Section 3

Machinery Installations

A. General Rules and Notes

1. General

1.1 These rules apply to the machinery of pleasure craft up to a length (**L**) [1] of 24 m in following operating categories [2]:

– sailing yachts: operating categories I to V

– auxiliary yachts: operating categories I to V

– motor yachts: operating categories III to V

If the length of 24 m, or the operating category, is exceeded, the Rules for Classification and Construction, I – Ship Technology, Part 1 – Seagoing Ships, Chapter 2 – Machinery Installations, apply.

1.2 Installations deviating from the rules may be accepted if they have been assessed by GL for their suitability and have been approved as equivalent.

1.3 For machinery and technical installations not included in these rules, GL may set special stipulations based on relevant rules and technical regulations if deemed necessary for the safety of the craft.

Furthermore GL reserve the right for all types of installations to state requirements beyond these rules, if deemed necessary due to newly-acquired knowledge or operating experience.

1.4 Deviations necessitated by design or intended service in case of special craft ("Fast Motor Yacht", "Special Sailing Yacht", "Special Motor Yacht", "Racing Sailing Yacht") may be accepted following consideration by GL.

In such cases GL reserve the right of restrictive entries in the certificate regarding the operation of the craft (e.g. operating category, weather clause).

1.5 National and regional rules and regulations beyond the requirements of these Rules remain unaffected. This in particular applies to craft used for commercial purposes.

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1 Definition see Section 1, A.

2 Definition of operating categories see Rules for Classification and Construction, I – Ship Technology, Part 0 – Classification and Surveys, Section 2, F.2.2.

2. Documents for examination

2.1 For checking compliance with these Rules, drawings and documentation giving clear indication of the arrangement and dimensions of the components are to be submitted in triplicate. If necessary these are to be supplemented by descriptions and data sheets.

The scope of the documentation to be submitted is based on Form F 146 (Ref: Annex F to these Rules.)

Supervision of construction is based on the approved documentation which shall be submitted before commencing construction.

2.2 The approved documentation is binding. Any subsequent changes shall have GL approval.

3. Construction of machinery installations

3.1 Scantlings of structural parts and components; materials and welding

All parts shall be able to withstand the specific stresses due to the vessel's motion, heel, trim, vibration, increased corrosive action and, if applicable, also slamming. Where rules for the scantling of components are not available, acknowledged engineering rules shall be applied.

Materials for components as well as for the fabrication of welded components subject to the rules in Section 1 shall comply with Annex D.

3.2 Environmental conditions

3.2.1 Heel and trim

Unimpaired operation of the machinery installation is to be safeguarded for

– continuous heel of up to 15° (static)

– short-term heel of up to 30° (dynamic)

– short-term trim of up to 20° (dynamic)

In the case of sailing craft, immediate starting of the machinery shall be safeguarded, even after the craft has been under sail at heeling angles exceeding the limits stated above.

3.2.2 Temperatures

Design of the machinery installation shall be subject to the following conditions:

– outside air temperature 45 °C

– outside water temperature 32 °C

– the ambient temperature during operation in the vicinity of internal combustion (IC) engines shall not exceed 60 °C.

3.2.3 Other environmental conditions

Basic assumptions for all compartments shall be salt-laden air and a relative humidity of up to 100 % at a reference temperature of 45 °C, plus the occurrence of condensation. Oil vapours have to be taken into account additionally in engine spaces.

Equipment on the open deck shall be resistant against saltwater spray and short-term immersion in sea water.

3.3 Arrangement

3.3.1 Machinery installations shall be arranged with adequate access for operation, checking and routine maintenance.

3.3.2 In the case of IC engines which can also be started manually, the cranking position is to be arranged with sufficient space and ergonomically favourable.

3.3.3 IC engines shall be installed separate from other spaces of the craft. Compartments for gasoline fuelled engines shall be gastight against accommodation spaces.

3.4 Foundations

Machinery installations shall be securely fastened to the craft, taking into account the loads to be expected. Foundations and seatings shall be properly integrated into the structure of the hull.

3.5 Bilges

3.5.1 Where oil or fuel leakage is likely to occur, the bilges are to be designed as to prevent such leakages from spreading to other parts of the craft. Drip trays are to be provided as appropriate

3.5.2 Means for collecting oil leakages, or parts of the craft where oil- or fuel leakage may occur, may not be connected to the common bilge system. Suitable equipment is to be provided for the environmentally-safe disposal of oil or oily water.

3.6 Ventilation

Adequate ventilation shall be provided in spaces where machinery is installed, taking appropriate account of the air required for combustion and cooling.

As regards the ventilation of spaces where gasoline engines and tanks are installed Section 4, C.3.1.1 is to be observed in addition.

3.7 Protective equipment, insulation

3.7.1 Machinery installations shall be such that the risk of accidents is substantially excluded.

Exposed moving parts and rotating shafts are to be protected by means of suitable guards. This may be dispensed with if moving parts and rotating shafts are adequately protected by other permanently installed equipment.

3.7.2 Crank handles of IC engines which can also be crank-started are to disengage automatically when the engine starts and to be kick-back proof.

3.7.3 Insulating material for machinery installations at least shall be not readily ignitable, e.g. acc. to DIN 4102 or equivalent. The insulation shall be suitably protected against penetration by moisture and leaking oil. It is to be so applied that

– maintenance can be carried out without damaging the insulation, or

– the insulation can be easily removed for maintenance or repairs and properly replaced on completion of the work.

3.7.4 Components of the installation having a high surface temperature (> 80 °C), such as exhaust lines, are to be fully insulated.

3.8 Painting

Only fire retardant paints are to be used on machinery and in areas where machinery is installed.

4. Operating and monitoring equipment

4.1 General

Operating and monitoring equipment is to be arranged suitably and distinct, and be provided with permanent identification.

4.2 Means of reversing

Craft with propulsive power ≥ 5 kW are to be equipped with means of reversing the direction of travel. Reversing levers are to be so arranged that their operating direction matches the desired direction of travel.

4.3 Scope of monitoring equipment

For permanently installed engines with propulsive power ≥ 5 kW, the control position is to be provided at least with optical/acoustic warning devices for oil pressure and cooling water temperature. The alarm

thresholds are to be set in accordance with the engine manufacturers' instructions.

