above Table 4-3-2, the value of K3 shall be determined in each case.

2. For propellers having a diameter of 2500 mm or less, the value of K3 shall be taken as the value in the above Table 4-3-2 multiplied by the following factor:

$$2 - 0.4 \frac{D}{1000} \quad \text{for } 2500 \text{ mm} \geq D > 2000 \text{ mm}$$

$$1.2 \quad \text{for } D \leq 2000 \text{ mm}$$

3.4 Controllable pitch propeller.

The Controllable pitch propeller generally comply with the requirements specified in INTLREG ,Part 5A Rules and Regulations for Classification of Steel Vessels Chapter 5,Section 3 [3.6]

SECTION 4 WATERJET PROPULSION SYSTEMS

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4.1 Application

4.1.1. Waterjet propulsion systems shall conform to requirements in this section, according to their design, in addition to the applicable requirements in this Chapter.

4.2 Documents

Documents shall be submitted are generally as follows:

- a) Drawings and data for approval
 - (i) General arrangement and sectional assembly (showing the materials, and dimensions of the principle components including the water intake duct).
 - (ii) Shafting arrangement (showing the arrangements, shapes and constructions of the main propulsion machineries, reduction gears, clutches, couplings, main shafts, bearings. thrust bearings, sealing devices and impellers).
 - (iii) Details of water intake duct.
 - (iv) Construction of impeller (showing the detailed blade profiles, the maximum radius of the impeller from the center of the main shaft, number of blades and material specifications).
 - (v) Details of bearings, thrust bearings and forward sealing devices of the main shaft.
 - (vi) Details of deflectors.
 - (vii) Details of reversers.
 - (viii) Diagram of hydraulic piping system.
 - (ix) Calculation sheets of torsional vibration of main shaft.
- b) Drawings and data for reference
 - (i) Calculation sheets of bending natural frequency when bending vibration due to self-weight is expected.
 - (ii) Strength calculation sheets for deflectors and reversors.
 - (iii) Others deemed necessary by this Society.

4.3 Materials.

The materials of parts of the waterjet propulsion system are suitable for respective uses intended, and the following essential components shall comply with the requirements INTLREG ,Part 5A Rules and Regulations for Classification of Steel Vessels Chapter 7,Section 7

- a. Main shaft.
- b. Shaft coupling and coupling bolts.
- c. Impeller.
- d. Water intake duct, nozzle and impeller casing which are composing a part of shell plating.

4.4 Construction.

- a) The following design load conditions shall be considered:
 - (i) maximum thrust force ahead.
 - (ii) maximum side force and moment,
 - (iii) maximum reversing force and moment.

- b) The supporting area of the stern shall be adequately strengthened to withstand the above design load.
- c) Support for shaft bearing in way of duct penetration shall be adequately strengthened against primary structure.
- d) Others deemed necessary by this Society.

SECTION 5 TORSIONAL VIBRATION

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5.1 Application

5.1.1.

- a) This Chapter shall be applicable to the torsional vibration of main propulsion shafting system (excluding a part of waterjet propulsion system) and auxiliary diesel engines for essential service.
- b) The torsional vibration of novel designed engine or some parts of the installation such as gear, chain, cam mechanism or elastic coupling etc. shall be submitted for special approval.

5.1.2. General.

The torsional vibration of main propulsion shafting system and auxiliary diesel engines for essential service shall comply with the requirements specified in INTLREG ,Part 5A Rules and Regulations for Classification of Steel Vessels Chapter 2,Section 1[1.10.6] and Chapter 4 Section 4

5.2 Tests and Inspections

5.2.1. Tests and inspections of shaftings shall comply with the requirements specified in INTLREG ,Part 5A Rules and Regulations for Classification of Steel Vessels Chapter 4,Section 5

5.2.2. Tests and inspections of propellers shall comply with the requirements specified in INTLREG ,Part 5A Rules and Regulations for Classification of Steel Vessels Chapter 5,Section 4

5.2.3. Alternative proposals of tests and inspections shall be specially considered if any requirements specified in [5.2.1] and [5.2.2] above are considered impracticable.

CHAPTER 5 PUMPS AND PIPING

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SECTION 1 GENERAL

Contents

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1.1 General

- 1.1.1. Ships Classed shall be provided with necessary piping and pumping facilities for acquiring safe and efficient operation in the services for which they are intended.
- 1.1.2. The following items shall comply with the requirements specified in INTLREG ,Part 5A Rules and Regulations for Classification of Steel Vessels Chapter 8 and Chapter 9
- a) Design pressure and temperature.
 - b) Classes of pipes.
 - c) Materials
 - d) Strength of pipes.
 - e) Application of pipes, valves and other fittings.
 - f) Pipe welding
 - g) Construction of pumps.
 - h) General requirements of piping arrangements.
 - i) Plans shall be submitted for consideration and approval.

