Section 14

Steering Gears, Rudder Propeller Units, Lateral Thrust Units, Winches, Hydraulic Control Systems, Fire Door Control Systems and Stabilizers

A. Steering Gears

1. General

1.1 Scope

The requirements contained in A. apply to the steering gear including all the equipment used to operate the rudder, the steering station and all transmission elements from the steering station to the steering gear. For the rudder and manoeuvring arrangement, see Chapter 1 – Hull Structures, Section 14.

The requirements set out in **SOLAS** Chapter II-1, Regulation 29 and 30 in their most actual version are integral part of this rule and are to be applied in their full extent.

1.2 Documents for approval

Assembly and general drawings of all steering gears, diagrams of the hydraulic and electrical equipment together with detail drawings of all important load-transmitting components are to be submitted to GL in triplicate for approval.

The drawings and other documents are to contain all the information relating to materials, working pressures, pump delivery rates, drive motor ratings, etc. necessary to enable the documentation to be checked.

2. Materials

2.1 Approved materials

2.1.1 As a rule, important load-transmitting components of the steering gear are to be made of steel or cast steel complying with the Rules II – Materials and Welding, Part 1 – Metallic Materials.

With the consent of GL, cast iron may be used for certain components.

Pressure vessels in general are to be made of steel, cast steel or nodular cast iron (with a predominantly ferritic matrix).

For welded structures, the Rules II – Materials and Welding, Part 3 – Welding are to be observed.

2.1.2 Casings with integrated journal and guide bearings on ships with a nozzle rudder and ice class are not to be made of grey cast iron.

2.1.3 The pipes of hydraulic steering gears are to be made of seamless or longitudinally welded steel tubes. The use of cold-drawn, unannealed tubes is not permitted.

At points where they are exposed to damage, copper pipes for control lines are to be provided with protective shielding and are to be safeguarded against hardening due to vibration by the use of suitable fastenings.

2.1.4 High-pressure hose assemblies may be used for short pipe connections subject to compliance with Section 11, U., if this is necessary due to vibrations or flexibly mounted units.

2.1.5 The materials used for pressurized components including the seals are to be suitable for the hydraulic oil in use.

2.2 Testing of materials

2.2.1 The materials of important force-transmitting components of the steering gear as well as of the pressurized casings of hydraulic steering gears are to be tested under the supervision of GL in accordance with the Rules II – Materials and Welding, Part 1 – Metallic Materials.

For pressurized oil pipes the requirements according to Section 11, Table 11.3 are to be observed.

For welded pressurized casings, the Rules II – Materials and Welding, Part 3 – Welding are to be considered.

2.2.2 In the case of small hand-operated main steering gears and small manually operated auxiliary steering gear GL may dispense with testing the materials of individual components such as axiometer gear shafts, etc.

3. Design and equipment

3.1 Number of steering gears

Every ship is to be equipped with at least one main and one auxiliary steering gear. Both steering gears are to be independent of each other and, wherever possible, act separately upon the rudder stock. GL may agree to components being used jointly by the main and auxiliary steering gear.

3.2 Main steering gear

3.2.1 Main steering gears are, with the rudder fully immersed in calm water, to be capable of putting the rudder from 35° port to 35° starboard and vice versa at the ship's speed for which the rudder has been designed in accordance with Chapter 1 – Hull Structures, Section 14. The time required to put the rudder from 35° port to 30° starboard or vice versa is not to exceed 28 seconds.

The main steering gear is to be as a rule poweroperated.

In every tanker, chemical tanker or gas carrier of 10 000 GT and upwards and in every other ship of 70 000 GT and upwards, the main steering gear is to comprise two or more identical power units.

3.2.2 Manual operation is acceptable for rudder stock diameters up to 120 mm calculated for torsional loads in accordance with Chapter 1 – Hull Structures, Section 14, C.1. Not more than 25 turns of the handwheel are to be necessary to put the rudder from one hard over position to the other. Taking account of the efficiency of the system, the force required to operate the handwheel is generally not to exceed 200 N.

3.3 Auxiliary steering gear

3.3.1 Auxiliary steering gears are, with the rudder fully immersed in calm water, to be capable of putting the rudder from 15° port to 15° starboard or vice versa within 60 seconds at 50 % of the ship's maximum speed, subject to a minimum of seven knots. Hydraulically operated auxiliary steering gears are to be fitted with their own piping system independent of that of the main steering gear. The pipe or hose connections of steering gears are to be capable of being shut off directly at the pressurized casings.

3.3.2 Manual operation of auxiliary steering gear systems is permitted up to a theoretical stock diameter of 230 mm referring to steel with a minimum nominal upper yield stress R_{eH} = 235 N/mm^2.

3.4 Power unit

3.4.1 Where power operated hydraulic main steering gears are equipped with two or more identical power units, no auxiliary steering gear need be installed provided that the following conditions are fulfilled.

3.4.1.1 On passenger ships, requirements 3.2.1 and 4.1 are to be complied with while any one of the power units is out of operation.

3.4.1.2 On cargo ships, the power units are to be designed in a way that requirements 3.2.1 and 4.1 are complied with while operating with all power units.

The main steering gear of tankers, chemical tankers or gas carriers of 10 000 GT and upwards is to comprise either:

– two independent and separate power actuating systems (power units(s), hydraulic pipes, power actuator), each capable of meeting the requirements as set out in 3.2.1 and 4.1, or

– at least two identical power actuating systems which, acting simultaneously in normal operation, are to be capable of meeting the requirements as set out in 3.2.1 and 4.1

3.4.1.3 In the event of failure of a single component of the main steering gear including the piping, excluding the rudder tiller or similar components as well as the cylinders, rotary vanes and casing, means are to be provided for quickly regaining control of one steering system.

For tankers, chemical tankers or gas carriers of 10 000 GT and upwards, steering capability is to be regained within 45 sec after a single failure.

3.4.1.4 In the event of a loss of hydraulic oil, it is to be possible to isolate the damaged system in such a way that the second control system remains fully operable.

3.5 Rudder angle limitation

The rudder angle in normal service is to be limited by devices fitted to the steering gear (e.g. limit switches) to a rudder angle of 35 ° on both sides. Deviations from this requirement are permitted only with the consent of GL.

3.6 End position limitation

For the limitation by means of stoppers of the end positions of tillers and quadrants, see Chapter 1 – Hull Structures, Section 14, G.

In the case of hydraulic steering gears without an end position limitation of the tiller and similar components, a mechanical end position limiting device is to be fitted within the rudder actuator.

3.7 Locking equipment

Steering gear systems are to be equipped with a locking system effective in all rudder positions, see also Chapter 1 – Hull Structures, Section 14, G.

Where hydraulic plants are fitted with shut-offs directly at the cylinders or rotary vane casings, special locking equipment may be dispensed with.

For steering gears with cylinder units which may be independently operated these shut-off devices do not have to be fitted directly on the cylinders.

3.8 Overload protection

3.8.1 Power-operated steering gear systems are to be equipped with overload protection (slip coupling, relief valves) to ensure that the driving torque is limited to the maximum permissible value.

The overload protection device is to be secured to prevent re-adjustment by unauthorized persons. Means are to be provided for checking the setting while in service.

The pressurized casings of hydraulic steering gears which also fulfil the function of the locking equipment mentioned in 3.7 are to be fitted with relief valves unless they are so designed that the pressure generated when the elastic-limit torque is applied to the rudder stock cannot cause rupture, deformation or other damage of the pressurized casing.

3.8.2 Relief valves have to be provided for protecting any part of the hydraulic system which can be isolated and in which pressure can be generated from the power source or from external forces.

The relief valves are to be set to a pressure value equal or higher than the maximum working pressure but lower than the design pressure of the steering gear (definition of maximum working pressure and design pressure in accordance to 4.1).

The minimum discharge capacity of the relief valve(s) are not to be less than 1,1 times the total capacity of the pumps, which can deliver through it (them).

With this setting any higher peak pressure in the system than 1,1 times the setting pressure of the valves is to be prohibited.