Motor- and auxiliary yacht propulsion engine control positions are additionally to be provided with revolution indicators.

For other permanently installed machinery, e.g. diesel generators, warning devices are to be provided analogously, unless dangerous operating conditions are prevented by automatic shut-down arrangements.

4.4 Emergency cut-offs

If power-driven machinery space ventilators and fuel transfer or -supply pumps are fitted, they are to be provided with an emergency cut-off at the control position. However, this does not apply to the ventilator required according to Section 4, C.3.1.1.

4.5 Craft with more than one steering position

Where craft have more than one steering position, safe operation of the craft under engine power shall be possible from each of the positions.

The minimum requirements stated under 4.1 to 4.4 are to be met at each steering position.

5. Trials

Trials of the completed machinery installation are carried out in accordance with the Rules for Classification and Construction, I – Ship Technology, Part 0 – Classification and Surveys.

B. Internal Combustion Engines

1. General

Inboard engines [3] for main propulsion or auxiliary propulsion, or prime movers of essential auxiliaries shall be approved for use with pleasure craft in accordance with these Rules. The rated power at associated rated revolutions declared by the engine manufacturers shall be the continuous power.

For the dimensioning of major engine components, the Rules for Classification and Construction, I – Ship Technology, Part 1 – Seagoing Ships, Chapter 2 – Machinery Installations, are to be applied analogously.

Main and auxiliary propulsion engines of ≥ 400 kW are subject to tests in accordance with B.6.

[3] Permanently-fitted outboards of motor yachts are also regarded as permanently installed engines. These rules do not apply to outboard motors used as auxiliary propulsion units in sailing yachts.

2. Foundations

2.1 Inboard engines

2.1.1 Inboard engines should be flexibly mounted on their foundations/seatings. The recommendations for installation given by the engine manufacturers shall be observed.

2.1.2 If the mounting is flexible, the connections for fuel, cables plus operating and monitoring equipment are to be made flexible.

2.1.3 Oil proof elastic mounts shall be used.

2.2 The fastening of outboard motors to the hull is to be flexible, unless this has already been incorporated in the design of the motor.

3. Safety devices on the engine

3.1 Each diesel engine is to be equipped with a safety or speed regulator which prevents the engine's rated rotational speed being exceeded by more than 15 %.

3.2 In the case of diaphragm-type fuel supply pumps, the installation has to ensure that fuel cannot either leak or get into the engine lubricating oil circuit if the diaphragm is damaged.

3.3 Regarding monitoring devices, see A.4.3.

4. Equipment

4.1 For the routing and securing of pipe and hose connections to the engine E. is to be applied analogously.

4.2 Only pipe connectors with metallic sealing shall be used in diesel engine fuel injection pipes.

4.3 For outboard motors, instantaneous fuel couplings may be used. These shall be so designed that fuel cannot leak when connecting or disconnecting.

4.4 Filters

4.4.1 Filters are to be fitted in fuel supply lines and on the discharge side of lubricating oil pumps. Propulsion engines ≥ 400 kW shall be fitted with double or automatic filters fitted in the supply lines to the fuel injection pumps.

In lubricating oil lines of these engines, switch-over double filters, automatic filters or equivalent devices of an approved type, which can be cleaned without interrupting operation, are to be fitted in the main oil flow downstream of the pumps.

4.4.2 Casings of filters fixed to the engine shall be of suitable metallic material.

Filters in the fuel system screwed-on from underneath shall be secured against becoming unscrewed.

4.5 Cooling system

4.5.1 To prevent deposits in the coolant passages in raw-water-cooled engines, the outlet temperature of the cooling water is to be limited to 55 °C.

4.5.2 In case of fresh-water-cooled engines, data and recommendations supplied by the engine manufacturers are to be observed for dimensioning the heat exchanger.

Fresh cooling water lines to and from keel coolers, or alike, shall be fitted with shut-off devices.

4.5.3 The discharged air from air-cooled engines shall not cause any unacceptable heating of the machinery space. If appropriate, the discharge is to be led directly into the open.

4.5.4 Air duct outlets are to be made spray-water proof.

4.6 For spaces where petrol engines are installed, safety equipment in accordance with Section 4, C.3. is to be provided. The exhaust-ventilation ducts shall be arranged such as to provide the removal of any petrol vapours from as low as possible in the engine compartment.

4.7 Regarding exhaust lines, see E.

5. Starters

5.1 Starters shall be reliable and safe to operate.

5.2 Small IC engines with electric starters should also be provided with alternative manual starting arrangements as far as practicable.

5.3 Engines which can only be started electrically are to be equipped with electric generators to provide automatic charging of the starter batteries.

It is recommended that the starter batteries be dedicated and be separated from electrical circuits other than the motor circuits.

5.4 The total capacity of the starter batteries depends on the size of the engine and shall be sufficient for at least six successive starts without recharging, at an ambient temperature of 5 °C.

6. Tests and trials

6.1 Tests of materials

For crankshafts and con-rods, proof of material quality is to be provided by acceptance test certificates in accordance with DIN 50049 3.1.B.

6.2 Pressure tests

The individual components of IC engines are to be subjected to pressure tests in accordance with the Rules for Classification and Construction, I – Ship Technology, Part 1 – Seagoing Ships, Chapter 2 – Machinery Installations, supervised by the engine manufacturer.

6.3 Trials at the manufacturer's

Engines are to be subjected to a GL-supervised bench trial at the manufacturers in accordance with the conditions laid down in the Rules for Classification and Construction, I – Ship Technology, Part 1 –Seagoing Ships, Chapter 2 – Machinery Installations.

C. Propeller Shafts, Propellers, Gearing, Couplings

1. General

The following applies to permanently installed propeller shaft arrangements including propellers, reduction gear and flexible couplings, to pivoted "Z"-drives of outboard motors and to "Z"-drives of permanently installed propulsion engines.

2. Propeller shaft

2.1 The propeller shaft in terms of these rules is the shaft linking propeller and gear, flexible coupling or cardan shaft. In the case of outboard-mounted "Z"-drives, the propeller shaft is identical with the output shaft from that drive.

