RULES FOR STATUTORY SURVEY OF SEA-GOING SHIPS

PART VI
LIFTING APPLIANCES

January
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GDAŃSK

RULES FOR STATUTORY SURVEY OF SEA-GOING SHIPS developed and published by Polski Rejestr Statków S.A., hereinafter referred to as PRS, consist of the following parts:

Part I – Survey Regulations
Part II – Life-saving Appliances
Part III – Signal Means
Part IV – Radio Installations
Part V – Navigational Equipment
Part VI – Lifting Appliances.

Part VI – Lifting Appliances, January 2020, of the *Rules for Statutory Survey of Sea-going Ships* was approved by the Executive Board of PRS S.A. on 17 December 2019 and enters into force on 1 January 2020.

Since the date of entry into force, the requirements specified in *Part VI* apply to all ships flying the Polish flag who are under PRS statutory survey.

For ships flying flags other than Polish who are under PRS statutory survey, this *Part VI* may be used as the set of recommendations and guidelines unless the Flag State Administration considers it as the rules.

This *Part VI* replaces the *Rules for Lifting Appliances, 2017* of the *Rules for Statutory Survey of Sea-going Ships*.

* *Polish Register of Shipping means Polski Rejestr Statków S.A., seated in Gdańsk, al. gen. Józefa Hallera 126, 80-416 Gdańsk, Poland,* registered in the Register of Entrepreneurs of the National Court Register, under entry number 0000019880. Polish Register of Shipping, its affiliates and subsidiaries, their respective officers, employees or agents are, individually and collectively, referred to as Polish Register of Shipping or as PRS for short.

PRS/RP, 12/2019

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1 GENERAL

1.1 Application

1.1.1 *Part VI – Lifting Appliances* applies to the arrangements specified in 1.3.2 installed onboard the ship, other vessels as well as fixed and mobile offshore drilling units flying the Polish flag intended for loading, unloading and moving cargoes from one postion to another and also for transporting persons.

1.1.2 The requirements of this *Part* of the *Rules* also apply to loose gear of lifting appliances which forms permanent equipment of ships.

1.1.3 For ships flying flags other than Polish who are under PRS statutory survey, this *Part VI* may be used as the set of recommendations and guidelines unless the Flag State Administration considers it as the rules.

1.1.4 The possibility for application of lifting appliances not covered by the requirements of this part of the *Rules* or appliances intended for service in special conditions not defined in *Part VI* is subject to PRS consideration in each particular case.

1.1.5 It is recommended that lifting appliances on existing ships or ships under construction on the date of entering into force of this *Part* of the *Rules* fulfil the requirements of the *Rules* to the extent as wide as practicable.

1.2 Definitions

Definitions of general terminology used in the *Rules for Statutory Survey* are contained in *Part I – Survey Regulations*.

For the purposes of *Part VI*, the following definitions have been adopted:

Deck crane – lifting appliance for load lifting which operates without a system of ropes and blocks fixed outside its own structure.

Boom derrick – ship cargo handling gear for sustaining and moving a load with boom and system of wire ropes and blocks fixed to masts, columns, decks and winches.

Effective radius – distance between the lifted load gravity centre and the ship side plane or pontoon transom at its horizontal draft.

Fittings – components of lifting appliances subjected to loads and ensuring which mobile joints, except for the components of machinery.

Goods lift – lift unit designed solely for the vertical transport of cargoes.

Goods passenger lift – lift unit designed solely for non-simultaneous transporting of goods or persons except that transporting of persons engaged in loading and unloading the goods is permitted.

Heavy boom derrick – boom derrick of lifting capacity 25 t and above with a single span.

Hoist – underslung winch, powered tackle or hand-operated tackle fixed on board the ship.

Interchangeable gear – any elements connected to the lifting appliance structure by detachable means. These elements, such as blocks, hooks, shackles, swivels, chain cables, links, rings, turnbuckles etc., are interchangeable between the lifting appliances.

Lift – lifting appliance designed for transporting of persons or goods in the lift car moving in the vertical trunk fitted with doors. In vessels the trunk may deviate from the vertical within the limits specified in 6.1.5.1.

Lifting appliance – any stationary or mobile appliances including power-driven quay-supported ramps used on board the ship for lifting, descending or transporting a load from one location to another where the load is underslung or supported.

Light boom derrick – boom derrick of lifting capacity less than 25 t with a single span.

Load test weights – weights used for load tests whose mass is certified with accuracy ±2%.

Loose gear – hooks, rings, shackles, links, traverses, lifting beams, container spreaders, rope slings etc. by means of which a load can be attached to a lifting appliance and which does not form an integral part of the appliance or load.

Radius – distance between the lifted load gravity centre and the vertical axis of crane slewing.

Passenger lift – lift unit designed solely for vertical transporting of persons.

Permanently attached gear – lugs, clamps, bearing rings and similar components of a lifting appliance permanently attached to booms, masts, decks, superstructures or other parts of the ship.

Powered derrick – derrick whose loaded boom may be lifted, descended and slewed by means of winches forming an integral part of the appliance or used solely for this purpose.

Safe working load (SWL) of lifting appliance – the maximum load including the weight of loose gear (slings, traverses, pallets, nets, etc. as well as grabs, electromagnetic grabs, bins and other containers) which the appliance is approved to lift and move.

Safe working load (SWL) of loose equipment, exclusive of pulley blocks, is the load that each piece of such equipment may be subjected to by an underslung cargo of specified weight or by imposing an equivalent load resulting from the cargo weight.

Safe working load (SWL) of a pulley block is the maximum load which the block eye is approved to lift.

Safe working load (SWL) of a single block without an eye is half the safe working load (SWL) which the block eye is approved to lift.

Safe working load (SWL) of a single block with an eye is a third of the safe working load (SWL) which the block eye is approved to lift.

Telescopic, hydraulic deck crane – a lifting appliance used for lifting cargo, operating without the system of ropes and blocks mounted outside the structure, lowered, folded and rotated by means of cylinders or hydraulic cylinders integrated with the equipment and hydraulic system.

The terminology used in *Part VI* of the *Rules* is given in figures from 1.2.1 to 1.2.4. Rigging patterns shown in those figures reflect typical solutions and are provided for reference only.

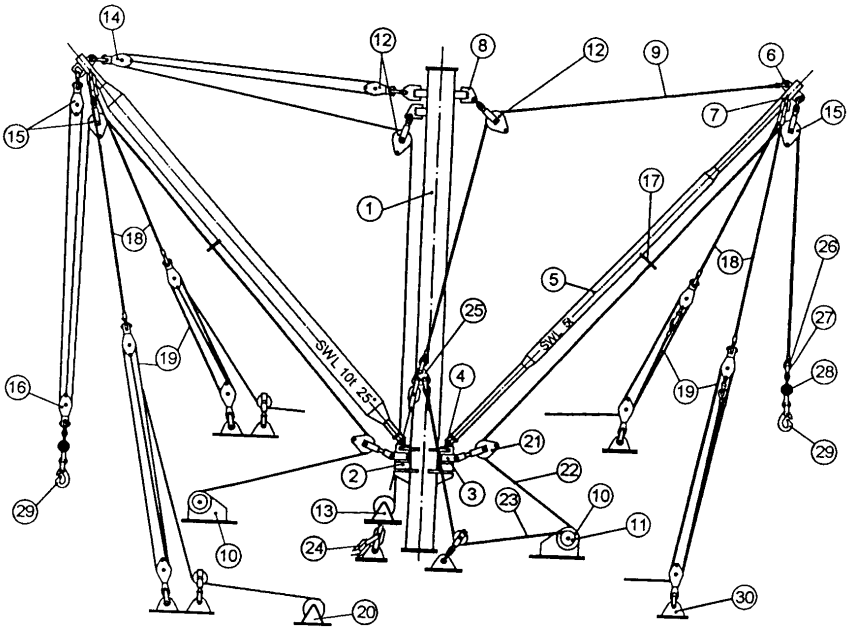


Fig. 1.2.1 Rigging of single-span derrick for light and heavy cargoes

1 – column,
2– boom bearing,
3– runner lead block bracing,
4– boom heel double lug fitting,
5– cargo boom,
6 – flat boom bracket,
7– guy boom bracket,
8 – topping lift column bracket,
9 – topping lift,
10 – cargo winch,
11 – cargo winch side head,
12 – topping lift block,
13 – span winch,
14 – topping lift lower block,
15 – head block,
16 – heel block,
17 – runner guide,
18 – guy penant,
19 – guy tackle,
20 – guy winch,
21 – heel block,
22 – runner,
23 – topping lift pulling line,
24 – topping lift chain,
25 – span triangular plate,
26 – thimble,
27 – shackle,
28 – ball weight with swivel,
29 – cargo hook, 30 – bracket