3.9 Controls

3.9.1 Control of the main and auxiliary steering gears is to be exercised from a steering station on the bridge. Controls are to be mutually independent and so designed that the rudder cannot move unintentionally.

3.9.2 Means are also to be provided for exercising control from the steering gear compartment. The transmission system is to be independent of that serving the main steering station.

3.9.3 Suitable equipment is to be installed to provide means of communication between the bridge, all steering stations and the steering gear compartment.

3.9.4 Failures of single control components (e.g. control system for variable displacement pump or flow control valve) which may lead to loss of steering are to cause an audible and visible alarm on the navigating bridge, if loss of steering cannot be prevented by other measures.

3.10 Rudder angle indication

3.10.1 The rudder position is to be clearly indicated on the bridge and at all steering stations. Where the steering gear is operated electrically or hydraulically, the rudder angle is to be indicated by a device (rudder position indicator) which is actuated either by the rudder stock itself or by parts which are mechanically connected to it. In case of time-dependent control of the main and auxiliary steering gear, the midship position of the rudder is to be indicated on the bridge by some additional means (signal lamp or similar). In general, this indicator is still to be fitted even if the second control system is a manually operated hydraulic system. See also Chapter 3 – Electrical Installations, Section 9, C.

3.10.2 The actual rudder position is also to be indicated at the steering gear itself.

An additional rudder angle indicator fitted at the main engine control station is recommended.

3.11 Piping

3.11.1 The pipes of hydraulic steering gear systems are to be installed in such a way as to ensure maximum protection while remaining readily accessible.

Pipes are to be installed at a sufficient distance from the ship's shell. As far as possible, pipes should not pass through cargo spaces.

Connections to other hydraulic systems are not permitted.

3.11.2 For the design and dimensions of pipes, valves, fittings, pressure vessels etc., see Section 8 and Section 11, A., B., C., D. and U.

3.12 Oil level indicators, filters

3.12.1 Tanks within the hydraulic system are to be equipped with oil level indicators.

3.12.2 The lowest permissible oil level is to be monitored. Audible and visual alarms are to be provided for the navigating bridge and in the machinery space or machinery control room. The alarm on the navigating bridge is to be an individual alarm.

3.12.3 Arrangements are to be provided to maintain the cleanliness of the hydraulic fluid taking into consideration the type and design of the hydraulic system.

3.13 Storage tank

In hydraulic operated steering gear systems, an additional permanently installed storage tank is to be fitted which has a capacity sufficient to refill at least one of the control systems including the service tank.

This storage tank is to be permanently connected by pipes to the control systems so that the latter can be refilled from a position inside the steering gear compartment.

3.14 Arrangement

Steering gears are to be installed in a way to be accessible at any time and to be easily maintainable.

3.15 Electrical equipment

For the electrical equipment, the rules in Chapter 3 – Electrical Installations, Section 7, A. have to be observed.

3.16 Seating

Seating of the steering gear has to be applied according to GL Rules VI – Additional Rules and Guidelines, Part 4 – Diesel Engines, Chapter 3 – Guidelines for the Seating of Propulsion Plants and Auxiliary Machinery. In case of seating on cast resin the forces according to the elastic limit torque of the rudder shaft as well as the rudder bearing forces have to be transmitted to the ship's structure by welded stoppers.

4. Power and dimensioning

4.1 Power of steering gears

The power of the steering gear has to comply with the requirements set out in 3.2 and 3.3, see also **SOLAS** Chapter II-1, Part C, Reg. 29.

The maximum effective torque for which the steering gear is to be equipped is not to be less than

$$M_{max} = \frac{\left(\frac{D_t}{4,2}\right)^3}{k_r} \quad [\text{Nm}] \qquad (1)$$

D_t = theoretical rudder stock diameter [mm], derived from the required hydrodynamic rudder torque for the ahead running condition in accordance with the Rules Chapter 1 – Hull Structures, Section 14, C.1 and Section 15, B.9 and D.3.7.

The working torque of the steering gear is to be larger than the hydrodynamic torque Q_R of the rudder according to Chapter 1 - Hull Structures, Section 14, B.1.2, B.2.2, B.2.3 and cover the friction moments of the related bearing arrangement.

The corresponding maximum working pressure is the maximum expected pressure in the system, when the steering gear is operated to comply with the power requirements as mentioned above.

Frictional losses in the steering gear including piping have to be considered within the determination of the maximum working pressure.

The design pressure p_c for calculation to determine the scantlings of piping and other steering gear components subjected to internal hydraulic pressure is to be at least 1,25 times the maximum working pressure as defined above and has not to be less than the setting of the relief valves as described under 3.8.2.

In the case of multi-surface rudders controlled by a common steering gear the relevant diameter is to be determined by applying the formula:

$$D_{ti} = \sqrt[3]{D_{t1}^{\;3} + D_{t2}^{\;3} + ...}$$

k_r = material characteristic

$$k_r = \left(\frac{235}{R_{eH}}\right)^e \qquad (2)$$

e = 0,75 where $R_{eH} > 235 \frac{N}{mm^2}$

= 1,0 where $R_{eH} \le 235 \frac{N}{mm^2}$

R_{eH} = yield strength of rudder stock material [N/mm²].

The applied value for R_{eH} is not to be greater than 0,7 R_m or 450 N/mm² whichever is less.

R_m = tensile strength [N/mm²]

4.2 Design of transmission components

4.2.1 The design calculations for those parts of the steering gear which are not protected against overload are to be based on the elastic-limit torque of the rudder stock.

The elastic-limit torque to be used is

$$M_F = 2 \cdot \frac{\left(\frac{D}{4,2}\right)^3}{k_r} \quad [\text{Nm}] \qquad (3)$$

D = minimum actual rudder stock diameter [mm]. The value used for the actual diameter need not be larger than $1,145 \cdot D_t$.

The stresses in the components of the steering gear determined in this way are not to exceed the yield strength of the materials used. The design of parts of the steering gear with overload protection is to be based on the loads corresponding to the response threshold of the overload protection.

4.2.2 Tiller and rotary vane hubs made of material with a tensile strength of up to 500 N/mm² have to satisfy the following conditions in the area where the force is applied, see Figure 14.1:

Height of hub $H \ge 1,0 \cdot D$ [mm]

Outside diameter $D_a \ge 1,8 \cdot D$ [mm]

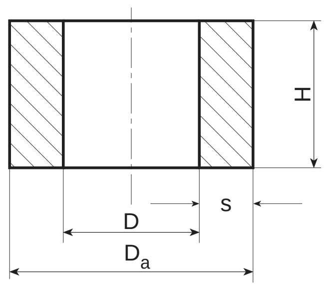

Fig. 14.1 Hub dimensions

In special cases the outside diameter may be reduced to

$D_a = 1{,}7 \cdot D$ [mm]

but the height of the hub must then be at least

$H = 1{,}14 \cdot D$ [mm]

4.2.3 Where materials with a tensile strength greater than 500 N/mm² are used, the section of the hub may be reduced by 10 %.

4.2.4 Where the force is transmitted by clamped or tapered connections, the elastic-limit torque may be transmitted by a combination of frictional and positive locking mechanism using adequately pre-tensioned bolts and a key.

For the elastic limit torque according to formula (3), the thread root diameter of the bolts can be determined by applying the following formula:

$$d_k \geq 9{,}76 \cdot D \sqrt{\frac{1}{z \cdot k_r \cdot R_{eH}}} \quad \text{[mm]} \qquad (4)$$

D = actual rudder stock diameter [mm]. The value used for the actual diameter need not be larger than $1{,}145 \cdot D_t$.

z = total number of bolts [–]

R_{eH} = yield strength of the bolt material [N/mm²]

4.2.5 Split hubs of clamped joints are to be joined together with at least four bolts.

The key is not to be located at the joint in the clamp.

4.2.6 Where the oil injection method is used to joint the rudder tiller or rotary vanes to the rudder stock, methods of calculation appropriate to elasticity theory are to be applied. Calculations are to be based on the elastic-limit torque allowing for a coefficient of friction $\mu_o = 0{,}15$ for steel and $\mu_o = 0{,}12$ for nodular cast iron. The von Mises equivalent stress calculated from the specific pressure p and the corresponding tangential load based on the dimensions of the shrunk joint is not to exceed 80 % of the yield strength of the materials used.