2.2 Standard values for the propeller shaft diameter may be determined from 6.1.

Regarding permissible torsional vibration stresses in the propeller shaft, see 6.3.1.

2.3 Cardan shafts or ball-joint couplings are considered adequately dimensioned if they comply with the manufacturers' recommendations for the given propulsion and installation conditions. If these shafts or couplings have not been GL type approved, GL reserve the right to require proof of adequate dimensioning from the manufacturers.

It is to be ensured that bearings or equipment driven by the cardan shaft can safely take up the forces exerted by the shaft.

2.4 Propeller shafts permanently installed in the hull are to be so supported that displacement of individual bearings caused by flexing of the hull does not cause excessive bearing pressures in the adjoining bearings or in the gear bearings. Bearings should be as wide apart as practicable. As a guidance for the maximum distances between bearings the following may be applied:

$$\ell_{max} = C \cdot \sqrt{\frac{d}{n}} \quad [mm]$$

ℓ_{max} = maximum distance between bearings

d = shaft diameter [mm]

n = shaft revs. [min^{-1}]

C = 12 000 for steel shafts

C = 8 000 for bronze shafts

Where engine and gear are flexibly mounted and with the stern tube bearings of rubber, the C-value in above formula should be at least C = 6000 if the propeller shaft is led directly from the gear output flange to the propeller. In such cases flexible mounting of the stern seal to the stern tube is to be applied.

2.5 Guidance for permissible values of bearing pressures p_{max}, peripheral speeds v_{max} and bearing clearance s_L in stern tube bearings:

Type of bearing	**p_{max} [N/mm²]**	**v_{max} [m/s]**	**s_L [mm]**
Grey cast iron or bronze bearing, grease lubricated	0,5	2,5 – 5	~ 0,6
Rubber bearing, water lubricated	0,2	6	~ 0,5
White metal bearing, oil lubricated	0,8	> 6	~ 0,4

2.6 If the material of the propeller shaft is not corrosion-resistant, the propeller hub shall be suitably sealed against entry of water.

3. Propellers

3.1 Fixed-pitch propellers for pleasure craft should be of an established design. Any design differing from these shall be approved by GL.

3.2 Propellers should preferably be made of a cast copper alloy suitable for use in sea water. For propellers in units with outboard motors and with "Z"-drives, aluminium alloys suitable for use in sea water may also be chosen.

Propellers should in general be fastened to the propeller shaft taper by means of a key and cap nut. The cap nut shall be suitably secured. For lower powers and in particular in case of outboard motors and "Z"-drives, the propeller may also be fastened by another proven method.

3.3 For the dimensioning of the blades of fixed and variable pitch propellers 6.2. applies.

4. Gearing

4.1 The design of gearing for the propulsion of pleasure craft is considered to be suitable, if among other things:

- the toothing is adequately dimensioned in accordance with the Rules for Classification and Construction, I – Ship Technology, Part 1 – Seagoing Ships, Chapter 2 – Machinery Installations, Section 5, or DIN 3990/ISO 6336,
- gearing shafting is designed fatigue-resistant in accordance with standard engineering practice,
- roller bearings are designed for a rated working life of at least 1000 hours at full load for small craft with outboards - operating category IV – V - and sailing yachts, and at least 5 000 hours at full load for larger craft in operating category III,
- the lubricating oil bulk temperature does not exceed 90 °C with a water temperature of 32 °C and operating at full load,
- in case of hydraulically controlled reversing gears, a single emergency manoeuvre from "full ahead" to "full astern" does not cause damage to toothing, clutches, shafts and other components of the gearing.

4.2 As regards additional stress due to torsional vibrations, reference is made to 6.

5. Flexible couplings

Flexible couplings between engine and gearing or between the flexibly mounted engine plus gearbox and the propeller shaft shall be of a proven type. The permissible loads recommended by the manufacturers of the coupling shall not be exceeded.

6. Calculations and guidance for permissible stresses

6.1 Propeller shaft diameter

The propeller shaft diameter d_p can be determined as a guidance as follows:

$$d_p = k \cdot \sqrt[3]{\frac{P}{n_2} \cdot C} \quad [mm]$$

P = propulsive power [kW]

n_2 = propeller shaft revs. [min^{-1}]

k = 100 for shafts of non-corrosion-resistant steel not protected against seawater

= 90 for shafts of corrosion-resistant steel [4], wrought copper alloys [5], nickel alloys (Monel) [6] or for non-corrosion resistant steel if the shaft is protected against contact with seawater

= 75 for shafts of high-tensile wrought nickel alloys [7]

C = 1,2 for craft in operating category III [8] with one propulsion line

= 1,0 for craft with two propulsion units and operating category III [5]

= 0,8 for craft in operating categories IV and V

6.2 Thickness of propeller blades

Standard values for the thickness $t_{0,25}$ of propeller blades at a radius of 0,25 R can be determined as follows:

$$t_{0,25} = k \cdot \sqrt{\frac{P \cdot 10^3}{n_2 \cdot B \cdot z} \cdot C} \quad [mm]$$

P = propulsive power [kW]

n_2 = propeller revs. [min^{-1}]

B = width of blade at 0,25 R [mm]

z = number of blades

k = 50 for propellers of high-tensile cast brass

= 46 for propellers of corrosion-resistant austenitic steel

= 42 for propellers of high-tensile nickel-aluminium-bronze

= 75 for propellers of an aluminium alloy (cast in chill mould)

= 100 – 120 for propellers of synthetic material

C = 1,2 for craft in operating category III

= 0,8 for craft in operating categories IV and V

Controllable pitch propellers for motor yachts in operating category III shall be of a GL-approved type.

6.3 Torsional-vibration stresses

To check the torsional-vibration behaviour of the propulsion plant, a torsional-vibration calculation shall be carried out.