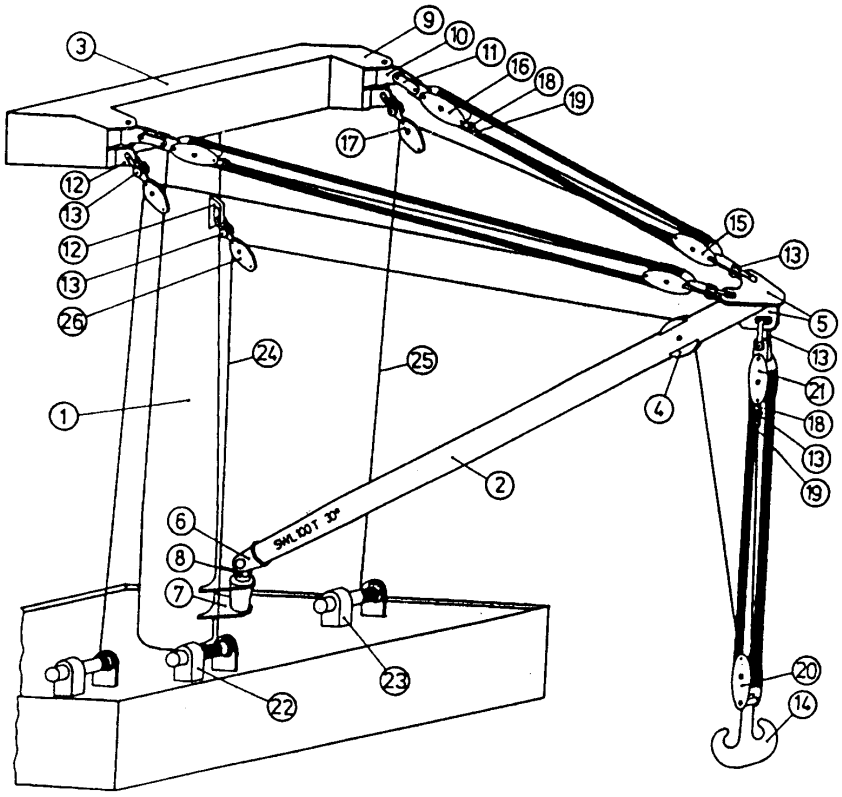


Fig. 1.2.2 Twin span derrick rigging

1 – crane mast,
2 – crane boom,
3 – cross tree,
4 – built-in sheave,
5 – crane head fitting,
6 – boom heel fitting,
7 – gooseneck bearing,
8 – gooseneck,
9 – span bearing,
10 – span trunnion piece,
11 – connecting piece,
12 – oval eye plate,
13 – C-shackle,
14 – cargo hook with swivel,
15 – lower span tackle block,
16 – upper span tackle block,
17 – span lead block,
18 – becket,
19 – ferrule secured with thimble,
20 – lower cargo block,
21 – upper cargo block,
22 – cargo winch,
23 – span winch,
24 – cargo runner,
25 – span rope,
26 – cargo lead block.

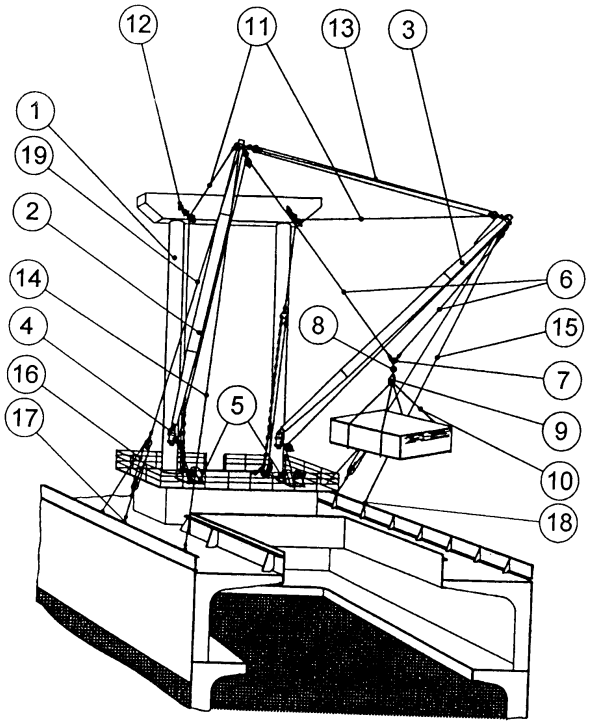


Fig. 1.2.3 Crane booms in union purchase with guywinches

1 – portal mast,
2 – hatch boom,
3 – outboard crane boom,
4 – gooseneck trunnion,
5 – cargo winches,
6 – cargo runners,
7 – triangular plate,
8 – ball weight with swivel,
9 – cargo hook,
10 – sling,
11 – span ropes,
12 – span rope column bracket,
13 – schooner guy,
14 – preventer guy,
15 – preventer guy,
16 – guy tackle,
17 – bracket,
18 – preventer guy bracket,
19 – guy pendant

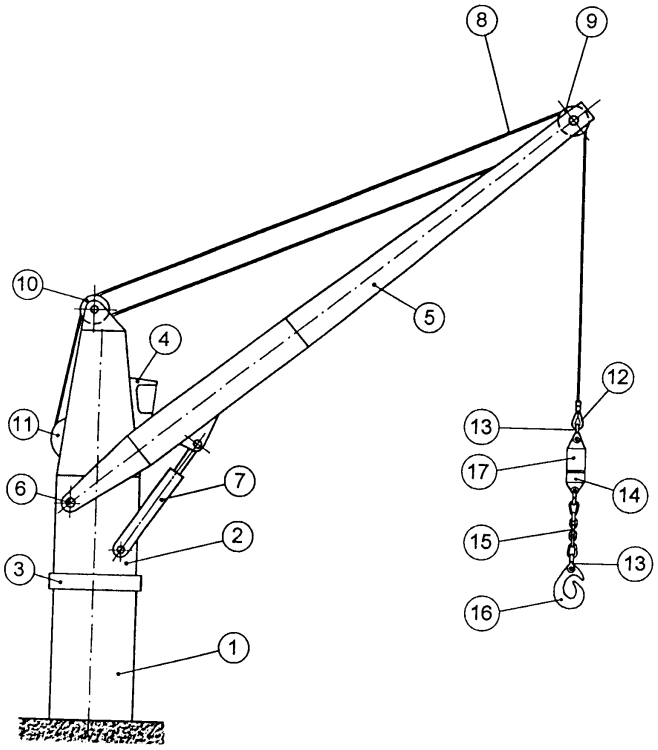


Fig. 1.2.4 Slewing crane

1 – crane pedestal,
2 – slewing column,
3 – slewing circle assembly,
4 – operator's cabin,
5 – jib,
6 – jib foot bearing,
7 – luffing cylinder,
8 – runner,
9 – boom point sheave assembly,
10 – runner sheave assembly on slewing column,
11 – cargo winch,
12 – thimble,
13 – shackle,
14 – swivel,
15 – short link chain,
16 – cargo hook,
17 – rope weight.

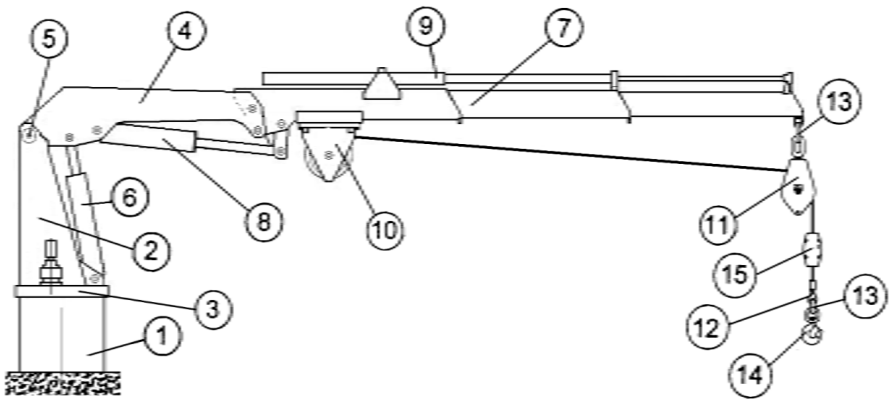


Fig. 1.2.5 Telescopic deck crane

1 – crane pedestal,
2 – slewing column,
3 – slewing circle assembly,
4 – jib I,
5 – jib foot bearing I,
6 – luffing cylinder I,
7 – telescopic jib,
8 – telescopic jib cylinder,
9 – telescopic mechanism cylinder,
10 – rope (runner) winch,
11– removable block,
12 – thimble,
13 – shackle
14 – swivel hook,
15 – rope (runner) weight.

1.3 Scope of Survey

1.3.1 General principles of the survey forms, the documentation required, types and scopes of surveys are specified in *Part I – Survey Regulations* of the *Rules for Statutory Survey of Sea-going Ships*.