4.2.7 Where circumferential tension components are used to connect the rudder tiller or rotary vanes to the rudder stock, calculations are to be based on two and a half times the maximum torque (but not more than the elastic limit torque) allowing for a coefficient of friction of $\mu_o = 0{,}12$. The von Mises equivalent stress calculated from the contact pressure p and the corresponding tangential load based on the dimensions of the shrunk-on connection is not to exceed 80 % of the yield strength of the materials used.

When more than one circumferential tension components are used, the torque capacity of the connection is to be determined by adding the torques of the sole tension components and applying a reduction factor of 0,9.

5. Tests in the manufacturer's works

5.1 Testing of power units

The power units are required to undergo tests on a test stand in the manufacturer's works.

5.1.1 For diesel engines, see Section 2.

5.1.2 For electric motors, see Chapter 3 – Electrical Installations, Section 21.

5.1.3 For hydraulic pumps and motors see VI – Additional Rules and Guidelines, Part 5 – Pumps, Chapter 1 – Guidelines for Design, Construction and Testing of Pumps are to be applied analogously. Where the drive power is 50 kW or more, this testing is to be carried out in the presence of a GL Surveyor.

5.2 Pressure and tightness tests

Pressure components are to undergo a pressure test.

The test pressure is p_p.

$$p_p = 1{,}5 \cdot p_c \qquad (5)$$

p_c = design pressure for which a component or piping system is designed with its mechanical characteristics [bar]. For pressures above 200 bar the test pressure need not exceed p + 100 bar.

For pressure testing of pipes, their valves and fittings, see Section 11, B.4 and U.5.

Tightness tests are to be performed on components to which this is appropriate.

5.3 Final inspection and operational test

Following testing of the individual components and after completion of assembly, the steering gear is required to undergo final inspection and an operational test. Among other things the overload protection is to be adjusted at this time.

6. Shipboard trials

The operational efficiency of the steering gear is to be proved during the sea trials. For this purpose, the Z manoeuvre corresponding to 3.2.1 and 3.3.1 is to be executed as a minimum requirement.

B. Rudder Propeller Units

1. General

1.1 Scope

The requirements of B. are valid for the rudder propeller as main drive, the ship's manoeuvring station and all transmission elements from the manoeuvring station to the rudder propeller.

1.2 Documents for approval

Assembly and sectional drawings as well as part drawings of the gears and propellers giving all the data necessary for the examination are to be submitted in triplicate to GL for approval.

2. Materials

2.1 Approved materials

The selection of materials is subject, as and where applicable, to the provisions of A.2.1 and to those of Sections 4, 5 and 6.

2.2 Testing of materials

All important components of the rudder propeller involved in the transmission of torques and bending moments are to be tested under the supervision of GL in accordance with the Rules II – Materials and Welding, Part 1 – Metallic Materials.

3. Design and equipment

3.1 Number of rudder propellers

Each ship is to have at least two rudder propellers. Both units are to be capable of being operated independently of the other.

3.2 Locking devices

Each rudder propeller is to be provided with a locking device to prevent the unintentional rotation of the propeller and the slewing mechanism of the unit which is out of operation at a time. The locking device is to be designed to securely lock the non-operated unit while operating the ship with the maximum power of the remaining rudder propeller units, however at a ship speed of at least 7 kn.

3.3 Control

3.3.1 Both the drive and the slewing mechanism of each rudder propeller are to be controlled from a manoeuvring station on the navigating bridge.

The controls are to be mutually independent and so designed that the rudder propeller cannot be turned unintentionally.

An additional combined control for all rudder propellers is permitted.

Means have to be provided, fulfilling the same purpose as the steering angle limitation in A.3.5. These may be dispensed with in cases where no danger for the ship is caused by unintentional slewing of the units at full power and ship speed to any angle.

3.3.2 The failure of a single element within the control and hydraulic system of one unit is not to lead to the failure of the other units.

3.3.3 An auxiliary steering device is to be provided for each rudder propeller. In case of a failure of the main steering system the auxiliary steering device is at least to be capable of moving the rudder propeller to midship position.

3.3.4 Where the hydraulic systems of more than one rudder propeller are combined, it is to be possible in case of a loss of hydraulic oil to isolate the damaged system in such a way that the other control systems remain fully operational.

3.4 Position indicators

3.4.1 The position of each rudder propeller is to be clearly discernible on the navigating bridge and at each manoeuvring station.

3.4.2 The actual position is also to be discernible at the rudder propeller itself.

3.5 Pipes

The pipes of hydraulic control systems are subject to the provisions of A.3.11 wherever relevant.

3.6 Oil level indicators, filters

Oil level indicators and filters are subject to the provisions of A.3.12 wherever relevant.

3.7 Lubrication

3.7.1 The lubricating oil supply is to be ensured by a main pump and an independent standby pump.

3.7.2 In the case of separate lubricating systems in which the main lubricating oil pumps can be replaced with the means available on board, the standby pump may be replaced by a complete spare pump. This spare pump is to be carried on board and is to be ready for mounting.

4. Dimensioning

4.1 Gears

For the design of gears see Section 5.

The slewing gears are in general to be designed as spur or bevel gears.

4.2 Shaft line

For the dimensioning of the propeller shaft, between propeller and gear wheel, see Section 4. For the dimensioning of the remaining part of this shaft and all other gear shafts see Section 5.

4.3 Propellers

For the design of propellers, see Section 6.

4.4 Support pipe

The design of the support pipe and its attachment to the ship's hull is to take account of the loads due to the propeller and nozzle thrust including the dynamic components.

4.5 Pipes

For arrangement and design of pipes, valves, fittings and pressure vessels, see Section 8 and Section 11, A., B., C., D., U.

5. Tests in the manufacturer's works

5.1 Testing of power units

A.5.1 applies wherever relevant.

5.2 Pressure and tightness test

A.5.2 applies wherever relevant.

5.3 Final inspection and operational test

5.3.1 After inspection of the individual components and completion of assembly, rudder propellers are to undergo a final inspection and operational test. The final inspection is to be combined with a trial run lasting several hours under part or full-load conditions. A check of the tooth clearance and of the tooth contact pattern is to be carried out.

5.3.2 When no suitable test bed is available for the operational and load testing of large rudder propellers, the tests mentioned in 5.3.1 can be carried out on the occasion of the dock test.

5.3.3 Limitations on the scope of the test require GL's consent.

6. Testing on board

6.1 The faultless operation, smooth running and bearing temperatures of the gears and control system are to be checked during the sea trials under all steaming conditions.

After the conclusion of the sea trials, the toothing is to be examined through the inspection openings and the contact pattern is to be checked. The tooth contact pattern is to be assessed on the basis of the reference values for the percentage area of contact given in Section 5, Table 5.6.

6.2 The scope of the check on contact pattern following the sea trials may be limited with the Surveyor's agreement provided that the checks on contact pattern called for in 5.3.1 and 5.3.2 have been satisfactory.

C. Lateral Thrust Units

1. General

1.1 Scope

The requirements contained in C. apply to the lateral thrust unit, the control station and all the transmission elements from the control station to the lateral thrust unit.

1.2 Documents for approval

Assembly and sectional drawings for lateral thrust units with an input power of 100 kW and more together with detail drawings of the gear mechanism and propellers containing all the data necessary for checking are each to be submitted to GL in triplicate for approval. For propellers, this only applies to an input power exceeding 500 kW.

2. Materials

Materials are subject, as appropriate, to the provisions of Sections 4 and 5.

Section 6 applies analogously to the materials and the material testing of propellers.

3. Dimensioning and design

3.1 General requirements

The design of the relevant components of lateral thrust units is to be in accordance with Sections 4 and 5, that of the propellers with Section 6.

The pipe connections of hydraulic drive systems are subject to the applicable requirements contained in A.2.1.3 and A.2.1.4.