6.3.1 Standard values for permissible torsional-vibration stresses in the propeller shaft

The torsional-vibration stresses τ_w permissible in the propeller shaft are calculated in accordance with the following formula:

$$\tau_w = (59 - 39 \cdot \lambda) \cdot C_K \quad \left[N/mm^2\right]$$

λ = partial load/full load rotational speed ratio

C_K = coefficient of influence for the fatigue strength of the shaft in the area between the aft stern tube bearing and the propeller

= 1,0 for propeller shafts of corrosion-resistant material if the hub is protected against the entry of water; otherwise such shafts are to be given C_K = 0,8.

= 0,8 for other than corrosion-resistant propeller shafts if the shaft and the hub are suitably sealed against the entry of water

= 0,6 for other than corrosion-resistant propeller shafts not protected against the contact with seawater

6.3.2 Standard values for permissible torsional-vibration stresses in gearing

In the higher speed range the torsional-vibration stresses with gearing are not to exceed 30 % of the rated transmitted torque of the respective stage.

There shall not be any lifting of the toothing (load change) with the propeller clutched-in.

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4 Preferably austenitic steels with 18 % chrome and 8 % nickel

5 e.g. wrought copper-nickel zinc alloy Cu Zn 35 Ni in acc. with DIN 1766

6 Nickel content > 60 %, tensile strength $\sigma_B > 400$ N/mm^2

7 e.g. "Monel alloy K-500", tensile strength $\sigma_B > 900$ N/mm^2

8 Sailing yachts with auxiliary propulsion engine(s) and auxiliary yachts also in operating categories I and II.

6.3.3 Permissible torsional-vibration stresses in flexible couplings

Flexible couplings in the propulsion plant shall be designed to withstand the alternating torques arising with the associated frequencies, over the entire range of rotational speeds.

D. Storage of Liquid Fuels

1. General

1.1 Fuel tanks shall be made of a suitable corrosion-resistant material, if necessary fitted with wash plates and securely fastened to the craft.

1.2 Portable fuel tanks are to be securely fixed.

1.3 Galvanised steel shall not be used for diesel fuel tanks.

1.4 Only metal tanks are permissible for gasoline.

1.5 Special approval is required for fuel tanks of plastics.

2. Arrangement of fuel tanks

2.1 Fuel tank shall be arranged such that unacceptable heating is avoided.

2.2 Gasoline tanks are to be separated from machinery spaces and living quarters by gastight partitions. Section 4, C.3. is to be observed.

3. Fuel tank equipment

3.1 General

3.1.1 Pipe connections are preferably to be arranged in the tank top. They shall not weaken the tank; welded doubles are to be provided if necessary. Through-bolts are not permitted in tank boundaries.

3.1.2 Appliances which are not part of the tank equipment may be attached to the tank only via intermediate supports. In this case, the tank boundaries are to be adequately strengthened.

3.1.3 Diesel fuel tanks shall be provided with hand holes for cleaning. In the case of small tanks which can easily be removed and flushed such hand holes can be dispensed with.

3.1.4 Regarding hoses for filling- and vent lines plus hose connections, see E.2.2.2.

3.1.5 Tanks and filler necks are to be earthed with a bonding wire of at least 4 mm^2.

3.2 Filling arrangements

3.2.1 Fuel tanks shall be filled from the deck through a permanently installed filling line of at least NB 40. Filler necks are to be so arranged that in the event of an overflow fuel cannot get into the inside of the boat. The filler neck is to be clearly marked with the type of liquid.

3.2.2 The filling line shall terminate inside the tank at not less than 1/3 tank height.

3.3 Tank vent line

3.3.1 Each fuel tank is to be equipped with a fixed vent line led to the open. The vent line shall be run such that fuel cannot be trapped.

3.3.2 The cross-sectional area of the vent line depends on the method of fuelling:

– 10 mm for open filling through filler neck

– 1,25 times the filling line cross-sectional area for filling via a fixed connection

In case of fuel systems with more than one tank and transfer pump(s), also the discharge pipe diameter of the transfer pump shall be considered for the determination of the vent line diameter as appropriate.

3.3.3 Ingress of water and the spillage of fuel when heeled shall be prevented by suitable routing of the lines. For air pipes of 32 mm in diameter and above, automatic closures are to be provided.

3.3.4 Vent lines of gasoline tanks are to be equipped with suitable flame arrestors.

3.4 Fuel extraction lines and spill lines

3.4.1 The suction of the extraction line is to be arranged sufficiently high above the tank bottom to prevent dirt and water being sucked in.

3.4.2 Spill lines are to be connected to the tank at the tank top.

3.5 Tank drainage

3.5.1 Diesel storage and supply tanks are to be provided with suitable drainage arrangements.

On diesel supply tanks drainage arrangements may be omitted if an adequately sized water separator is fitted in the extraction line.

3.5.2 Tank drainage fittings are not permissible in gasoline tanks.

3.5.3 Drainage fittings near the tank bottom shall be equipped with a self-closing valve which additionally is to be provided with a cap or plug.

3.5.4 Tank drainage may also be facilitated via a line introduced into the tank from the tank top, using a suitable pump (e.g hand pump with appropriate connections, also transportable).

3.5.5 All drainage arrangements shall be easily accessible and located conveniently to allow safe drainage into a collecting receptacle.

3.6 Tank sounding equipment

Each fuel tank is to be provided with means for hand-sounding from the deck or with a proven remote level indicator.

Gauge glasses, sightglasses or float indicators with mechanical transmission are not permitted.

4. Tests

Fuel tanks including all connections shall be subjected to pressure testing with the hydrostatic pressure corresponding to the height of 2 000 mm above the overflow level of the tank.

E. Piping, Fittings, Pumps

1. General

These rules apply to piping systems, including pumps and fittings, for the operation of the machinery; as well as for the operation of the craft insofar as its safety is concerned.

These rules are also to be applied to piping systems referred to in other parts of this Section.

2. Materials

2.1 General

2.1.1 Materials for piping and fittings shall be suitable for their purpose. Regarding welding of pipes and fittings, see Annex D.

2.1.2 Piping and fittings are preferably to be made of metal. Where plastic pipes or hoses are used due to the installation conditions, the special requirements stated under 2.2 are to be observed.

2.2 Plastic pipes and hoses

2.2.1 Plastic pipes

2.2.1.1 The use of plastic pipes is restricted to systems conveying water, like drinking water, seawater, bilge water, waste water/sewage.