1.3.2 The following lifting appliances are subject to PRS survey:

.1 cranes, overhead cranes, winches, hoists of lifting capacity 1 t and above;
.2 floating cranes and cranes installed on floating docks of lifting capacity 1 t and above;
.3 cranes on off-shore drilling units;
.4 goods lifts of lifting capacity 150 kg above except hand-operated ones;
.5 goods passenger lifts and passenger lifts, irrespective of their lifting capacity;
.6 vehicle lifts;
.7 ramp operating arrangements;
.8 mobile cranes of lifting capacity 1 t and above which form permanent equipment of ship, vessel or drilling unit.

Following a special agreement, PRS may also survey a lifting appliance of different purpose, smaller lifting capacity or type different from the above mentioned.

1.3.3 PRS survey activities of a lifing appliance covers:
- **.1** consideration and approval of technical documentation;
- **.2** survey of construction (manufacture), installation on board the ship (vessel) and repair;
- **.3** inspections and tests;
- **.4** stamping;
- **.5** issuing relevant PRS documents and extending their validity.

1.3.4 The subject of PRS survey are:
- **.1** For boom derricks:
  - steel load-bearing structures;
  - winches and span rope drums;
  - fittings and ropes;
- **.2** for other lifting appliances than those listed in .1:
  - steel load-bearing structures;
  - mechanisms, brakes, drives;
  - fittings and ropes;
  - protecting devices;
- **.3** electrical equipment of lifting appliances;
- **.4** machinery driving arrangement;
- **.5** boilers and pressure vessels forming componenets of lifting appliances;
- **.6** piping of lifting appliances;
- **.7** for lifts (in addition to the requirements specified in items from .2 do .6):
  - trunks with their fittings,
  - cars and counterweights with their equipment,
- **.8** loose gear of lifting appliances which form permanent equipment of ships.

1.3.5 The survey of lifting appliances is beyond the scope of the classification survey of a ship or vessel.

1.3.6 The survey of boom derricks, deck cranes and hoists on board the factory ships and fishing vessels as well as union purchase stationary booms for common operation with another ship is performed like the survey of ordinary lifting appliances for cargo handling operations, i.e. PRS does not participate in determination of the lifting capacity necessary for working together with fishing arrangements as this falls within the ship owner's responsibility.

1.3.7 The survey of powered boom derricks, overhead cranes and hoists is performed like for deck cranes, whereas the survey of tackle hoists (e.g. jumper, gording, gin) – like for boom derricks.

1.3.8 The survey of machinery, its hydraulic and steam drive arrangements, piping, electric equipment, materials as well as associated boilers and pressure vessels in the scope not covered by the requirements of this *Part* of the *Rules* is performed in accordance with the applicable requirements specified in the relevant parts of the *Rules for Classification and Construction of Sea-going Ships*.

If, however, the requirements specified in this part of the *Rules* are equivalent or different from those contained in the *Rules for Classification and Construction of Sea-going Ships*, then the requirements of this part of the *Rules* prevail.

1.4 Technical Documentation

Prior to commencement of the manufacture of lifting appliances covered by the requirements specified in this part of the *Rules*, the following documentation shall be submitted to PRS Head Offcie for approval:

1.4.1 Boom Derricks' System:

.1 general arrangement plan showing the positions of slewing boom derricks, heavy boom derricks and their operating ranges;
.2 drawing of rigging for each boom derrick clearly showing reeled ropes, strip number in a tackle and positions of specific components of interchangeable gear;
.3 diagram of forces acting on each boom derrick element (boom, mast, column, mechanisms, fittings, ropes), strength calculations for the fixing arrangements of mast, column and boom securing on voyage;
.4 design drawings of masts, columns and booms together with their strength and stability calculations;
.5 detailed drawings of boom bearings, mast fittings, guy fittings etc.;
.6 for operation in union purchase – instructions for operation of booms which specifies the boom working range, SWL for boom pairs as well as type, dimensions and arrangement of rigging to synchronize booms in union purchase operation;
.7 list of used blocks, chain cables, shackles, hooks etc. containing: material grade, safe working load (SWL), proof load, standard according to which particular elements are made;
.8 list of steel wire and fibre ropes including their nominal diameter, structure, nominal yield strength of wire and rope breaking load;
.9 material specifications for steel intended for masts, booms and associated fixing devices and welding procedure;
.10 technical documentation of machinery components and their drives covering:
- sectional assembly drawings;
- drawings of shafts, gear wheels, rope drums, brakes and clutches;
- drawings of seating frames and the associated regions of hull including welding particulars;
- strength calculations of load-bearing parts or their results;
- machinery test programme;
- technical characteristics;
- hydraulic system diagrams;
- description of safety protective arrangements (limit switches, load limit controls, alarm system, etc.);

.11 electric equipment technical documentation covering:
- operating description and main characteristics;
- list of such components as machinery, apparatus and materials;
- assembly drawings;
- electric drive diagram indicating its essential components;
- test programme.

1.4.2 Deck Crane System:

.1 general arrangement plan showing the positions of deck cranes and their working ranges;
.2 assembly drawing of cranes indicating their machinery components and safety arrangements;
.3 drawings of all the load-bearing structure elements covering jib, slewing column, turret, platform, gate, trucks, slewing circle assembly, post, foundation, means of securing on voyage, etc. together with their strength calculations (or with the proof that these structural elements are equivalent to those made in accordance with the standards accepted by PRS) and their welding procedure;
.4 detailed drawings of rope sheaves, axes, pins, rail wheels, running frames, slewing circle assembly including its bearing screws, etc.;

.5 list of applied blocks, chain cables, shackles, hooks etc. indicating the material grade, SWL, proof load, standard in accordance with which a particular element is made;
.6 list of ropes indicating nominal diameter, workmanship and structure as well as the required minimum breaking load;
.7 specification of the steel used for the construction of crane structural elements;
.8 technical documentation of machinery components and their drives covering:
- assembly drawings;
- drawings of shafts, gear wheels, rope drums, brakes and clutches together with their strength calculations;
- diagram of hydraulic system indicating its components;

.9 electirical equipment technical documentation covering:
- operating description and main characteristics;
- electric drive diagram indicating its essential components together with their specifications;
- test programme.

1.4.3 Lifts

.1 technical characteristics;
.2 lift general view;
.3 diagram of forces acting on the lift elements together with their strength and stability calculations;
.4 drawing of the engine room and its trunk; drawings of the trunk doors, guide rails and buffers showing details of their fixing arrangements; drawings of cars and counterweights showing details of their suspension; drawings of load bearing strands and rope suspension devices together with their strength calculations. For elements made in compliance with PRS-accepted standards, strength calculations are not required;
.5 drawings of safety protective arrangements;
.6 technical documentation of winches covering:
- technical characteristics;
- drawings of shafts and worms, gear wheels, wormwheels, drums, friction disk and pulleys under load;

.7 electirical equipment technical documentation covering:
- operating description and main characteristics;
- electric drive diagram indicating its essential components and the lift control diagram;

.8 test programme;
.9 list of spare parts
.10 lift operating and maintenance instructions.

1.4.4 Vehicle Lifts

.1 technical characteristics;
.2 assembly drawing of the lift and its driving system assemblies;
.3 diagram of forces acting on the lift load-bearing structure elements and their driving system assemblies during its operation and standstill, together with strength and stability calculations;
.4 drawings of lift components, together with their fixing arrangements as well as drawings of the lift driving system assemblies including the material grades;
.5 list, technical characteristics and drawings for safety protective arrangements and alarm system;
.6 hydraulic system diagram, if any;

.7 electric drive diagram indicating its essential components and the lift control diagram;
.8 onboard test programme;
.9 list of assemblies and spare parts.

1.4.5 Ramp Operating Arrangements

.1 assembly drawing of the ramp operation gear;
.2 drawings of pulleys and their fixing arrangements;
.3 calculations determining: rated characteristics, loads induced by vehicles, wheel centres, wheel tracks, working load capacity and angles, design load specification and the components' centres of gravity;
.4 particulars of frames of the hydraulic systems and drive systems, if any;
.5 rigging system;
.6 diameter, structure, workmanship and certified breaking load for ropes and chain cables;
.7 material specifications of steel used for the load-bearing structure;
.8 drawings of gear wheels, shafts, clutches, brakes, connecting bolts, welded drums and similar winch components together with material specifications and design stresses;
.9 drawings of the means of securing in stowed position;
.10 diagrams of hydraulic or pneumatic systems, if any;
.11 electric drive diagram indicating its essential components, working current, electric equipment rated characteristics as well as types and cross-sectional areas of cables.

1.4.6 Overhead Cranes

.1 technical characteristics;
.2 assembly drawing together with the detailed list of its machinery components and safety protective arrangements;
.3 drawings of all the load-bearing structure components, together with their strength calculations and load-bearing structure welding procedure;
.4 technical documentation of the machinery components and their drives covering:
- assembly drawings;
- drawings of shafts, gear wheels, rope drums, brakes and clutches together with their strength calculations,
- diagram of hydraulic or pneumatic system, together with the specification of their components;

.5 electric equipment technical documentation covering:
- operating description and main characteristics;
- electric drive diagram indicating its essential components;
- test programme;

.6 drawing of the means of securing in stowed position;
.7 programme of factory tests and shipboard tests.