Lateral thrust units are to be capable of being operated independently of other connected systems.

Windmilling of the propeller during sea passages has to be taken into account as an additional load case. Otherwise effective countermeasures have to be introduced to avoid windmilling, e.g. a shaft brake.

In the propeller area, the thruster tunnel is to be protected against damages caused by cavitation erosion by effective measures, such as stainless steel plating.

For monitoring the lubricating oil level, equipment shall be fitted to enable the oil level to be determined.

For the electrical part of lateral thrust units, see Chapter 3 – Electrical Installations, Section 7, B.

3.2 Additional requirements for lateral thrust units for dynamic positioning (DP)

Bearings, sealings, lubrication, hydraulic system and all other aspects of the design must be suitable for continuous, uninterrupted operation.

Gears must comply with the safety margins for DP as specified in Section 5, Table 5.1. The lubrication system for the gearbox must comply with Section 5, E.

For units with controllable pitch propellers, the hydraulic system must comply with Section 6, D.4.2. The selection and arrangement of filters has to ensure an uninterrupted supply with filtered oil, also during filter cleaning or exchange.

Where ships are equipped with automated machinery, the thruster unit has to comply with the requirements for main gears and main propellers in Chapter 4 – Automation.

4. Tests in the manufacturer's works

A.5. is applicable as appropriate.

For hydraulic pumps and motors with a drive power of 100 kW or more, the tests are to be conducted in the presence of a GL Surveyor.

For lateral thrust units with an input power of less than 100 kW final inspection and function tests may be carried out by the manufacturer, who will then issue the relevant Manufacturer Inspection Certificate.

5. Shipboard trials

Testing is to be carried out during sea trials during which the operating times are to be established.

D. Windlasses

1. General

1.1 Scope

The requirements contained in D. apply to bower anchor windlasses, stern anchor windlasses, combined anchor and mooring winches and chain stoppers. For anchors and chains, see Chapter 1 – Hull Structures, Section 18.

1.2 Documents for approval

1.2.1 For each type of anchor windlass and chain stopper, general and sectional drawings, circuit diagrams of the hydraulic, electrical and steam systems and detail drawings of the main shaft, cable lifter, brake, stopper bar, chain pulley and axle are to be submitted in triplicate for approval.

One copy of a description of the anchor windlass including the proposed overload protection and other safety devices is likewise to be submitted.

1.2.2 Where an anchor windlass is to be approved for several strengths and types of chain cable, the calculation relating to the maximum braking torque is to be submitted and proof furnished of the power and hauling-in speed in accordance with 4.1 corresponding to all the relevant types of anchor and chain cable.

1.2.3 One copy of the strength calculation for bolts, chocks and stoppers securing the windlass to the deck is likewise to be submitted. This calculation is to consider forces acting on the windlass caused by the loads specified in 4.2 and 4.3.

2. Materials

2.1 Approved materials

2.1.1 The provisions contained in A.2.1 are to be applied as appropriate to the choice of materials.

2.1.2 Cable lifters and chain pulleys are generally to be made of cast steel. Nodular cast iron is permitted for stud link chain cables of

up to 50 mm diameter for grade K 1

up to 42 mm diameter for grade K 2

up to 35 mm diameter for grade K 3

In special cases, nodular cast iron may also be used for larger chain diameters by arrangement with GL.

Grey cast iron is permitted for stud link chain cables of

up to 30 mm diameter for grade K 1

up to 25 mm diameter for grade K 2

up to 21 mm diameter for grade K 3

2.2 Testing of materials

2.2.1 The materials for forged, rolled and cast parts which are stressed by the pull of the chain when the cable lifter is disengaged (main shaft, cable lifter, brake bands, brake spindles, brake bolts, tension straps, stopper bar, chain pulley and axle) are to be tested under the supervision of GL in accordance with the Rules II – Materials and Welding, Part 1 – Metallic Materials.

In the case of anchor windlasses for chains up to 14 mm in diameter an Manufacturer Inspection Certificate issued by the producer may be accepted as proof.

2.2.2 In the case of hydraulic systems, the material used for pipes (see Section 11, Table 11.3) as well as for pressure vessels is also to be tested.

3. Design and equipment

3.1 Type of drive

3.1.1 Windlasses are normally to be driven by an engine which is independent of other deck machinery. The piping systems of hydraulic and steam-driven windlass engines may be connected to other hydraulic or steam systems provided that this is permissible for the latter. The windlasses are, however, to be capable of being operated independently of other connected systems.

3.1.2 Manual operation as the main driving power can be allowed for anchors weighing up to 250 kg.

3.1.3 In the case of hydraulic drives with a piping system connected to other hydraulic systems a second pump unit is recommended.

3.1.4 In the case of windlasses with two cable lifters both cable lifters are to be engageable simultaneously.

3.2 Reversing mechanism

Power-driven windlasses are to be reversible. On windlasses for ships with a Range of Service rating up to **RSA (50)** and on those powered by internal combustion engines a reversing mechanism may be dispensed with.

3.3 Overload protection

For the protection of the mechanical parts in the event of the windlass jamming, an overload protection (e.g. slip coupling, relief valve) is to be fitted to limit the maximum torque of the drive engine (cf. 4.1.2). The setting of the overload protection is to be specified (e.g. in the operating instructions).

3.4 Couplings

Windlasses are to be fitted with disengageable couplings between the cable lifter and the drive shaft. In an emergency, hydraulic or electrically operated couplings are to be capable of being disengaged by hand.

3.5 Braking equipment

Windlasses are to be fitted with cable lifter brakes which are capable of holding a load in accordance with 4.2.3 with the cable lifter disengaged. In addition, where the gear mechanism is not of self-locking type, a device (e.g. gearing brake, lowering brake, oil hydraulic brake) is to be fitted to prevent paying out of the chain should the power unit fail while the cable lifter is engaged.

3.6 Pipes

For the design and dimensions of pipes, valves, fittings, pressure vessels, etc. see Section 8 and Section 11, A., B., C., D. and U.

3.7 Cable lifters

Cable lifters are to have at least five snugs.

3.8 Windlass as warping winch

Combined windlasses and warping or mooring winches are not to be subjected to excessive loads even when the maximum pull is exerted on the warping rope.

3.9 Electrical equipment

For the electrical equipment the rules of Chapter 3 – Electrical Installations, Section 7, E.2. have to be observed.

3.10 Hydraulic equipment

For oil level indicators see A.3.12.1. For filters see F.3.2.2.

4. Power and dimensioning

4.1 Driving power

4.1.1 Depending on the grade of the chain cable and anchor depth windlasses must be capable of exerting the following nominal pull Z at a mean speed of at least 0,15 m/s:

$$Z = d^2 (f + 0{,}218 \cdot (h - 100)) \text{ [N]}$$

d = diameter of anchor chain [mm]

h = anchor depth [m]

f = nominal pull factor [–]

Grade	K 1	K 2	K3
f	37,5	42,5	47,5

The calculation of nominal pull is to be based on a minimum anchor depth of 100 m.

The pull of stern windlasses with an anchor rope can be determined by reference to the anchor weight and the diameter of the corresponding chain cable.

4.1.2 The nominal output of the power units is to be such hat the conditions specified in 4.1.1 can be met for 30 minutes without interruption. In addition, the power units are to be capable of developing a maximum torque equal to a maximum pull Z_{max} of

$$Z_{max} = 1{,}5 \cdot Z \text{ [N]}$$

at a reduced speed for at least two minutes.

4.1.3 At the maximum torque specified in 4.1.2, a short-time overload of up to 20 % is allowed in the case of internal combustion engines.

4.1.4 An additional reduction gear stage may be fitted in order to achieve the maximum torque.

4.1.5 With manually operated windlasses, steps are to be taken to ensure that the anchor can be hoisted at a mean speed of 0,033 m/s with the pull specified in 4.1.1. This is to be achieved without exceeding a manual force of 150 N applied to a crank radius of about 350 mm with the hand crank turned at about 30 rpm.