2.2.1.2 Plastic pipes are not allowed for piping leading to overboard without shut-off at the shell or for bilge piping lines within machinery spaces. In FRP hulls, however, cockpit drains without shut-off may be of a material corresponding to that of the hull.

2.2.1.3 Plastic pipes and pipe fittings shall comply with an acknowledged standard. The limiting operating pressures and temperatures stated in the standard are to be adhered to.

2.2.1.4 For pipes made of rigid PVC with glued joints and pipe fittings, DIN 86012 or equivalent applies. Processing and pipe laying shall be carried out in accordance with DIN 86015 or equivalent.

2.2.1.5 When laying plastic pipes, attention shall be paid to providing adequate and proper fastening devices, and protection against unacceptable external heating.

2.2.2 Flexible hoses

2.2.2.1 Hoses shall be suitable for the media envisaged to be conveyed, operating pressures and temperatures.

For hoses not complying with any standard, proof of suitability is to be provided. Such hoses shall have continuous marking which allows for identification even of short lengths.

2.2.2.2 Only hoses with a textile or wire-mesh intermediate layer may be used.

2.2.2.3 Hoses for drinking water shall be of a quality suitable for handling foodstuff.

2.2.2.4 For hoses connecting to overboard without seacock, such as cockpit drains, hoses with a textile or wire-mesh intermediate layer in accordance with DIN series 20018, 20021, 20022 or equivalent are to be used. If passing through a machinery space, type approved fire resistant hoses are to be used or else a rigid standpipe extending at least 100 mm above the waterline shall be provided. This standpipe shall at least match the strength and fire resistance of the shell in the area of the outlet opening.

2.2.2.5 Hoses for exhaust lines with water injection are to have a wire-mesh intermediate layer in accordance with DIN series 20022 or be of equivalent quality.

2.2.2.6 For liquid fuels, lubricating oil or hydraulic oil, only type-approved fire resistant hoses are permissible [9].

2.2.2.7 In gasoline piping, only short lengths of hose for connection to the consumer are permitted.

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9 Except for gasoline, not applicable to tank filling lines and vent lines.

2.2.2.8 For connection to consumers, fittings, pipes, etc., hoses with fixed end fittings are to be used [1].

2.2.2.9 Hose connections in systems conveying water may also be made using standard hose fitting ends or to suitably-shaped pipe ends. Fastenings to raw pipe ends are not permissible. Proven stainless steel hose clamps are to be used for fastening.

Hoses in systems connecting to overboard are to be fastened to the fitting ends by double clamps.

2.2.2.10 Hose lines are to be so routed and fastened that movement due to vibration or motion of the vessel, chafing and unacceptable heating is avoided and so that visual checking is possible at any time.

Hoses runs piercing structural components are to be suitably protected in way of the penetration.

2.2.2.11 Hoses may be taken through watertight or gastight bulkheads only by means of suitable bulkhead penetration fittings.

3. Hull fittings

3.1 Except for cockpit drains, all connections to the hull below or near the waterline are to be provided with seacocks.

3.2 Seacocks shall be easy to reach; if necessary, extension rods are to be provided.

3.3 If the seacock is not fitted directly to the shell, the pipe between the shell and the seacock shall at least match the strength and fire resistance of the shell in the area of the outlet opening.

3.4 Seacocks and through hull fittings shall be of ductile metallic material.

Other materials, e.g. fibre reinforced plastics, may be allowed if proof of adequate strength and fire resistance at least equal to that of the hull has been provided.

4. Pumps

4.1 Pumps are to be located accessibly and securely fixed.

4.2 Power pumps of the displacement type are to be fitted with means of overpressure protection if there are valves or cocks fitted in the piping system on the discharge side of the pump.

4.3 Centrifugal pumps shall not be damaged if operated with a closed shut-off fitting over a lengthy period of time.

5. Fuel lines

5.1 Fuel lines are generally to be made of corrosion-resistant metal with as few disconnectable pipe connections as practicable. Pipe joints may be made by welding or brazing. Brazed joints are to be made using fittings and hard solder.

The number of breakable connections shall be kept to a minimum, respective of the particular arrangement.

5.2 Only metal-to-metal screwed connections are permissible. Threaded sleeve joints requiring hemp, sealing strip, etc. in order to safeguard tightness may not be used.

5.3 As a general rule the use of hoses is only permitted for the connection of consumers to rigid piping. The use of hoses is to be limited to short lengths. 2.2.2 is to be observed.

5.4 Fuel lines are to be securely fastened and be arranged protected against damage.

5.5 The arrangement of fuel lines in the vicinity of machinery parts with high surface temperatures and of electrical appliances is to be avoided.

5.6 Extraction pipes are to be fitted with a valve or cock directly at the tank. Such valve or cock shall be capable of being closed from deck or the steering position. This also applies to other tank connections which if damaged would release the contents of the tank, e.g. equalising- or transfer lines.

5.7 The valve or cock may be omitted if the connection and piping is arranged such that fuel cannot be released from the tank in the event of damage to the piping. Siphoning action of the connected piping is to be considered if applicable.

5.8 Spill lines are to be connected at the tank top of the service tank. Means of closure may not be fitted in the spill line.

If the spill is connected to more than one tank, changeover valves are to be fitted, which also in the intermediate position safeguard that at least one way is always open.

5.9 Casings of fuel filters or water separators are to be of metal. Glass casings may be used only for diesel fuel.

If so, the arrangement shall be protected and easily visible.

5.10 If power-driven transfer pumps are fitted in fuel systems with more than one tank, suitable means are to be provided to prevent overfilling of service or

storage tanks (e.g. overflow systems, high level alarm and automatic stop of the pump).

High level alarms shall trigger an acoustic signal a suitable period of time before an unacceptably high level is reached. The signal shall be audible under all conditions of operation.

5.11 In fuel systems with power-driven transfer pumps, it shall be possible to maintain the full fuel supply to the engines also in case of failure of a transfer pump. In systems with only one power-driven pump, this requirement is considered to be met if fuel can also be supplied to the engines directly from all the storage tanks fitted, or if additionally there is a hand pump for topping-up the supply tank.