1.4.7 Winches and Hoists

.1 technical characteristics;
.2 assembly drawing together with the detailed list of its machinery components and safety protective arrangements;
.3 drawings of all the load-bearing structure components together with their strength calculations and load-bearing structure welding procedure;
.4 technical documentation of the machinery components and their drives covering:
- assembly drawings;
- drawings of shafts, gear wheels, rope drums, brakes and clutches together with their strength calculations,

- diagram of hydraulic or pneumatic system, together with the specification of their components;

.5 electric equipment technical documentation covering:
- operating description and main characteristics;
- electric drive diagram indicating its essential components;
- test programme;

.6 drawing of the means of securing in stowed position;

.7 programme of factory tests and shipboard tests.

1.4.8 Technical documentation of lifting appliances mentioned in paragraphs from 1.4.1 to 1.4.7 may be submitted to PRS separately (irrespective of the technical documentation of ship, vessel or off-shore drilling unit), in that case, however, the type and intended service of such a ship, vessel or off-shore drilling unit shall be indicated.

1.4.9 For the machinery, fittings and equipment made in compliance with PRS-accepted standards, their documentations need not be submitted to PRS.

1.4.10 In justified cases the scope of documentation to be submitted to PRS may be extended at PRS discretion. The scope of documentation may also be reduced provided that the supplied documentation contains all the information necessary for the technical safety assessment of the equipment in question.

1.4.11 PRS may require the strength calculations of the ship structure and hull strengthening in way of masts, columns, derricks, cranes, winches, hoists and fittings.

1.4.12 In case of modification to the lifting appliances, the technical documentation relevant to the scope of such modification shall be submitted.

1.4.13 On reporting to the Initial Survey of lifting appliances constructed without PRS survey, the technical documentation together with the calculations in the scope specified in paragraphs from 1.4.1 to 1.4.7, shall be submitted.

In special cases, PRS may agree to reduce the scope of documentation required, taking account of the documents supplied by factories and technical supervision bodies recognized by PRS.

1.5 General Technical Requirements

1.5.1 General Requirements

1.5.1.1 Construction, dimensions, and technical condition of lifting appliances shall ensure the transport of suspended cargo in compliance with the design characteristics specified in this *Part* of the *Rules* (vessel's heel and trim, wind pressure, etc.) and the intended working parameters in the anticipated operating areas.

Loads occuring at an intended runner deflection from the vertical and induced by neither vessel inclination nor forces of inertia due to the lifting appliance operation nor the swinging cargo, shall be taken into account separately and indicated in the documentation submitted to PRS.

1.5.1.2 I.C. and steam engines, hydraulic motors, installations and piping, as well as electric equipment not covered by specific requirements of this *Part* of the *Rules* shall fulfil the requirements specified in sub-chapter 1.16 of *Part VI – Machinery Installations and Refrigerating Plants*, chapters 6 and 7 of *Part VII – Machinery, Boilers and Pressure Vessels*, as well as *Part VIII – Electrical Installations and Control Systems* of the *Rules for Classification and Construction of Sea-going Ships*.

1.5.1.3 Construction of lifting appliances on open decks shall ensure their safe service in the intended working range at heels and trims as specified in Table 2.5.2.3 and in the anticipated ambient temperatures.

Unless the customer has specified the interval of ambient temperatures, this shall be agreed by the design engineer with PRS. It is recommended that the interval be determined taking account of the vessel operating area and the lifting appliance location onboard the vessel, and for the offshore drilling unit from –25° C to +45° C, and for electrical equipment from –25° C do +55° C (see 2.2.4).

1.5.1.4 Axes and pins supporting revolving assemblies and elements shall be effectively secured against revolution and axial displacement. The securing elements shall be so designed as not to be damaged by the reactive forces.

Guiding and running rollers installed on pins as well as fixed rope ends securing the rope to the structure shall be effectively secured against axial displacement. Securing elements which bear axial forces shall not be loaded by pin-born forces.

All points to be lubricated shall be so arranged as to make their service safe and convenient.

1.5.1.5 All screw joints, keyed joints and cotter joints of lifting appliances shall be secured against loosening and disconnection.

1.5.1.6 Interchangeable gear and loose gear shall be so secured as to avoid their bending or torsion this being achieved by the use of swivels. Swivels with ball bearings or roller bearings capable of being lubricated are permitted. Loaded swivels shall turn freely.

1.5.1.7 Arrangement of pulleys, blocks and the arrangements for rope fixing to the steel structure shall be such as to prevent ropes from falling off the pulleys or drums as well as rubbing against each other or the steel structure. Rope fixing arrangements shall be so designed as to withstand the maximum static proof load.

1.5.1.8 Rope ends fixed to the steel structure or fittings may be provided with the following rope end fittings:
- braid rope plaited on a thimble;
- braid rope plaited on a thimble with its end gripped in pressed clamp;
- rope poured in a conical socket;
- rope fitted in a socket with self-locking wedge additionally fitted with at least one rope socket.

The rope end fittings shall comply with the standards recognized by PRS and their dimensions shall correspond to the rope diameter and breaking load.

Cast and pressed joints may only be effected by workshops approved by PRS for such operations.

Rope ends fixed to winch drums need not have thimbles or sockets.

1.5.1.9 The actual load breaking the rope end provided with socket shall not be less than 90% of bare rope breaking load.

In case of doubts, PRS surveyor may require fulfilment of this condition to be demonstrated by relevant load tests.

1.5.1.10 The actual load breaking the end of ropes connected to interchangeable gear or loose gear shall not be less than the rope breaking load.

1.5.1.11 Cargo hooks, grab links and other load-handling devices underslung to a single runner shall be so installed as to enable their turning when loaded. It is recommended that rolling bearings be applied.

1.5.1.12 Design of mechanisms of lifting appliances with the drive capable of being disengaged shall preclude the fall of cargo and spontaneous motion of the lifting appliance or its movable components after the drive has been disengaged.

Mechanisms with hydraulic drive shall be provided with a means to preclude the fall of cargo and spontaneous motion of the lifting appliance or its movable componenets in case of the hydraulic oil pressure drop.

1.5.1.13 Lifting and derricking mechanisms shall be so designed that lowering the cargo or boom or jib at normal operation of the appliance be possible only by the use of its drive.

The hoisting mechanism shall be provided with a means to safely lower and put the underslung cargo in case of the control unit failure or power failure.

This requirement shall also be fulfilled by the derricking mechanisms if their stability or the stability of vessel on unprotected waters may be impaired.

1.5.1.14 If the cargo winch is provided with a variable gear and the gear stick neutral position enables free revolutions of the drum, brake shall be fitted on the drum side in accordance with the requirements specified in paragraph 1.5.3.4. The gear stick shall be fitted a locking device to preclude the gear disengagement during the cargo handling operations.

1.5.1.15 For boom derricks and hoists intended for the working together with fishing arrangements, other deck machinery may be used where the runner is laid on the machinery item head in coils and its end is kept in hand while working with the fishing arrangement.

In that case, the rope shall be fixed to the head (in accordance with the requirement of 1.5.1.8). The deck machinery used so is subject to the relevant requirements of this *Part* of the *Rules*.

1.5.2 Rope Drums

1.5.2.1 Winch drums shall be so designed, made and situated that the rope be protected against being worn out prematurely and be accommodated on the drum.

1.5.2.2 The minimum diameter of drum measured under the first rope tier shall not be less than the value determined in accordance with the following formula:

$$D_{i_{min}} = \chi_i \quad \frac{R_m}{1770} d_l, \text{ [mm]} \qquad (1.5.2.2)$$

$D_{i_{min}}$ – miminum diameter of drum or pulley, [mm],
R_m, – rope wire tensile strength, [MPa],
d_l, – rope diameter, [mm],
χ_i – ratio of drum or pulley diameter to rope diameter taken in accordance with table 1.5.2.2,
$\chi_i = \chi_b$ – for drum,
$\chi_i = \chi_l$ – for pulley.

Table 1.5.2.2

Ratio χ_i				
Item	Service conditions	χ_b for drums		χ_1 for pulleys
		with groove	without groove	
1	Unloaded ropes	13.5	11.5	10.5
2	Loaded ropes used at a speed $V_K \leq 0.67$ m/s and in not more than 16 load cycles per hour	18	14	16
3	Loaded ropes used at a speed $V_K > 0.67$ m/s and in not more than 16 load cycles per hour	22	18	20
4	Shipboard derricks of service groups K_{21}, K_{21a}, K_{31}, K_{31a}, without grab use	22	18	20
5	Grab cranes	28	18	24
6	Multirope grab cranes	28	22	31.5

1.5.2.3 Grooved drums shall have such a length that the total length of rope be reeled in not more than 3 tiers. Subject to PRS consent in each particular case, the rope may exceptionally be reeled in more than 3 tiers on winch drums of heavy boom derricks and twin span cranes provided that the crane is fitted with a device to lay or press the rope to the drum and the angle of incoming or outgoing rope is not more than 2°.