4.2 Dimensioning of load-transmitting components and chain stoppers

4.2.1 The basis for the design of the load-transmitting components of windlasses and chain stoppers are the anchors and chain cables specified in Chapter 1 – Hull Structures, Section 18.

4.2.2 The cable lifter brake is to be so designed that the anchor and chain can be safely stopped while paying out the chain cable.

4.2.3 The dimensional design of those parts of the windlass which are subjected to the chain pull when the cable lifter is disengaged (cable lifter, main shaft, braking equipment, bedframe and deck fastening) is to be based on a theoretical pull equal to 80 % of the nominal breaking load specified in the GL Rules II – Materials and Welding, Part 1 – Metallic Materials for the chain in question. The design of the main shaft is to take account of the braking forces, and the cable lifter brake is not to slip when subjected to this load.

4.2.4 The theoretical pull may be reduced to 45 % of the nominal breaking load for the chain provided that a chain stopper approved by GL is fitted.

4.2.5 The design of all other windlass components is to be based upon a force acting on the cable lifter pitch circle and equal to the maximum pull specified in 4.1.2.

4.2.6 At the theoretical pull specified in 4.2.3 and 4.2.4, the force exerted on the brake handwheel is not to exceed 500 N.

4.2.7 The dimensional design of chain stoppers is to be based on a theoretical pull equal to 80 % of the nominal breaking load of the chain.

4.2.8 The total stresses applied to components are to be below the minimum yield point of the materials used.

4.2.9 The foundations and pedestals of windlasses and chain stoppers are governed by Chapter 1 – Hull Structures, Section 10, B.5.

4.3 Strength requirements to resist green sea forces

4.3.1 For ships of length 80 m or more, where the height of the exposed deck in way of the item is less than 0,1**L** or 22 m above the summer load waterline, whichever is the lesser, the attachment of the windlass located within the forward quarter length of the ship has to resist the green sea forces.

The following pressures and associated areas are to be applied (Fig. 14.2):

– 200 kN/m^2 normal to the shaft axis and away from the forward perpendicular, over the projected area in this direction

– 150 kN/m^2 parallel to the shaft axis and acting both inboard and outboard separately, over the multiple of f times the projected area in this direction

f = 1 + B/H, but not greater than 2,5

B = width of windlass measured parallel to the shaft axis [m]

H = overall height of the windlass [m]

Where mooring winches are integral with the anchor windlass, they are to be considered as part of the windlass.

4.3.2 Forces in the bolts, chocks and stoppers securing the windlass to the deck, caused by green sea forces specified in 4.3.1, are to be calculated.

The windlass is supported by N bolt groups, each containing one or more bolts (Fig. 14.3).

The axial forces R_i in bolt group (or bolt) i, positive in tension, is to be obtained from:

$$R_{xi} = P_x \cdot h \cdot x_i \cdot A_i / I_x \quad [kN]$$

$$R_{yi} = P_y \cdot h \cdot y_i \cdot A_i / I_y \quad [kN]$$

R_i = $R_{xi} + R_{yi} - R_{si}$ [kN]

P_x = force acting normal to the shaft axis [kN]

P_y = force acting parallel to the shaft axis, either inboard or outboard whichever gives the greater force in bolt group i [kN]

h = shaft height above the windlass mounting [cm]

x_i, y_i = x and y coordinates of bolt group i from the centroid of all N bolt groups, positive in the direction opposite to that of the applied force [cm]

A_i = cross sectional area of all bolts in group i [cm^2]

I_x = $\Sigma A_i x_i^2$ for N bolt groups [cm^4]

I_y = $\Sigma A_i y_i^2$ for N bolt groups [cm^4]

R_{si} = static reaction at bolt group i, due to weight of windlass [kN]

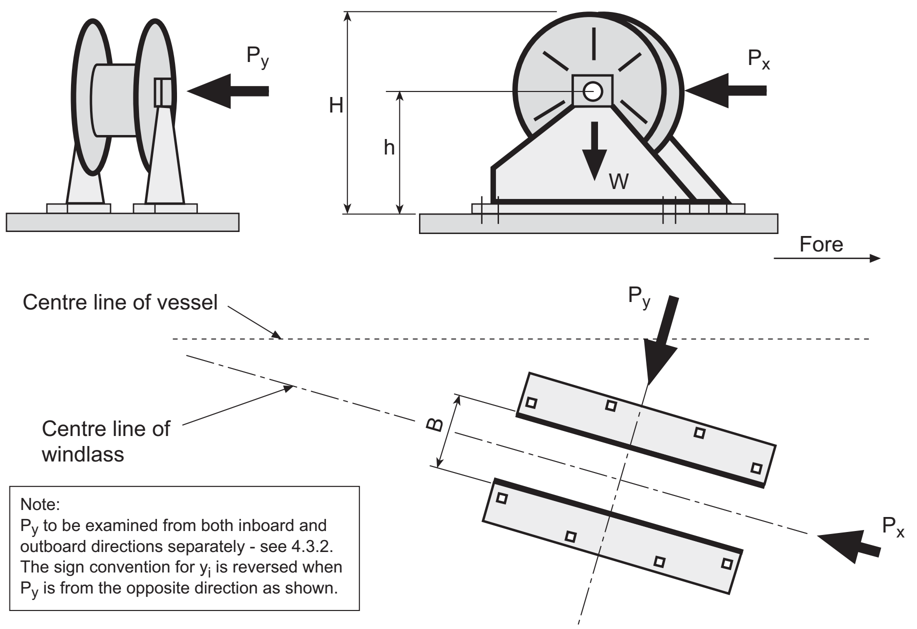

Fig. 14.2 Direction of forces and weight

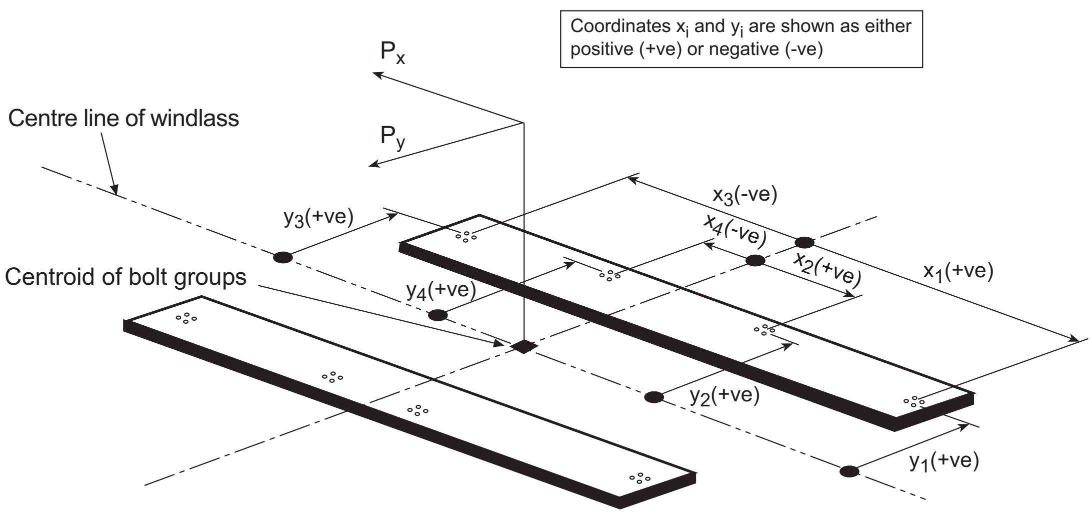

Fig. 14.3 Sign convention

4.3.3 Shear forces F_{xi} and F_{yi} applied to the bolt group i, and the resultant combined force are to be obtained from:

$$F_{xi} = \frac{P_x - \alpha \cdot m_w}{N} \quad [kN]$$

$$F_{yi} = \frac{P_y - \alpha \cdot m_w}{N} \quad [kN]$$

$$F_i = \sqrt{\left(F_{xi}^2 + F_{yi}^2\right)} \quad [kN]$$

α = coefficient of friction, to be taken equal to 0,5

m_w = weight-force of windlass [kN]

N = number of bolt groups

Axial tensile and compressive forces and lateral forces calculated in 4.3.1, 4.3.2 and 4.3.3 are also to be considered in the design of the supporting structure.