6. Exhaust lines

6.1 Engine exhaust lines are to be led to the open separately and so insulated and run that combustible material cannot catch fire on the pipes and no detrimental heating effect on the environment can arise.

Temperatures of brackets and of bulkhead/deck/shell penetrations shall not exceed 80 °C.

6.2 Thermal expansion is to be compensated.

6.3 If exhaust lines terminate near the waterline, measures shall be taken to prevent water from entering the engine(s).

6.4 In metal exhaust lines, means of draining fittings are to be provided at the lowest points.

Cooling jackets of exhaust lines shall be capable of being drained completely.

6.5 Main- and auxiliary engine exhaust lines shall have effective silencers fitted. Depending on the type of silencer, means for cleaning and draining are to be provided.

6.6 For hoses in exhaust lines 2.2.2.5 shall be observed.

6.7 Thermoplastic components may be used in exhaust lines with water injection only and on condition of monitoring of the cooling water flow or the temperature in the exhaust line immediately downstream of the point of water injection.

7. Cooling water lines (raw water)

7.1 A filter is to be fitted in the raw-water supply line. For small auxiliary engines an inlet strainer on the hull is sufficient.

7.2 Drain fittings are to be arranged as necessary. It shall be possible to drain the entire raw-water system.

7.3 Shell or keel coolers are to be fitted with vent valves at the highest point.

7.4 For the cooling water supply to the engines, one cooling water pump per engine is sufficient, unless in accordance with A.1.1 the Rules for Classification and Construction, I – Ship Technology, Part 1 – Seagoing Ships, Chapter 2, are to be applied analogously.

7.5 If the installation is such that the bilge pump is also used as reserve cooling water pump for the engine and can take suction from overboard, the bilge suction lines shall be so connected to the pump that ingress of water from overboard into the bilge system is prevented.

7.6 Use of copper alloy pipes suitable for sea water is recommended. Steel pipes shall be internally galvanised or provided with other suitable corrosion protection.

As regards the use of hoses, 2.2.2 is to be observed.

7.7 In the case of engines with cooling water injection into the exhaust line, measures are to be taken to prevent that, after the engine has stopped, cooling water can enter the cylinders of the engine via the water inlet and the exhaust line. Siphoning shall be prevented by providing an automatic vacuum-breaker as appropriate. The vacuum breaker is to be arranged at the highest point at the pressure side of the cooling water line, raised above the water line.

8. Bilge pumping arrangements

8.1 Scope

8.1.1 Each craft is to be equipped with a bailer.

8.1.2 Craft within operating categories IV and V and with a length **L** of 6 m or more are to be provided with at least one fixed manual bilge pump in accordance with Table 3.1.

The nominal flow rate of manual bilge pumps shall be based on 45 strokes per minute.

Table 3.1 Bilge pumps

Length L (m)	Hand pump flow rate (m^3/h)	Power pump flow rate (m^3/h)	Bilge pipe NB (mm)	
			main pipe	branch pipe
< 8	3	5	32	
< 10	5	6	32	
< 15	5	7,5	40	
< 20	6	9	50	40
≤ 24	6	10,5	50	40

8.1.3 For craft in operating categories extending beyond those listed in 8.1.2, a power-driven bilge pump with at least the flow rate specified in Table 3.1 shall be installed in addition.

For sailing yachts without power (auxiliary) propulsion or power-driven electric generator(s), installation of a second manual bilge pump is sufficient. The rate of flow shall at least match that of the manual pump required in accordance with the Table.

8.1.4 The power-driven bilge pump may also be coupled to the main or auxiliary propulsion engine.

8.2 Bilge piping, bilge suctions

8.2.1 Bilge piping are to be so arranged that also with unfavourable trim the bilges can be drained completely.

8.2.2 In craft with watertight subdivisions or subdivided bilges, every bilge pump shall be capable of taking suction from every compartment aft of the forepeak bulkhead.

The pumps are to be connected to a bilge main with branch pipes leading to the compartments. The branch pipes are to be connected to the main via closable non-return valves or equivalent.

8.2.3 The forepeak shall not be connected to the common bilge system. For larger craft, the forepeak should be connected to a suitable power pump which shall not have any direct connection with the common bilge system, e.g. the raw-water or the fire pump. Alternatively the forepeak may be drained to the adjoining compartment aft, through a self-closing valve fitted to the forepeak bulkhead, or by means of a separate hand pump.

8.2.4 If several bilge pumps are connected to a common discharge line, a closable non-return valve or a combination of shut-off fitting and non-return valve is to be provided on the discharge side of each pump.

8.2.5 If several power-driven bilge pumps are fitted, one of these is to have a direct bilge suction device from the machinery space.

8.2.6 Plastic bilge piping is not permitted in machinery spaces. Regarding use of hoses see 2.2.2.

8.2.7 In the arrangement of bilge suction devices the following is to receive attention:

– free access for the bilge water,

– each suction device to have a strainer,

– accessibility for checking and maintenance.

8.3 Overboard connections

8.3.1 It shall be warranted that water cannot enter the craft through the bilge pumping line - even in the event of maloperation. The outlet from the line is to be arranged as high above the waterline as possible and the line is to be run to this via a pipe bend taken up to the deck. If that arrangement is not possible, two non-return devices shall be fitted between the outlet and the inlet (bilge suction). At least one of these devices is to be mounted at the hull.

The outlet at the vessel's side, however, shall always be closable. (See also 3.).

8.3.2 In the case of pumps which can also take a suction from the sea, the impossibility of seawater entering the craft is to be guaranteed by the installation of three-way cocks with L-plugs, angle cocks or similar, into the suction line.

8.4 Arrangement of bilge pumps

The manual bilge pump is to be operable from the steering position/the cockpit. In larger craft the power-driven pump may be operable from the steering position alternatively, if the height of installation of the manual pump would reduce the required output.

9. Fresh water, sanitary installations

9.1 Fresh water system

9.1.1 Walls of tanks for fresh water shall not be walls of fuel or sewage tanks.

9.1.2 If the storage tank is filled via a fixed connection, the bore of the filling pipe is to be used for dimensioning the vent line. If filling is not under pressure, a vent pipe with a nominal bore of 10 mm is sufficient.