1.5.2.4 Smooth drums may have such a length that the total working length of rope be reeled in one tier only.

1.5.2.5 Drums with multitier arrangement of ropes as well as smooth drums shall have flanges on both sides higher than the rope top tier by at least 2.5 the rope diameter.

Drums with a roller guide for the single-tier reeling of rope shall be provided with rim on the side corresponding to the rope reeling direction unless other measures have been taken to prevent the rope whip-back.

1.5.2.6 The direction for the rope reeling on drum shall be marked unambigously.

Drums, on which the rope may be shifted (loosened or pulled off the drum), as a result of being loaded, shall be provided with the respective preventive device.

1.5.2.7 The number of rope coils remaining on a grooved drum shall not be less than 2, and on the smoooth drum – not less than 3.

The rope shall be fixed to the drum by means of self-locking wedge or by means of at least two shape-locked clamps.

The rope fixing arrangement shall withstand the maximum static load of rope corresponding to the proof load. For floating cranes, however, the rope fixing arrangement shall withstand at least 2.5 times the rope load taking account of the two redundant coils on drum and the friction factor 0.1 between the rope and drum.

1.5.2.8 Each drum shall be so situated as to ensure the correct reeling of rope. Rope instantaneous deflection angle from the groove shall not exceed 1:15. For smooth drums rope instantaneous deflection angle shall not exceed 1:20. Exceptionally, greater deflection may be permitted by PRS after the correct rope reel-off has been demonstrated.

It is recommended that each rope drum which is out of the operator's sight during its operation be provided with a suitable device to ensure the correct rope reeling and positioning on drum.

1.5.3 Brakes

1.5.3.1 Each mechanism of lifting appliance shall be provided with a brake or braking device which:
- is capable of stopping all movements of the lifting appliance under the rated load; the concurrent inertial forces shall not exceed the values specified in paragraph 2.5.2.4 for the strength calculations;
- is capable of holding the cargo and lifting appliance under load occurring in their positions (e.g. due to the force of gravity, wind pressure as well as hull list and movements).

The mechanisms and their foundations shall have sufficient strength to safely withstand the forces occurring while stopping.

1.5.3.2 Drum winches are permitted to be provided with such braking devices as:
- automatic brakes (i.e. locked in the released position);
- hydraulic elements associated with devices preventing the drop cargo of cargo, jib or boom.

Such devices shall operate in case:
- the steering stick has been set in the neutral position;
- any safety cut-out switch has been activated;
- of power break, including the loss of power supply or significant power decay.

1.5.3.3 Winch brake torque in the immobile position of lifting appliance under the rated load shall fulfil the following criterionu:

$$M_H > \left(1 + \frac{\psi_i}{2.2n}\right) M_{na} \qquad (1.5.3.3)$$

M_H – required brake torque, [Nm],
M_{na} – moment loading the brake shaft due to the maximum static load of drum rope, [Nm],
Ψ_i – hoist load coefficient to be determined in accordance with table 5.1.3.6.5,
n – number of brakes operated simultaneously.

1.5.3.4 Brakes which are locked in the released position shall be used unless otherwise specified elsewhere in this *Part* of the *Rules*.

Brakes shall provide for smooth stopping as well as have simple and readily accessible adjustment devices and also enable easy replacement of their friction linings/pads. The design friction torque of brake shall not be readily variable by simple means.

1.5.3.5 The force necessary to control brakes shall not exceed 160 N for manual operation or 300N for foot operation.

For brakes used frequently in their normal mode of service, the value necessary to control such brakes shall be half as much as the above specified values.

Brake pedal surface shall not be slippery.

1.5.3.6 Manual operated brakes not tightened in the released position shall be provided with means of their tightening in the stopped state. Weights shall not be used to induce braking torque. A compression spring in suitable guides shall be used for that purpose.

1.5.3.7 The brake between a motor and gear box shall be installed on the gear box shaft.

1.5.3.8 Where several mechanisms are driven by one drive and individual mechanisms may be disconnected from the drive, each of such mechanisms shall be provided with a brake.

1.5.3.9 Brake drum shall be protected from weather, sea water, snow, ice, grease and oil unless it has been designed for service in such conditions.

1.5.3.10 Electromagnetic release coil power supply shall be so arranged as to preclude inadvertent supply caused by the motor's generator operation, stray currents or insulation breakdown.

1.5.3.11 Lifting and derricking mechanisms of the lifting appliances intended for lifting explosive or poisonous cargoes as well as acids and other cargoes considered dangerous shall be provided with two independent automatic brakes, tightened in the released position to ensure retaining the cargo (jib/boom) in case of power failure. The brakes may operate non-simultaneously.

Where a clutch is installed between motor and gear box, the brake shall be installed on the clutch part on the gear box side or on the gear box shaft. The other brake may be installed on the motor shaft or elshwere on the driving mechanism.

Brakes shall be so designed as to enable making one brake inactive readily in order to check the correct operation of the other brake.

Lifting and derricking mechanisms with hydraulic cylinders are not required to be provided with another arrangement equivalent to the other brake.

1.5.3.12 Manually operated lifting mechanisms shall be provided with automatic brakes activated by the weight of lifted cargo or with the so called safety crank which combines a crank, ratchet and brake.

Manually operated lifting appliances shall be so designed that one operator's force needed for operating the appliance does not exceed 160 N. For manual chain cable operation, means shall be provided to prevent the chain cable from falling off the sprocket projections.

1.5.4 Means of Control

1.5.4.1 Means of control for the mechanisms of lifting appliances shall be so arranged that the movement direction of handle, lever or handwheels corresponds to the movement direction of cargo. Therefore, handwheel clockwise movement shall correspond to cargo lifting, radius reduction (boom lifting) or turning right; vertical lever pulling or horizontal lever lifting shall correspond to cargo lifting or radius reduction; whereas lever tilting right shall correspond to turning right.

1.5.4.2 Handles, levers and handwheels shall be so designed as to ensure that their position be maintained automatically in the neutral position as well as in work positions (at gradual adjustment) and their specific positions shall be marked (see 1.5.4.7). Automatic maintaining of the neutral position or work positions of a means of control is understood as the condition that a greater force is required to leave the current position than the force required to move that means of control.

Means shall also be provided to lock handles, levers and handwheels in neutral position.

Handles, levers, handwheels and pedals shall be so arranged as to ensure their convenient operation.

1.5.4.3 Means of control of lifting appliances shall be so arranged as to preclude the possibility for simultaneous work of more than two mechanisms. This requirement does not apply to those appliances whose design provides and allows for a greater number of simultaneous movements.

1.5.4.4 The force required to operate the means of control shall not exceed 120 N for manual operation or 300N for foot operation. The force required to operate frequently used means of control shall not exceed 40 N. Rarely used means of control may be operable with a force not exceeding 160 N.

The travel of a means of control shall not exceed:
- 600 mm for manual operation;
- 250 mm for foot operation.

1.5.4.5 For push-button control, separate buttons shall represent different directions of movement.

Control buttons shall be provided with springs or other elements self-restoring to 'stop' position when the operator stops or reduces pressure.

1.5.4.6 Means of control and indicators shall be so arranged on the control panel as to be readily visible. The directions or functions induced by the means of control and indicators shall be clearly marked with a permanent mark.

Start-up levers shall be marked with symbols and caption indicating the direction of movement to start-up a particular arrangement.

The captions shall be in both national and English languages.

1.5.4.7 Means of control (controllers, switches, buttons) of the lifting appliances intended for handling dangerous goods (explosives, acids, radioactive materials, etc.) or intended for periodical transport of persons in man riding baskets as well as means of control in portable remote controls shall be self-restoring to neutral position (see paragraph 1.5.4.2).

Where the winch drum is out of the operator's sight in the case of remote control, correct rope reeling on drum shall be ensured (see also paragraph 1.5.2.8).

1.5.5 Electric Drives and Systems

1.5.5.1 In lifting appliances with electric drive, power supply to the electric motors shall be possible only where respective handles, handwheels and steering levers are in the neutral position.

It is recommended that indication shall be provided on the control panel or in its immediate vicinity to indicate the presence of voltage in the power supply system and also visual signalling to indicate switching on and off the drive.

1.5.5.2 Short circuit or other failure in the electric drive control circuits shall cause neither starting nor prolonged operation of the drive, brake release nor leaving brakes in the released position.

In case of blackout in the control circuits, all the powered mechanisms being in operaration shall stop automatically also when the means of control are not in the neutral position.