4.3.4 Tensile axial stresses in the individual bolts in each bolt group i are to be calculated. The horizontal forces F_{xi} and F_{yi} are normally to be reacted by shear chocks.

Where "fitted" bolts are designed to support these shear forces in one or both directions, the von Mises equivalent stresses in the individual bolts are to be calculated, and compared to the stress under proof load.

Where pourable resins are incorporated in the holding down arrangement, due account is to be taken in the calculations.

The safety factor against bolt proof strength is to be not less than 2,0.

5. Tests in the manufacturer's works

5.1 Testing of driving engines

A.5.1 is applicable as appropriate.

5.2 Pressure and tightness tests

A.5.2 is applicable as appropriate.

5.3 Final inspection and operational testing

5.3.1 Following manufacture, windlasses are required to undergo final inspection and operational testing at the maximum pull. The hauling-in speed is to be verified with continuous application of the nominal pull. During the tests, particular attention is to be given to the testing and, where necessary, setting of braking and safety equipment.

In the case of anchor windlasses for chains > 14 mm in diameter this test is to be performed in the presence of the GL Surveyor.

In the case of anchor windlasses for chains ≤ 14 mm diameter, the Manufacturer's Inspection Certificate will be accepted.

5.3.2 Where the manufacturing works does not have adequate facilities, the aforementioned tests including the adjustment of the overload protection can be carried out on board ship. In these cases, functional testing in the manufacturer's works is to be performed under no-load conditions.

5.3.3 Following manufacture, chain stoppers are required to undergo final inspection and operational testing in the presence of the GL Surveyor.

6. Shipboard trials

The anchor equipment is to be tested during sea trials.

As a minimum requirement, this test is required to demonstrate that the conditions specified in 3.1.4 and 4.2.2 can be fulfilled.

E. Winches

1. Towing winches

The design and testing of towing winches are to comply with Chapter 1 – Hull Structures, Section 25, C.5.

2. Winches for cargo handling gear and other lifting equipment

The design and testing of these winches are to comply with VI – Additional Rules and Guidelines, Part 2 – Loading Gear, Chapter 2 – Guidelines for the Construction and Survey of Lifting Appliances.

3. Lifeboat winches

The design and testing of life boat winches are to comply with VI – Additional Rules and Guidelines, Part 2 – Loading Gear, Chapter 1 – Guidelines for Life-Saving Launching Appliances.

4. Winches for special equipment

The GL Guidelines VI – Additional Rules and Guidelines, Part 2 – Loading Gear, Chapter 2 – Guidelines for the Construction and Survey of Lifting Appliances are to be applied, as appropriate, to winches for special equipment such as ramps, hoisting gear and hatch covers.

F. Hydraulic Systems

1. General

1.1 Scope

The requirements contained in F. apply to hydraulic systems used, for example, to operate hatch covers, closing appliances in the ship's shell and bulkheads, and hoists. The requirements are to be applied in analogous manner to the ship's other hydraulic systems except where covered by the requirements of Section 11.

1.2 Documents for approval

The diagram of the hydraulic system together with drawings of the cylinders containing all the data necessary for assessing the system, e.g. operating data, descriptions, materials used, etc., are to be submitted in triplicate for approval.

1.3 Dimensional design

For the design of pressure vessels, see Section 8; for the dimensions of pipes and hose assemblies, see Section 11.

2. Materials

2.1 Approved materials

2.1.1 Components fulfilling a major function in the power transmission system normally are to be made of steel or cast steel in accordance with the Rules II – Materials and Welding, Part 1 – Metallic Materials. The use of other materials is subject to special agreement with GL.

Cylinders are preferably to be made of steel, cast steel or nodular cast iron (with a predominantly ferritic matrix).

2.1.2 Pipes are to be made of seamless or longitudinally welded steel tubes.

2.1.3 The pressure-loaded walls of valves, fittings, pumps, motors, etc. are subject to the requirements of Section 11, B.

2.2 Testing of materials

The following components are to be tested under supervision of GL in accordance with the Rules II – Materials and Welding, Part 1 – Metallic Materials:

a) Pressure pipes with D_N > 50 (see Section 11, Table 11.3)

b) Cylinders, where the product of the pressure times the diameter:

$$p_{e,zul} \cdot D_i > 20000$$

$p_{e,zul}$ = maximum allowable working pressure [bar]

D_i = inside diameter of tube [mm]

c) For testing the materials of hydraulic accumulators, see Section 8, B.

Testing of materials by GL may be dispensed with in the case of cylinders for secondary applications provided that evidence in the form of a Manufacturer Test Report (e.g. to EN 10204- 2.3) is supplied.

3. Hydraulic operating equipment for hatch covers

3.1 Design and construction

3.1.1 Hydraulic operating equipment for hatch covers may be served either by one common power station for all hatch covers or by several power stations individually assigned to a single hatch cover. Where a common power station is used, at least two pump units are to be fitted. Where the systems are supplied individually, change-over valves or fittings are required so that operation can be maintained should one pump unit fail.

3.1.2 Movement of hatch covers is not to be initiated merely by the starting of the pumps. Special control stations are to be provided for controlling the opening and closing of hatch covers. The controls are to be so designed that, as soon as they are released, movement of the hatch covers stops immediately.

The hatches should normally be visible from the control stations. Should this, in exceptional cases, be impossible, opening and closing of the hatches is to be signalled by an audible alarm. In addition, the control stations must then be equipped with indicators for monitoring the movement of the hatch covers.

At the control stations, the controls governing the opening and closing operations are to be appropriately marked.

3.1.3 Suitable equipment is to be fitted in, or immediately adjacent to, each power unit (cylinder or similar) used to operate hatch covers to enable the hatches to be closed slowly in the event of a power failure, respectively due to a pipe rupture.

3.2 Pipes

3.2.1 Pipes are to be installed and secured in such a way as to protect them from damage while enabling them to be properly maintained from outside.

Pipes may be led through tanks in pipe tunnels only. The laying of such pipes through cargo spaces is to be restricted to the essential minimum. The piping system is to be fitted with relief valves to limit the pressure to the maximum allowable working pressure.

3.2.2 The piping system is to be fitted with filters for cleaning the hydraulic fluid.

Equipment is to be provided to enable the hydraulic system to be vented.

3.2.3 The accumulator space of the hydraulic accumulator is to have permanent access to the relief valve of the connected system. The gas chamber of the accumulator may be filled only with inert gases. Gas and operating medium are to be separated by accumulator bags, diaphragms or similar.

3.2.4 Connection between the hydraulic system used for hatch cover operation and other hydraulic systems is permitted only with the consent of GL.

3.2.5 For oil level indicators, see A.3.12.1.

3.2.6 The hydraulic fluids must be suitable for the intended ambient and service temperatures.

3.3 Hose assemblies

The construction of hose assemblies is to conform to Section 11, U. The requirement that hose assemblies should be of flame-resistant construction may be set aside for hose lines in spaces not subject to a fire hazard and in systems not important to the safety of the ship.

3.4 Emergency operation

It is recommended that devices be fitted which are independent of the main system and which enable hatch covers to be opened and closed in the event of failure of the main system. Such devices may, for example, take the form of loose rings enabling hatch covers to be moved by cargo winches, warping winches, etc.

4. Hydraulically operated closing appliances in the ship's shell

4.1 Scope

The following requirements apply to the power equipment of hydraulically operated closing appliances in the ship's shell such as shell and landing doors which are normally not operated while at sea. For the design and arrangement of the closures, see Chapter 1 – Hull Structures, Section 6, H.

4.2 Design

4.2.1 The movement of shell doors, etc. may not be initiated merely by the starting of the pumps at the power station.

4.2.2 Local control, inaccessible to unauthorized persons, is to be provided for every closing appliance in the ship's shell. As soon as the controls (pushbuttons, levers or similar) are released, movement of the appliance is to stop immediately.

4.2.3 Closing appliances in the ship's shell normally are to be visible from the control stations. If the movement cannot be observed, audible alarms are to be fitted. In addition, the control stations are then to be equipped with indicators enabling the execution of the movement to be monitored.