9.1.3 Filling connections are to be identified unmistakably.

9.2 Sanitary equipment

9.2.1 General

9.2.1.1 When installing sanitary equipment, the official regulations applicable to the area of operation are to be observed.

9.2.1.2 Sewage discharge lines are to be so arranged or equipped that it is impossible for water to enter the craft from outboard. See also 3.

9.2.1.3 Each sanitary discharge is to have a gate valve or sea cock at the hull penetration. See also 3.

9.2.2 Sewage tanks

9.2.2.1 Vent lines are to be taken out into the open.

9.2.2.2 For the discharge ashore of dirty water and sewage, a discharge line with a threaded deck connection in accordance with ISO 4567 shall be provided.

9.2.2.3 For the discharge lines overboard, 9.2.1 is to be observed.

F. Cooking, Baking and Heating Appliances

1. General

1.1 Galley stoves or cookers operating with liquid fuels shall be provided with save-walls of non-combustible materials. Measures are to be taken to prevent any leaking fuel to spread through the craft.

1.2 Stoves, cookers and heating appliances are to be so installed that undue heating of adjacent structures will not occur.

1.3 For the operation of galley stoves and cookers using liquid fuels, there shall be adequately sized ventilation openings. If such openings are closable a notice shall be fitted at the appliance:

"Ventilation openings are to be kept
open during the use of the stove/cooker!"

2. Heaters burning liquid fuels

2.1 Only fuels with a flash point ≥ 55 °C may be used, unless specially approved by GL.

2.2 Only heaters with closed combustion chamber and air supply and exhaust gas lines tight against the interior of the craft are permitted.

2.3 Heaters which do not fully meet the requirements regarding safety time margin of the DIN standard may be approved if safety of operation is proved in some other way, e.g. explosion-proof design of the combustion chamber and the exhaust gas ducts.

3. Liquefied gas for cooking, heating and cooling appliances

The installation of liquefied gas systems has to be carried out in accordance with ISO 10239. Prospective surveys for acceptance and revisions are subject to national regulations.

For classification purposes the surveys for acceptance as well as the revisions, at intervals not exceeding a period of 2 years, are performed in compliance with GL Rules for Classification.

Surveys, carried out by experts of DVFG [10], will be accepted by GL.

G. Fire Extinguishing Equipment

1. General

1.1 Pleasure craft with accommodation or permanently installed IC engines are to be equipped with portable fire extinguishers suitable for A, B and C class fires according Table 3.2.

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Table 3.2 Classification of extinguishing media

Fire class	Nature of burning material	Extinguishing media
A	Solid combustible materials or organic nature (e.g. wood, coal, fibre materials)	Water, dry powder, foam
B	Inflammable liquids (e.g. oils, tars petrol)	Dry powder, foam, carbon dioxide
C	Gases (e.g. acetylene, propane)	Dry power, carbon dioxide

Preferably only dry chemical powder extinguishers should be used (see "Note" at the end of G.).

For machinery spaces CO_2 extinguishers are also acceptable. These shall however be stored in a space which shall be gastight against accommodation spaces.

1.2 The charge of an extinguisher shall be at least 2 kg and is not to exceed 6 kg.

1.3 The extinguishers are to be arranged conveniently and with suitable brackets.

1.4 Fire extinguishers are to be checked by an acknowledged expert every 2 years.

1.5 For fighting a fire in the machinery space, a closable inlet opening is to be provided allowing the application of the extinguishing agent without prior removal or opening of parts of the machinery space casing.

1.6 Machinery spaces with IC engines with a total installed power of 375 kW or more are additionally to be equipped with a fixed fire extinguishing system in accordance with 4. The inlet opening required under 1.5 may be omitted in this case.

1.7 For machinery spaces with IC engines up to a total installed power of 375 kW the amount of extinguishing agent determined in accordance with Table 3.2 for permanently installed engines may be reduced by up to 6 kg if a fixed fire extinguishing system in accordance with 4. is fitted.

1.8 Craft with a length **L** of 15 m or more are to be provided with a water fire extinguishing installation in accordance with 3.

1.9 All craft are additionally to be provided with:

– craft up to 15 m: at least one draw bucket

– craft of 15 m and upwards: at least 2 draw buckets

2. Number of fire extinguishers

The number of extinguishers required is to be selected based on the total weight of extinguishing agent, to be determined from the Table 3.3.

Table 3.3

Application	Minimum weight of extinguishing agent [kg]
Inboard engines	
– up to 50 kW	2
– up to 100 kW	4
– over 100 kW	
per extra 100 kW or part thereof	an additional 2
Additionally for craft with accommodation	
– up to 10 m	2
– up to 15 m	4
– up to 20 m	8
– up to 24 m	12

3. Water fire extinguishing installation

3.1 The water fire extinguishing installation is to be so designed that a solid jet of water can be directed to every part of the craft.

3.2 A suitable permanently installed manual pump is to be provided, which with its associated lines and the sea-suction is to be located outside the machinery space.

3.3 Motor yachts are additionally to be equipped with a power-driven fire pump which shall meet the requirements in accordance with 3.1. This pump with its associated lines and the sea-suction may be located in the machinery space. Pumps serving also other water services, e.g. a bilge pump, may be used for this purpose.

If the manual and the power-driven pump are supplying to a common fire main, a closable non-return valve is to be fitted on the discharge side of each connected pump.

3.4 A suitable fire hose of NB 25 with a nozzle of at least 6 mm nozzle diameter and suitable couplings is to be provided. The length of the hose is to be approx. 2/3 of the length of the craft, but not more than 15 m.

3.5 In case of a power-driven pump, the fire main is to be fitted with at least one closable valve with hose coupling fitting the fire hose (fire hydrant) which shall be located on deck.

4. Fixed fire extinguishing systems

4.1 For fixed installations, dry powder or CO_2 may be used as extinguishing agents (see "Note" at the end of G.).

4.2 The quantity of extinguishing agent required to be stored is to be determined as follows, taking into account the size of the space to be protected.