1.5.5.3 The control circuits of independent drives of powered topping lift drums and preventer guy drums shall be so designed as to preclude the possibility for their starting or prolonged operation when cargo is hung on the hook.

Instead of starting interlock, provision may be made to preclude starting of such drives by persons not qualified for the operation of those arrangements.

1.5.5.4 In the immediate vicinity of the control position of lifting appliances, a push button or safety cut-out switch reacting to blackout in the electric drive main circuit shall be installed within the operator's easy reach.

The push button or safety cut-out switch shall be painted red and provided with the inscription "STOP".

For hydraulic drive with the steering lever automatically returning to the neutral position, "STOP" is not required.

1.5.5.5 In the main circuit of lifting appliance, the above mentioned switch shall be installed and be available to the authorized crew members only or a suitable device shall be applied to lock that switch in the "off" position.

1.5.5.6 Bare conductors shall not be used for the power supply to movable lifting appliances.

1.5.5.7 The possibility of the electric drive inadvertent operation shall be precluded.

Starting the hoisting mechanism motor shall be possible only by tilting the steering lever from the neutral position.

Means of control of lifting appliances shall be so arranged that at least neutral position be switched in unambiguously. In mechanisms with motors with variable number of poles, switching in only one position shall correspond to each number of rpm.

The device restoring the neutral position of the means of control after it has been released from the operator's hand and retaining such position by precluding its spontaneous change of such position shall be so arranged as not to cause the operator's fatigue (see paragraph 1.5.4.4).

1.5.5.8 Where additional ventilation has been provided for the operation of electrical arrangements, the start or prolonged operation of the respective drives shall be possible only when the ventilation is in operation.

1.5.5.9 Grounding of a mobile part of a deck crane shall be effected by means of special conductor connected to the swinging part, or by means of current collector with at least two brushes to the revolving drum.

Grounding of mobile parts of lifting appliances by means of wheels and rails may be effected on condition that their reliable contact has been ensured.

1.5.6 Hydraulic Drives and Systems

1.5.6.1 Hydraulic systems shall fulfil the requirements specified in paragraph 1.5.1.2.

Dimensions and design of hydraulic systems shall fulfil the recognized principles accepted in technology for such installations.

Hydraulic system safe working in the expected conditions shall be ensured by the selection of respective means (i.e. filters, coolers, means of control, pressure adjustment in the main circuits) and the selection of hydraulic oil suitable for the intended service and ambient conditions.

1.5.6.2 Hydraulic system design shall prevent overpressure in the system. Piston outer positions in cylinders shall be limited.

1.5.6.3 Hydraulic systems between cylinders and hydraulic motors shall be made with increased safety level. This also applies to all the associated components.

For non-certified materials, increased safety factors shall be assumed for the performed tests: at least 2 – as related to the yield point and 2.5 – as related to the fatique strength.

The dimensions of flanged joints and screw joints shall be determined with respect to the tightness test with 1.5 the test pressure or 1.5 the maximum working pressure.

1.5.6.4 High-pressure hoses are permitted to be used. Such hoses shall be suitable for the intended medium, pressure, temperature, ambient conditions and application and shall also comply with the relevant standards recognized by PRS.

Bite type joints with seams may be used subject to PRS consent in each particular case.

Hose breaking pressure shall be at least 3.0 the adjusted relief valve opening pressure.

1.5.6.5 Installation system may be connected with another hydraulic system if such a connection is acceptable.

In that case a redundant pump unit and installation of suitable shut-off valves are recommended.

1.5.6.6 If the means of control of the hydraulic arrangements are in the neutral position, the lifting appliance movement – e.g. the movement posing the risk of mobile crane stability loss – shall be precluded.

1.5.6.7 In case of power failure in the supply of crane or its central unit, all the switched on mechanisms shall switch off, also when the means of control are not in the neutral position.

1.5.6.8 Hydraulic cylinders shall be fitted with safety arrangements reacting to the installation fracture in order to preclude the quick fall of cargo, jib or uncontrolled slewing of lifting appliance.

1.5.6.9 Hydraulic cylinders shall be so installed and connected to the supporting structure that no external bending moment can act on the piston rod.

1.6 Special Requirements

Interchangeable gear, such as hooks, shackles, swivels, chain cables and similar elements of lifting appliances installed on board the tankers, oil recovery vessels, gas carriers, chemical tankers, and similar ships shall be made as intrinsically safe in accordance with the relevant standards in force.

2 CALCULATION PRINCIPLES

2.1 Application and General Requirements

2.1.1 These principles apply to the design of load-bearing structures and fittings of lifting appliances installed on board ships and other vessels including mobile offshore drilling units (see 1.1.1).

2.1.2 These principles do not specify methods for determining forces and stresses acting in lifting appliance components. PRS may, however, in individual cases require the application of calculation methods approved by PRS.

In justified cases, strength and stability calculation of lifting appliances installed on board ships and other vessels as well as fixed and mobile offshore drilling units may – subject to PRS consent in each particular case – be performed in accordance with the relevant standards in force.

2.1.3 The calculation principles accepted for shipboard jib cranes apply to powered boom derricks, overhead cranes, hoists and winches, whereas the calculation principles accepted for boom derricks apply to tackle cranes (jumper type, gording type).

2.1.4 Container spreaders, traverses, beams, frames and other similar auxiliary loose gear are subject to the principles applicable to boom derricks.

2.1.5 For container spreaders, it shall be assumed that the container centre of gravity is shifted from its geometric centre by 0.1 of its length and 0.1 of its breadth. For such container spreaders,

a specific case of load where operational load is born by three grabs only, shall be calculated. For loose gear with four slings incapable of having its lengths equalized, their sufficient strength shall be demonstrated in the case where the load is born by three slings only.

2.1.6 Design load for loose gear shall be determined as the loose gear dead load and SWL multiplied by hoist load coefficient ψ. The stresses occurring in the loose gear load-bearing structure shall not exceed the values specified in sub-chapter 2.7 for load case I. In no case shall the proof load stress exceed 0.8 R_e.

2.1.7 Contact stress between rotating grip of the container spreader and the container corner fitting shall not exceed 50 MPa for static load.

In calculations of capacity of rolling bearings with minor rotational speeds, static coefficient increasing the normal load shall be taken not less than 1.2.

2.1.8 Groups of Load-bearing Structure Components

2.1.8.1 Due to loads imposed during crane operation, the load-bearing structure components shall be divided into two groups:

I group covers main load-bearing components, which are subject to high static loads or mainly to a dynamic load, which is a critical load due to occasional and permanent strength of the lifting appliance and loose gear.

I group components are inter alia: masts, columns, crane foundations, jibs, booms, hydraulic servo-motors of the derricking mechanism, slewing circle assemblies, traverses, lifting beams, etc.

II group includes the components which are subject to relative low loads or whose purpose is to ensure effective operation of the lifting appliance and loose gear (see table 3.1.2.3).

II group components are inter alia: crane slewing columns, span bearings, boom and jib heels and heads, hydraulic servomotors of slewing mechanisms, sheave assemblies, interchangeable gear, flat brackets, stanchions, stiffeners etc.

2.2 Operational Conditions

2.2.1 Sea Wave Effect

2.2.1.1 Lifting appliances designed without consideration for the sea wave effect may be operated in still water conditions, only. In this meaning, still water are such water surface condition, which do not cause perceptible vessel's movement.

„Unprotected waters" mean waters of a state which causes perceptible vessel's movement.

2.2.2 Vessel's Inclinations

2.2.2.1 Allowable heel and trim of a vessel shall be given in each crane documentation and considered in calculations. Guidelines on the consideration of vessel's inclinations in calculations are given in 2.5.2.3.

2.2.3 Wind Pressure

2.2.3.1 Lifting appliance may be operated at a wind speed not exceeding 18 m/s, which corresponds to a dynamic pressure of 0.2 kN/m^2 (wind force ca. 7 Bft). At higher wind speed, the lifting appliance shall be laid out and secured in voyage position. For floating cranes, other than above specified values can be assumed. Guidelines on considering wind pressure in calculations are given in 2.5.3.1.

2.2.4 Service temperature

2.2.4.1 The lowest ambient temperature, to be considered inter alia at the selection of materials (see subchapter 3.1), shall be determined for the intended service area as a mean value of measurements. Assumed mean lowest temperature may be higher than the temperatures noticed in not more than 9 days in a year, i.e. 2.5% of all days of the year.

2.2.4.2 Where no specific settlements have been made, –25 °C shall be taken as the lowest service temperature, in accordance with 1.5.1.3. The appliance operator shall, without any additional instructions, avoid operation of the lifting appliance at temperatures below –25° C.

2.2.4.3 If it is necessary to operate the crane at temperatures lower than –25° C, expected lowest ambient temperatures shall be given in the documentation submitted to PRS for approval and they shall be considered at the selection of materials, manufacturing procedure and the selection of appliances susceptible to low temperatures.