4.2.4 Closing appliances in the ship's shell are to be fitted with devices which prevent them from moving into their end positions at excessive speed. Such devices are not to cause the power unit to be switched off.

As far as is required, mechanical means are to be provided for locking closing appliances in the open position.

4.2.5 Every power unit driving horizontally hinged or vertically operated closing appliances is to be fitted with throttle valves or similar devices to prevent sudden dropping of the closing appliance.

4.2.6 It is recommended that the driving power be shared between at least two mutually independent pump sets.

4.3 Pipes, hose assemblies

3.2 and 3.3 are to be applied in analogous manner to the pipes and hose lines of hydraulically operated closing appliances in the ship's shell.

5. Bulkhead closures

5.1 General

5.1.1 Scope

5.1.1.1 The following requirements apply to the power equipment of hydraulically-operated watertight bulkhead doors on passenger and cargo vessels.

5.1.1.2 For details of the number, design and arrangement of bulkhead doors, see Chapter 1 – Hull Structures, Sections 11, 26 and 28.

The **SOLAS** regulations, Chapter II-1, Regulations 15, 16 and 25.9 are not affected by these provisions.

5.1.2 Design

Bulkhead doors are to be power-driven sliding doors moving horizontally. Other designs require the approval of GL and the provision of additional safety measures where necessary.

5.1.3 Piping

5.1.3.1 Wherever applicable, the requirements for pipes in hydraulic bulkhead closing systems are governed by the Rules in 3.2, with the restriction that the use of flexible hose assemblies is not permitted.

5.1.3.2 The hydraulic fluids must be suitable for the intended ambient and service temperatures.

5.1.4 Drive unit

5.1.4.1 A selector switch with the switch positions "local control" and "close all doors" is to be provided at the central control station on the bridge

Under normal conditions this switch is to be set to "local control".

In the "local control" position, the doors may be locally opened and closed without automatic closure.

In the "close all doors" position, all doors are closed automatically. They may be reopened by means of the local control device but are to close again automatically as soon as the local door controls are released.

It is not to be possible to open the closed doors from the bridge.

5.1.4.2 Closed or open bulkhead doors are not to be set in motion automatically in the event of a power failure.

5.1.4.3 The control system is to be designed in such a way that an individual fault inside the control system, including the piping, does not have any adverse effect on the operation of other bulkhead doors.

5.1.4.4 The controls for the power drive are to be located at least 1,6 m above the floor on both sides of the bulkhead close to the door. The controls are to be installed in such a way that a person passing through the door is able to hold both controls in the open position.

The controls are to return to their original position automatically when released.

5.1.4.5 The direction of movement of the controls is to be clearly marked and is to be the same as the direction of movement of the door.

5.1.4.6 In the event that an individual element fails inside the control system for the power drive, including the piping but excluding the closing cylinders on the door or similar components, the operational ability of the manually-operated control system is not to be impaired.

5.1.4.7 The movement of the power driven bulkhead doors may not be initiated simply by switching on the drive units but only by actuating additional devices.

5.1.4.8 The control and monitoring equipment for the drive units is to be housed in the central control station on the bridge.

5.1.5 Manual control

Each door is to have a manual control system which is independent of the power drive.

5.1.6 Indicators

Visual indicators to show whether each bulkhead door is fully open or closed are to be installed at the central control station on the bridge.

5.1.7 Electrical equipment

For details of electrical equipment, see Chapter 3 – Electrical Installations, Sections 9 and 14, D.

5.2 Passenger vessels

In addition to 5.1, the following requirements are to be taken into consideration in the case of passenger vessels:

5.2.1 Design and location

5.2.1.1 Bulkhead doors together with the power plants and including the piping, electric cables and control instruments must have a minimum distance of $0{,}2 \times B$ from the perpendiculars which interset the hull contour line when the ship is at load draught (B = beam).

5.2.1.2 The bulkhead doors are to be capable of being closed securely using the power drive as well as using the manual control even when the ship has a permanent heel of 15°.

5.2.1.3 The force required to close a door is to be calculated based on a static water pressure of at least 1 m above the door coaming.

5.2.1.4 All power driven doors are to be capable of being closed simultaneously from the bridge with the ship upright in not more than 60 seconds.

5.2.1.5 The closing speed of each individual door must have a uniform rate. Their closing time with power operation and with the ship upright may be not more than 40 seconds and not less than 20 seconds from the start of the motion with the door completely open until it is closed.

5.2.1.6 Power operated bulkhead closing systems may be fitted as an option with a central hydraulic drive for all doors or with mutually independent hydraulic or electric drives for each individual door.

5.2.1.7 The bulkhead closing system is not to be connected to other systems.

5.2.2 Central hydraulic system - power drives

5.2.2.1 Two mutually independent power pump units are to be installed if possible above the bulkhead or freeboard deck and outside the machinery spaces.

5.2.2.2 Each pump unit is to be capable of closing all connected bulkhead doors simultaneously.

5.2.2.3 The hydraulic system is to incorporate accumulators with sufficient capacity to operate all connected doors three times, i.e. close, open and reclose, at the minimum permitted accumulator pressure.

5.2.3 Individual hydraulic drive

5.2.3.1 An independent power pump unit is to be fitted to each door for opening and closing the door.

5.2.3.2 An accumulator is also to be provided with sufficient capacity to operate the door three times, i.e. close, open and reclose, at the minimum permitted accumulator pressure.

5.2.4 Individual electric drive

5.2.4.1 An independent electric drive unit is to be fitted to each door for opening and closing the door.

5.2.4.2 In the event of a failure of either the main power supply or the emergency power supply, the drive unit is still to be capable of operating the door three times, i.e. close, open and reclose.

5.2.5 Manual control

5.2.5.1 Manual control is to be capable of being operated at the door from both sides of the bulkhead as well as from an easily accessible control station located above the bulkhead or freeboard decks and outside the machinery space.

5.2.5.2 The controls at the door are to allow the door to be opened and closed.

5.2.5.3 The control above the deck is to allow the door to be closed.

5.2.5.4 The fully open door is to be capable of being closed using manual control within 90 seconds with the ship upright.

5.2.5.5 A means of communication is to be provided between the control stations for remote manual drive above the bulkhead of freeboard decks and the central control station on the bridge.

5.2.6 Indicators

The indicators described in 5.1.6 are to be installed at the operating stations for manual control above the bulkhead or freeboard deck for each door.

5.2.7 Alarms

5.2.7.1 While all the doors are being closed from the bridge, an audible alarm is to sound at each door. This alarm is to start at least 5 seconds - but not more than 10 seconds - before the door starts moving and is to continue right throughout the door movement.

5.2.7.2 When the door is being closed by remote control using the manual control above the bulkhead or freeboard deck, it is sufficient for the alarm to sound only while the door is actually moving.

5.2.7.3 The installation of an additional, intermittent visual alarm may be required in the passenger areas and in areas where there is a high level of background noise.

5.2.7.4 With a central hydraulic system, the minimum permitted oil level in the service tank is to be signalled by means of an independent audible and visual alarm at the central control station on the bridge.

5.2.7.5 The alarm described in 5.2.7.4 is also to be provided to signal the minimum permitted accumulator pressure of the central hydraulic system.

5.2.7.6 A decentralized hydraulic system which has individual drive units on each door, the minimum permitted accumulator pressure is to be signalled by means of a group alarm at the central control station on the bridge.

Visual indicators are also to be fitted at the operating stations for each individual door.

5.3 Cargo vessels

In addition to the specifications laid down in 5.1 the following requirements are to be observed for cargo vessels:

5.3.1 Manual control

5.3.1.1 The manual control is to be capable of being operated at the door from both sides of the bulkhead.

5.3.1.2 The controls are to allow the door to be opened and closed.

5.3.2 Alarms

Whilst all the doors are being closed from the bridge, an audible alarm is to be sounded all the time they are in motion.