Dry powder:

$$Q = 1{,}0 \cdot V_B \quad [kg]$$

CO_2:

$$Q = 0{,}8 \cdot V_B \quad [kg]$$

Q = quantity of extinguishing agent [kg]

V_B = gross volume of space [m^3]

4.3 Manual release of fixed fire extinguishing systems shall be activated from outside the machinery space.

4.4 Fixed piping with suitable nozzles is to be provided for conveying the extinguishing agent. The nozzles are to be so arranged as to ensure even distribution of the extinguishing agent.

4.5 CO_2 fire extinguishing system

4.5.1 CO_2 cylinders are to be installed with gas-tight separation from accommodation and accessible machinery spaces.

4.5.2 Automatic release of CO_2 systems is not permitted.

4.5.3 The CO_2 line to the machinery space is to be fitted with a shut-off valve in addition to the cylinder valve. The line between CO_2 cylinder and shut-off valve is to be designed for an operating pressure of $8 \cdot 10^6$ [Pa].

4.5.4 The release arrangement is to be suitably safeguarded against unintentional operation, taking also into account the presence of children on board.

A notice is to be provided at the release position:

"CO_2 fire extinguishing system for machinery space. Before releasing, make sure no one is in the space and all openings are closed."

This text is to be supplemented by brief operating instructions.

4.5.5 A warning notice is to be fixed to the access to accessible machinery spaces:

"This space is protected by a CO_2 fire extinguishing plant. If CO_2 is released there is danger of suffocation; leave space immediately. The space may only be re-entered after it has been thoroughly ventilated."

4.5.6 For larger accessible machinery spaces, provision of an acoustic alarm is recommended which should be activated before the CO_2 system is released.

4.5.7 The system is to be checked by an expert company at intervals not exceeding two years.

Note:

The use of extinguishers containing Halon and the installation of Halon fire-extinguishing systems is no longer permitted.

H. Steering Gear

1. Scope

The following applies to steering gear. This comprises of the steering engine and all elements of the transmission from the steering position to that engine.

2. Design

2.1 Modes of drive

Both, power and manual, drive may be applied. Means of emergency steering are to be provided, e.g. emergency tiller (see also Section 1, A.3.)

Emergency steering drive shall be such as to be readily available. In the case of power steering , it is to be ensured that in the event of failure of the power steering the emergency steering remains operable.

2.2 Steering gear for outboard motors

The outboard motor is to be fitted with a suitable tiller arm for connecting to the steering gear. Twin-engine plants are to have the two engines positively connected.

2.3 Steering gear for "Z"-drives and jet drives

The design of steering gear for these drives is to be agreed with GL.

2.4 Protection against overloading

2.4.1 Power-driven and manual-hydraulic steering gear shall be protected against overload (slipping clutch, safety valve) limiting the torque applied by the drive.

2.4.2 In the case of hydraulic steering gear, also inadmissible torques caused e.g. by grounding of the rudder, etc. are to be limited by safety valves. Safety valves which simultaneously are effective for both the driving and the driven end are permitted.

2.5 Rudder position indication

The midship position of the rudder shall be distinguishable at all times. Power driven steering gear is to be provided with a rudder position indicator.

2.6 Rudder angles

2.6.1 Power steering gear are to be provided with suitable devices (e.g. limit switches) limiting the possible travel such that the admissible rudder angle cannot be exceeded.

2.6.2 Regarding end stops for tillers, quadrants, etc., see Section 1, A.3.

3. Power and dimensioning

3.1 Power

The steering gear is to be so designed that, with the craft at full ahead, "Z"-drives and jet drives can be put from hard-over to hard-over to either side without undue effort.

The time taken for this shall as a rule not exceed 35 s.

3.2 Dimensioning of transmission elements

3.2.1 The stresses arising in the transmission elements shall lie below the yield strength of the materials employed.

3.2.2 For the dimensioning of tillers and quadrants, Section 1, A.3. is to be observed.

4. Testing

4.1 After installation the steering gear is to be submitted to a final survey and performance test.

4.2 In case of hydraulic gear a pressure test at 1,5 times the pressure setting of the safety valve is to be carried out.

I. Anchor Windlasses

1. Scope

The following applies to anchor windlasses required in accordance with Section 1, G.

2. Design

2.1 Driving mode

2.1.1 Manual drive is permissible as primary drive. Hand cranks shall be kick-back proof.

2.1.2 For power-driven windlasses, an emergency drive independent of the primary drive is recommended. If the emergency drive is to be manual, this is to be so arranged that switching-on the power drive cannot cause any danger.

2.2 Overload protection

An overload protection device is to be provided to limit the moment of the driving unit.

2.3 Clutches

Windlasses are to have clutches between chain sprocket and drive shaft.

2.4 Brakes

Windlasses shall be fitted with chain sprocket brakes which guarantee safe braking action and holding power of anchor and chain when the sprocket is unclutched. Furthermore in the case of non-self-locking gear, means are to be provided which prevent the chain from running out, if the drive fails with the chain sprocket clutched.

2.5 Chain sprockets

Chain sprockets shall have at least 5 teeth.

3. Power and dimensioning

3.1 It shall be possible to raise the threefold weight of the anchor at a mean speed of 3 m/min. In the case of manually driven windlasses, a manual force of 15 kg at a crank radius of about 35 cm and a cranking rate of about 30 rev./min is not to be exceeded.

3.2 The drive's capability of delivering a short-duration overload for breaking-out the anchor is to be ensured.

3.3 The dimensioning of the transmission elements is to be carried out in accordance with standard engineering practice.

J. Operating Instructions, Tools, Spare Parts

1. Operating instructions

The necessary operating and maintenance instructions for machinery and ancillary equipment shall be available on board.

2. Tools

Sufficient tools are to be carried to allow for simple repair or maintenance work to be carried out as described in the operating and maintenance instructions.

3. Spare parts

3.1 Craft of operating categories III and IV and beyond are to carry at least hose clips, V-belts and half a charge of engine lubricating oil as spares.

3.2 If extended voyages are intended, the operator is additionally obliged to supply tools, accessories, consumables and spares on board in accordance with requirements.

The recommendations of component manufacturers are to be taken into account.