2.2.5 Special Requirements

2.2.5.1 For the cranes, which significantly affect stability of the vessel, they are mounted on, it shall be demonstrated that the jib remains at position or the vessel remains stable after wave action. Unless taking other values is justified, a negative hoist load coefficient Ψ_i = –0,3 shall be applied.

2.2.5.2 Pontoons of floating cranes under load shall maintain for the lowest deck edge a freeboard of:
- 0.5 m during still water operation,
- 1.0 m during operation in unprotected waters (see 2.5.2.3).

2.2.5.3 For the floating cranes to be used in unprotected waters, after submitting them to inclining test and approving stability booklet, the permissible sea state and waving condition for cranes operation shall be defined. Means for their securing during voyage and instructions for their immediate transfer to protected waters shall be agreed with PRS.

2.3 Data for Calculations

2.3.1 Dimensions of the load-bearing structure components of lifting appliances shall be determined taking into account statical and dynamic loads, related to expected service conditions.

2.3.2 Strength calculations for various load-bearing structure components shall be performed for service conditions taking into account forces being due to:
- service load;
- dead load of the load-bearing structure of the crane and gear;
- the heel and trim of the vessel (see 1.5.1.3);
- vertical dynamic forces due to lifting the load (it is assumed that these vertical dynamic forces include vertical accelerations being the effect of lifting and swinging movements, as well as vertical vibrations due to sharp taking the load from the ground and putting it onto it);
- a horizontal component of acceleration due to slewing motion; the centrifugal radial acceleration due to slewing motion may be neglected.

2.3.3 Operational conditions and characteristics of the lifting appliance shall be specified, in particular:
- work load group;
- safe working load (SWL) or SWL to radius relation diagram;
- maximum permissible angle of heel and trim;

- dead load of crane components and their gravity centres, in particular dead load of a sling and hook, mass of a jib, its distribution being given on the jib, masses of counterweights, if applied, and total mass of the crane;
- lifting speed;
- horizontal component of acceleration on the jib top at maximum radius, due to slewing motion, as well as minimum braking time;
- maximum wind speed, at which the crane may be operated;
- pulley type (kind of sheave bearings, slide or rolling).

2.4 Work Load Groups

2.4.1 Depending on the kind of performed activity, the below four groups of cranes work load are distinguished:

- Group I: cranes not used for loading and unloading, very rarely operating at rated SWL, such as cranes used for loading spare parts, provisions or ship's equipment. (Cranes intended for hoisting hoses in tankers or the equipment for unloading to the board of gas tankers or chemical tankers carrying dangerous cargo are counted into group II);
- Group II: cranes used for loading and unloading general cargo, operated often at the load less than 75% the SWL, such as multi-function cranes. The number of stress change cycles within service period of such crane does not exceed 600 000.
- Group III: cranes intensively operated under loads close to their SWL, such as cranes intended for handling containers, where the weight of a loaded container is approximately equal to its deadweight. The number of stress change cycles within service period of such crane exceeds 600 000.
- Group IV: grab cranes used for handling bulk cargo, operated under load for more than 75% of their service time. See also table 5.1.3.6.5.

2.5 Design Loads

2.5.1 General

Any external loads acting on cranes in service are divided into:

- basic;
- additional;
- exceptional.

2.5.2 Basic Loads

2.5.2.1 Permanent loads – gravity forces due to dead load of the crane load-bearing structure, machinery, catwalks, permanent counterweights, etc, whose value and location in relation to considered part of structure remain unchanged during service.

2.5.2.2 SWL force – a force due to rated mass of payload together with gravity force due to mass of sling (hook, grab, traverses, spreaders, etc). The gravity force of sling mass may be neglected in calculations if its value does not exceed 5% of SWL force.

2.5.2.3 Forces due to vessel's inclination. At determination of the values of forces acting on the load-bearing structure of cranes installed onboard ships and other vessels, their transverse and longitudinal components shall be taken into account depending on navigation area and service condition. The minimum inclination values adopted in relation to the kind of vessel are presented in table 2.5.2.3.

Table 2.5.2.3

Inclination of vessels for determination of crane load components										
Nr	Vessel type	Protected waters				Unprotected waters				Remarks
		In-service condition		Out-of-service condition		In-service condition		Out-of-service condition		
		transverse	longitudinal	transverse	longitudinal	transverse	longitudinal	transverse	longitudinal	
1	Ships and similar vessels	5°	2°	3°	2°	10°	3°	30°	6°	See also 5.1.7.64 and 5.2
2	Floating docks	2°	2°	2°	2°	–	–	see No. 7 and 8*)		*) given conditions for passage and anchorage to be observed
3	Floating cranes SWL ≤ 60t	5°	2,5°	2°	2°	6°	3°	see No. 6 ÷ 8 *)		
4	Floating cranes SWL > 60t	3°	2°	2°	2°	6°	3°			
5	Pontoons L/B < 4	3°	2°	2°	2°	6°	3°			
6	Pontoons B < λ	–	–	–	–	–	–	15°	7.5°	See also data on acceleration components in 5.1.7.6.10
7	Pontoons B ~ 0,5 λ	–	–	–	–	–	–	10°	5°	
8	Pontoons B ~λ	–	–	–	–	–	–	5°	3°	
9	Semisubmersible platforms	–	–	–	–	3°	3°	3°	3°	the positioning (submerging) conditions to be observed
10	Submersible and emerging platforms	–	–	–	–	1°	1°	1°	1°	Not considered as vessels

Explanations: all inclination values are with mark ±

The heel and trim values given in table 2.5.2.3 shall be assumed as existing simultaneously. If during crane operation, vessel's inclination values greater than given in the above table can be expected, actual values of inclination shall be considered, which shall also be given in the crane acceptance documentation.

Inclination of floating cranes in service in protected waters (including initial inclination) shall not be greater than 13° and the inclination in the opposite direction – not greater than 6° with the crane without load.

2.5.2.4 Inertia Forces due to Vessel's Propulsion

2.5.2.4.1 Vertical inertia forces due to load-bearing structure vibration during load hoisting, lowering, derricking or crane travel are included in calculations by multiplying loads by hoist load coefficients ψ and φ. Coefficient ψ takes into account inertia forces due to cargo movement. Coefficient φ takes into account inertia forces due to other movements.

Values of coefficient ψ_i for deck cranes, depending on service group K_i, are given in table 5.1.3.6.5.

If sea waving affects a deck crane operation, the hoist load coefficient ψ shall be taken in accordance with 2.5.3.3, when its value is greater than the values given in table 5.1.3.6.5. Values of coefficient φ are specified in table 2.5.2.4.1.

Table 2.5.2.4.1

Crane	SWL, kN	φ
immobile	≤ 1000	1.05
	> 1000	1.00
mobile	> 1000	1.20

If sea waving affects a floating crane operation, the hoist load coefficient ψ shall be taken in accordance with 2.5.3.3, when its value is greater than the values given in table 5.1.3.6.5.

Values of coefficient φ for floating cranes shall be taken from table 2.5.2.4.1. If a floating crane is subject to waving, the coefficient φ shall be increased by 15%.

2.5.2.4.2 Horizontal inertia forces due to crane or truck travel shall be calculated as a product of mobile masses and the acceleration due to engine operation or deceleration due to braking. The forces may be calculated approximately from the below formula:

$$S_{ab} = k\Sigma S_{rad}, \quad [\text{kN}] \qquad (2.5.2.4.2)$$

S_{ab} – horizontal inertia force, [kN],
S_{rad} – load of a wheel under propulsion or brake, [kN],
k – factor acc. to table 2.5.2.4.2.

Table 2.5.2.4.2

Travel speed V_j [m/s]	k
$V_j < 2$	0.025
$2 \le V_j \le 4$	0.05
$V_j > 4$	0.075

Horizontal inertia forces perpendicular to jib axis due to derricking need not be included in calculations.

Horizontal inertia forces due to slewing mechanism operation shall be calculated as a product of mobile masses and acceleration due to engine operation or deceleration due to braking. Without precise grounds, these forces may be substituted by forces due to vessel's inclination by 2%, hoist load coefficients ψ and φ being considered.

Centrifugal forces may be neglected in calculations. Horizontal inertia forces due to vessel's movements in waves shall be taken into account only for the crane voyage condition, taking inertia forces in addition to statical inclination.

2.5.3 Additional Loads

2.5.3.1 Loads due to wind pressure shall be calculated with the assumption that the wind acts horizontally at a direction that increases general load of the load-bearing structure and causes movements of crane or its movable components in the most unfavourable direction.