6. Hoists

6.1 Definition

For the purposes of these requirements, hoists include hydraulically operated appliances such as wheelhouse hoists, lifts, lifting platforms and similar equipment.

6.2 Design

6.2.1 Hoists may be supplied either by a combined power station or individually by several power stations for each single lifting appliances.

In the case of a combined power supply and hydraulic drives whose piping system is connected to other hydraulic systems, a second pump unit is to be fitted.

6.2.2 The movement of hoists is not to be capable of being initiated merely by starting the pumps. The movement of hoists is to be controlled from special operating stations. The controls are to be so arranged that, as soon as they are released, the movement of the hoist ceases immediately.

6.2.3 Local controls, inaccessible to unauthorized persons, are to be fitted. The movement of hoists normally is to be visible from the operating stations. If the movement cannot be observed, audible and/or visual warning devices are to be fitted. In addition, the operating stations are then to be equipped with indicators for monitoring the movement of the hoist.

6.2.4 Devices are to be fitted which prevent the hoist from reaching its end position at excessive speed. These devices are not to cause the power unit to be switched off. As far as is necessary, mechanical means are to be provided for locking the hoist in its end positions.

If the locking devices cannot be observed from the operating station, a visual indicator is to be installed at the operating station to show the locking status.

6.2.5 3.1.3 is to be applied in analogous manner to those devices which, if the power unit fails or a pipe ruptures, ensure that the hoist is slowly lowered.

6.3 Pipes, hose assemblies

3.2 and 3.3 apply in analogous manner to the pipes and hose lines of hydraulically operated hoists.

7. Tests in the manufacturer's works

7.1 Testing of power units

The power units are required to undergo testing on a test bed. Manufacturer Test Report for this testing are to be presented at the final inspection of the hydraulic system.

7.2 Pressure and tightness tests

A.5.2 is applicable in analogous manner.

8. Shipboard trials

After installation, the equipment is to undergo an operational test.

The operational test of watertight doors has to include the emergency operating system and determination of the closing times.

G. Fire Door Control Systems

1. General

1.1 Scope

The requirements of G. apply to power operated fire door control systems on passenger vessels. These Rules meet the requirements for the control systems of fire doors laid down in Chapter II-2, Regulation 9.4 of **SOLAS 74** as amended. The following requirements may be applied as appropriate to other fire door control systems.

1.2 Documents for approval

The electric and pneumatic diagram together with drawings of the cylinders containing all the data necessary for assessing the system, e.g. operating data, descriptions, materials used, etc., are to be submitted in triplicate for approval.

1.3 Dimensional design

For the design of pressure vessels, see Section 8; for the dimensions of pipes, see Section 11.

2. Materials

2.1 Approved materials

Cylinders are to be made of corrosion resistant materials.

Stainless steel or copper is to be used for pipes.

The use of other materials requires the special agreement of GL.

The use of hose assemblies is not permitted.

Insulation material has to be of an approved type.

The quality properties of all critical components for operation and safety is to conform to recognized rules and standards.

2.2 Material testing

Suitable proof of the quality properties of the materials used is to be furnished. For parts under pressure Certificates according to Table 11.3, for all other parts Manufacturer Test Reports are required.

GL's Surveyor reserves the right to order supplementary tests of his own to be carried out where he considers that the circumstances justify this.

See Section 8, B. for details on the material testing of compressed air accumulators.

3. Design

3.1 Each door is to be capable of being opened and closed by a single person from both sides of the bulkhead.

3.2 Fire doors are to be capable of closing automatically even against a permanent heeling angle of the ship of 3,5°.

3.3 The closing time of hinged doors, with the ship upright, may be no more than 40 seconds and no less than 10 seconds from the start of the movement of the door when fully open to its closed position for each individual door.

The closing speed of sliding doors is to be steady and, with the ship upright, may be no more than 0,2 m/s and no less than 0,1 m/s.

Measures are to be taken to ensure that any persons in the door areas are protected from any excessive danger.

3.4 All doors are to be capable of being closed from the central control station either jointly or in groups. It also is to be possible to initiate closure at each individual door. The closing switch is to take the form of a locking switch.

3.5 Visual indicators are to be installed at the central control station to show that each fire door is fully closed.

3.6 Power driven doors leading from "special areas" (e.g. car decks, railway decks) in accordance with Chapter II-2, Regulation 3.46 of **SOLAS 74** as amended or from comparable spaces to control stations, stairwells and also to accommodation and service spaces and which are closed when the ship is at sea do not need to be equipped with indicators as described in 3.5 and alarms as described in 3.12.

3.7 Operating agents for the control system are to be installed next to each door on both sides of the bulkhead and by their operation a door which has been closed from the central control station can be re-opened. The controls are to return to their original position when released, thereby causing the door to close again.

In an emergency it is to be possible to use the controls to interrupt immediately the opening of the door and bring about its immediate closure.

A combination of the controls with the door handle may be permitted.

The controls are to be designed in such a way that an open door can be closed locally. In addition, each door is to be capable of being locked locally in such a way that it cannot longer be opened by remote control.

3.8 The control unit at the door is to be equipped with a device which will vent the pneumatic system or cut off the electric energy of the door control system, simultaneously shutting off the main supply line and thereby allowing emergency operation by hand.

3.9 The door is to close automatically should the central power supply fail. The doors may not reopen automatically when the central supply is restored.

Accumulator systems are to be located in the immediate vicinity of the door being sufficient to allow the door to be completely opened and closed at least ten more times, with the ship upright, using the local controls.

3.10 Measures are to be taken to ensure that the door can still be operated by hand in the event of failure of the energy supply.

3.11 Should the central energy supply fail in the local control area of a door, the capability of the other doors to function may not be adversely affected.

3.12 Doors which are closed from the central control station are to be fitted with an audible alarm. Once the door close command has been given this alarm is to start at least 5 seconds, but not more than 10 seconds before the door starts to move and continue sounding until the door is completely closed.

3.13 Fire doors are to be fitted with safety strips such that a closing door reopens as soon as contact is made with them. Following contact with the safety strip, the opening travel of the door is to be no more than 1 m.

3.14 Local door controls, including all components, are to be accessible for maintenance and adjustment.

3.15 The control system is to be of approved design. Their capability to operate in the event of fire is to be proven in accordance with the FTP-Code [1] and under supervision of GL.

The control system is to conform to the following minimum requirements.

3.15.1 The door still is to be capable of being operated safely for 60 minutes at a minimum ambient temperature of 200 °C by means of the central energy supply.

3.15.2 The central energy supply for the other doors not affected by fire may not be impaired.

3.15.3 At ambient temperatures in excess of 300 °C the central energy supply is to be shut off automatically and the local control system is to be de-energized. The residual energy is still to be sufficient to close an open door completely during this process.

The shut-off device is to be capable of shutting off the energy supply for one hour with a temperature variation corresponding to the standardized time-temperature curve given in Section II-2, Regulation 3 of **SOLAS 74** as amended.

3.16 The pneumatic system is to be protected against overpressure.

3.17 Drainage and venting facilities are to be provided.

3.18 Air filtering and drying facilities are to be provided.

3.19 For details of the electrical equipment cf. Chapter 3 – Electrical Installations, Section 14, D.

4. Tests in the manufacturer's works

The complete control system is to be subjected to a type approval test. In addition the required construction according to 2. and 3. and the operability have to be proven for the complete drive.

5. Shipboard trials

After installation, the systems are to be subjected to an operating test which also includes emergency operation and the verification of closing times.

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[1] IMO Res. MSC. 61(67)

H. Stabilizers

1. General

1.1 Scope

The requirements contained in H. apply to stabilizer drive units necessary for the operation and safety of the ship.

1.2 Documents for approval

Assembly and general drawings together with diagrams of the hydraulic and electrical equipment containing all the data necessary for checking are to be submitted in triplicate for approval.

2. Design

A.2.1.3 and A.2.1.4 are applicable in analogous manner to the pipe connections of hydraulic drive units.

3. Pressure and tightness test

A.5.2 is applicable in analogous manner.

4. Shipboard trials

The operational efficiency of the stabilizer equipment is to be demonstrated during the sea trials.