1.2 Ship's Side Fittings

- 1.2.1. Ship's side fittings shall be in accordance with the requirements of INTLREG ,Part 5A Rules and Regulations for Classification of Steel Vessels Chapter 9 ,in addition to the following:
- 1.2.2. Where valves or cocks are fitted to the shell plating , the fitting method shall be such that deemed appropriate by this society.
- 1.2.3. The overboard discharges locations subjected to pressure by the pump shall not to be such that water can be discharged into liferafts at fixed launching positions, unless special provision is made for preventing any discharge of water into them.

1.3 Air and Overflow Pipes

- 1.3.1. Air pipes and overflow pipes shall be in accordance with the requirements of INTLREG ,Part 5A Rules and Regulations for Classification of Steel Vessels Chapter 9 ,Section 5 ,in addition to the following:
- 1.3.2. The overflow pipes shall be provided under either one of the following categories:
- a) Where total sectional area of air pipes to tanks which can be pump up is less than 1.25 times total sectional area of filling pipes.
 - b) Where there is any opening below the open ends of air pipes fitted; and
 - c) Fuel oil settling tanks and fuel oil service tanks.

1.4 Sounding Pipes

- 1.4.1. Sounding pipes shall be in accordance with the requirements of INTLREG ,Part 5A Rules and Regulations for Classification of Steel Vessels Chapter 9 ,Section 6, in addition to the following:
- 1.4.2. Name plates of sounding pipes shall be affixed to the upper ends of sounding pipes.

SECTION 2 HULL AND DRAIN PIPING SYSTEM

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2.1 Requirements

2.1.1. Hull Piping system shall be in accordance with the requirements INTLREG ,Part 5A Rules and Regulations for Classification of Steel Vessels Chapter 9

2.2 Drainage of Cargo Holds

2.2.1. Drainage of cargo holds shall be in accordance with the requirements of INTLREG ,Part 5A Rules and Regulations for Classification of Steel Vessels Chapter 9 ,Section 2

2.2.2. Alternative proposals shall be specially considered where any requirements specified in [2.2.1] above are considered impracticable.

2.3 Drainage of Machinery and Tunnel Spaces

2.3.1. Drainage of Machinery and Tunnel spaces shall be in accordance with the requirements of INTLREG ,Part 5A Rules and Regulations for Classification of Steel Vessels Chapter 9

2.3.2. Alternative proposals shall be specially considered where any requirements specified in [2.3.1] above are considered impracticable.

2.4 Drainage from Refrigerated Cargo Holds

Drainage from refrigerated cargo holds shall be in accordance with the requirements of INTLREG ,Part 5A Rules and Regulations for Classification of Steel Vessels Chapter 9

2.5 Drainage from Spaces in Other Decks

2.5.1. Drainage from spaces in other decks shall be in accordance with the requirements of INTLREG ,Part 5A Rules and Regulations for Classification of Steel Vessels Chapter 9

2.5.2. Alternative proposals shall be specially considered where any requirements specified in 2.5.1 above are considered impracticable.

2.6 Drainage of Tanks

2.6.1. Drainage of tanks shall be in accordance with the requirements of Part 5A Rules and Regulations for Classification of Steel Vessels Chapter 9

2.6.2. Alternative proposals shall be considered if any requirements specified in [2.6.1] above are considered impracticable.

**SECTION 3 BILGE, BALLAST, COOLING WATER, FUEL
OIL, LUBRICATING OIL**

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3.1 Sizes of Bilge Suction Pipes

3.1.1. The internal diameter of main bilge line shall be not less than that required by the following formula:

$$d_1 = 25 + 1.68\sqrt{L(B + D)}$$

Where:

d1 = Internal diameter of main bilge line, in mm.

L = Length of ship (on load water line), in m.

B = Breadth of ship (or mono-hull craft), in m.

(For multi-hull craft, the breadth of a hull at or below the design waterline, in m)

D = Molded depth of ship to bulkhead deck, in m.

The actual internal diameter of the main bilge line shall be rounded off to the nearest pipe size of a recognized standard, but d1 is in no case to be less than 50 mm.

3.1.2. The internal diameter of branch bilge suction pipes shall be not less than that required by the following formula

$$d_2 = 12.5 + 2.15\sqrt{l(B + D)}$$

Where :

d2 = Internal diameter of branch bilge suction pipe, in mm

l = Length of the compartment, in m

B and D = are as defined in [3.1.1]

The actual internal diameter of branch bilge suction pipes shall be rounded off to the nearest pipe size of a recognized standard, but d2 is in no case to be less than 25 mm

3.2 Bilge pumps

3.2.1. Number of pumps.

Every ship 20 m in length or greater shall be provided with two power driven bilge pumps, one of which shall be attached to the propulsion unit. Ships under 20m in length shall be provided with one fixed power driven pump, which shall be an attached unit, and one portable hand pump.

3.2.2. Capacity.

The capacity of each bilge pump shall be in accordance with the following

Ship Length	Minimum Capacity per Pump (m ³ /hr)
L < 20	5.5 (hand pump 1.13 m ³ /hr)
20 ≤ L < 30	11
30 ≤ L ≤ 35	14.75

3.2.3. Where Centrifugal pumps are installed, suitable means for priming shall be provided.

3.2.4. Sanitary, ballast and general service pump shall be accepted as independent power bilge pumps, provided they are of the required capacity and fitted with the necessary control valves for pumping bilges

3.2.5. Connections at the bilge pumps shall be so arranged that one can be worked while the other is being overhauled.

3.3 Ballast system

3.3.1. The arrangement of ballast piping and number of suctions shall be such that any ballast tank shall be filled or emptied under normal service condition whether the ship is upright or listed.

3.3.2. Ballast piping arrangement shall be such as to prevent the possibility of water passing from the sea or from ballast tanks into dry cargo and machinery spaces or other dry compartments

3.4 Cooling Water System

3.4.1. Ballast water pipes shall not to pass through drinking water, feed water or lubricating oil tanks. Where it is unavoidable, the ballast water pipes shall be of steel and extra heavy and welded joints shall be adopted.

3.4.2. In case of a hold intended for carrying ballast water and cargo alternately, adequate provisions such as blank flange or spool piece shall be made in the ballast piping system to prevent inadvertent ingress of sea water through ballast pipes when carrying cargo and in the bilge piping system to prevent inadvertent ingress of ballast water through the bilge pipes when carrying ballast water

3.4.3. In case of a tank intended shall be used both for fuel oil and ballast water, adequate provision such as blank flange or spool piece shall be made to prevent mixing of fuel oil and ballast water in the ballast pipe when carrying fuel oil and in the fuel oil pipe when carrying ballast water

3.5 Cooling Water System

3.5.1. Cooling water pumps.

a) Number and capacity of cooling water pumps for the main propulsion machinery shall comply with the following requirements:

(i) Two sets of main cooling water pumps shall be provided with sufficient total capacity enough to maintain the supply of cooling water at the maximum continuous output of the main propulsion machinery, and each of which has sufficient capacity to obtain navigable speed of the ship.

(ii) Where two or more main propulsion machineries are provided, such system that each of them has an exclusive cooling water pump shall be accepted providing that it is possible to give a navigable speed even if one of them is out of use.

b) Number and capacity of cooling pump for essential auxiliary engine shall comply with the following requirements:

(i) Where each essential auxiliary engine is fitted with a built-in cooling water pump, the standby pump shall be dispensed with.

- (ii) If two or more auxiliary engines are supplied with cooling water from a common system, a standby cooling water pump is needed. The standby cooling water pump shall be substituted by other pumps of sufficient capacity.
- c) Where fresh water cooling is employed for main and/or auxiliary engines, a standby fresh water pump need not be fitted if there are suitable emergency connections from a salt water system.
- d) Ship of 24 m and under in length with main engine provided main cooling water pump driven by main engine, standby cooling water pump shall be omitted.

3.5.2. Sea inlets and strainers.

- a) Not less than two sea inlets shall be provided for the cooling water pumps of sea water cooling system. The suction of any cooling water pump under normal service conditions shall be supplied from either one of the sea inlets.
- b) Strainers shall be provided to the suction pipes between the sea inlets and the suctions of sea water cooling pumps. The strainers shall be so arranged that they shall be cleaned without interrupting the cooling water supply.

3.6 Fuel Oil System

3.6.1. Fuel oil system shall be in accordance with the requirements specified in INTLREG ,Part 5A Rules and Regulations for Classification of Steel Vessels Chapter 8, Sect 4

3.6.2. The limitation in the use of fuel oil shall be in accordance with the requirements specified [2.4.4] of this Part.

3.7 Lubricating Oil and Hydraulic system

3.7.1. Lubricating oil and hydraulic system shall be in accordance with the requirements specified in ,Part 5A Rules and Regulations for Classification of Steel Vessels Chapter 8 in addition to the following

3.7.2. In case of each essential auxiliary engine fitted with a built-in lubricating oil pump, the standby pump shall be dispensed with. If two or more auxiliary engines are connected to a common lubricating oil system, a standby pump is required.

3.8 Starting Air System

Starting air system shall be in accordance with the requirements of Part 5A Rules and Regulations for Classification of Steel Vessels Chapter 8

3.9 Exhaust Gas Piping Arrangement for Diesel Engine

Exhaust gas piping arrangement for diesel engine shall be in accordance with the requirement of [2.4.2] of this Part.

SECTION 4 TESTS AND INSPECTIONS

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4.1 Tests and inspections before installation on board.

4.1.1. Test and inspections of pipes before installation on board shall be in accordance with the requirements of Part 5A Rules and Regulations for Classification of Steel Vessels Chapter 8

4.1.2. Tests and inspections after assembly on board.

Tests and inspection of all piping systems after assembly on board shall be in accordance with the requirement Part 5A Rules and Regulations for Classification of Steel Vessels Chapter 8

4.2 Hydrostatic tests of valves and fittings.

4.2.1. Hydrostatic tests of valves and fittings shall be in accordance with the requirements of Part 5A Rules and Regulations for Classification of Steel Vessels Chapter 8