The wind pressure on the crane load-bearing structure shall be calculated taking into account the above requirements, according to the below formula:

$$W = k_i q A, \quad [\text{kN}] \tag{2.5.3.1-1}$$

where:

W – wind pressure, [kN],
k_i – aerodynamic factor, taking into account pressure and suction acting on the load-bearing structure, given in table 2.5.3.1-1,
q – characteristic value of wind pressure speed, equal to

$$q = 0.613 V^2 10^{-3}, \quad [\text{kN/m}^2] \tag{2.5.3.1-2}$$

Minimum pressure for the crane operational condition shall be assumed:

q = 0.3 kN/m^2,

while for standstill

q = 1.2 kN/m^2,

V – wind speed, [m/s],
A – windage area, [m^2].

If the load-bearing structure girder is screaned by an other one (see Fig. 2.5.3.1), the wind pressure W acting on the screaned girder is calculated by multiplying the wind pressure W by reducing factor η, then:

$$W_e = W\,\eta = \eta\, k_i\, q\, A, \quad [\text{kN}] \tag{2.5.3.1-3}$$

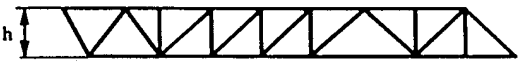
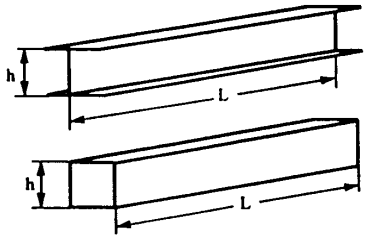
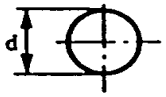
η – depends on dimensions b and h (see Fig. 2.5.3.1) and filling level β

$$\beta = \frac{A_n}{A_g} \tag{2.5.3.1-4}$$

A_n – windward net calculation area of girder, [m^2],
A_g – windward net size area of girder, [m^2],
b – a distance between the screaning girder and the screaned one, [m].

The value of reducing factor η is given in table 2.5.3.1–2. For the whole wall girders it is to be assumed β = 1. If in the load-bearing structures the filling level $\beta \geq 0.6$, then the value of reducing factor shall be taken as for the whole wall load-bearing structure.

Table 2.5.3.1-1

Structure			
Description	sketch		k_i
latticed			1.6
open		L/h	
closed		20	1.6
		10	1.4
		5	1.3
		2	1.2
Closed with circular section, latticed with circular section bars	 if $d\sqrt{q} < 1$, e.g. rope if $d\sqrt{q} > 1$, e.g. crane column; d[m], q[N/m²]		1.2 0.7

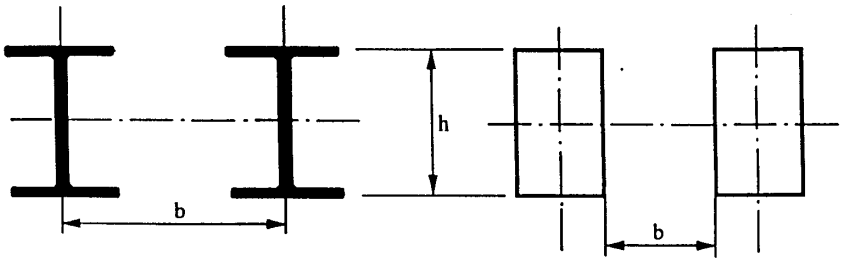


Fig. 2.5.3.1

Table 2.5.3.1-2

β / b/h	0.1	0.2	0.3	0.4	0.5	0.6 – 1.0
0.5	0.75	0.4	0.32	0.21	0.15	0.05
1	0.92	0.75	0.59	0.43	0.25	0.10
2	0.95	0.80	0.63	0.50	0.33	0.20
4	1.0	0.88	0.76	0.66	0.55	0.45
5	1.0	0.95	0.88	0.81	0.75	0.68

Wind pressure on cargo shall be taken in accordance with table 2.5.3.1-3.

Table 2.5.3.1-3

SWL [t]	Wind pressure [N]	SWL [t]	Wind pressure [N]
1	600	30	5500
2	1200	40	6500
3	1700	50	7500
4	2100	60	8000
5	2500	70	8500
6	2700	80	9000
8	2900	90	9500
10	3000	100	100 SWL
20	4500		
Intermediate values shall be calculated by linear interpolation.			

2.5.3.2 Load by icing – in case of possible icing and lack of precise data, the ice layer thickness of all load-bearing structure components exposed to weather shall be assumed equal to 3 cm. The specific gravity of ice is taken as equal to 7 kN/m^3.

The wind pressure to the load-bearing components of areas increased due to icing shall be calculated taking speed equal to 75% of the value given in 2.5.3.1.

For lattice structures, changes of areas A_n and A_g due to icing, affecting the filling factor β, shall be considered in calculations.

2.5.3.3 Loads Due to Sea Waves

Operation of cranes in unprotected waters requires special PRS consent.

For cranes, which shall operate in unprotected waters and are not provided with appropriate shock absorbing devices, the hoist load coefficient value ψ shall be calculated from the below formula:

$$\psi = 1 + 0.9(V_p + V_w)\sqrt{\frac{C}{gS_{SWL}}} \qquad (2.5.3.3)$$

where:

V_p – hoisting speed [m/s],
V_w – measured vertical speed of deck [m/s],
C – spring constant of the crane related to vertical travel of hook [kN],
g – gravity acceleration [m/s^2],
S_{SWL} – SWL force [kN].

When precise data are missing, speed V_W may be taken from table 2.5.3.3.

Table 2.5.3.3

Effective wave height H 1/3	V_w	Mean period, T_o
m	m/s	s
0.5	0.3	3.0
1.0	0.6	4.0
2.0	1.2	5.3
3.0	1.8	6.3
4.0	2.6	7.0
6.0	3.4	8.2
8.0	4.2	9.2

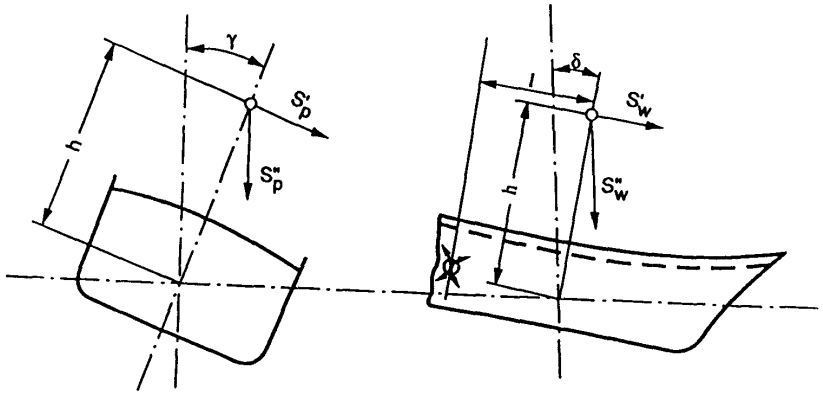
Intermediate values may be calculated by linear interpolation. The spring constant C shall be calculated taking into account only ropes and jibs. Deformations of ropes of the cargo travel reeving compensation system, increasing vertical shifts of hook, are not considered in these calculations. The calculations are performed for static condition, only.

Where precise data are missing, for ropes with round lays, module E = 1,1·10^5 MPa may be assumed.

2.5.3.4 Inertia Forces due to Sea Waves

For the crane in operating condition, inertia forces shall be determined in accordance with 2.5.3.3. For the deck crane in voyage condition, inertia forces shall be taken into account at calculation of its load-bearing structure components, supports and securing devices.

Inertia forces caused by gravity force *G* of dead load due to vessel's rolling and pitching including heaving, may be determined in accordance with the below Figure 2.5.3.4 and table 2.5.3.4.



rolling pitching including heaving

Fig. 2.5.3.4

Table 2.5.3.4

Crane	Angle of rolling γ	Angle of pitching δ
vessel's deck	30°	6°
on a pontoon $B \sim \lambda$ $B \sim 1/2\ \lambda$ $B \sim \lambda$	 15° 10° 5°	 7.5° 5° 3°

B – pontoon width [m],
λ – wave length [m].

For deck cranes, values of these forces may be determined as follows:

S'_p = 0.02G h 9.81 [kN],

S''_p = 1.2 G 9.81 [kN],

S'_w = 0.015G h 9.81 [kN],

S''_w = 2.0 G 9.81 [kN] – fore and aft positions,

S''_w = 1.5 G 9.81 [kN] – midship position,

For intermediate positions, the values shall be determined by interpolation.

S'_p, S''_p, S'_w, S''_w – inertia forces components [kN],

G – mass [t],
h – distance between crane or its component gravity centre and the design waterline [m],
l – distance between crane or its component gravity centre and midship, [m].

For cranes installed on floating pontoons with unrestricted operation in unprotected waters, the forces may be determined as below:

S'_p = 0.04 G h 9.81 [kN],

S''_p = 1.26 G 9.81 [kN],

S'_w = 0.02 G h 9.81 [kN],

S''_w = [1.3 G + 0.02 G l] 9.81 [kN].

For cranes installed on floating pontoons with restricted mean- and short-time operation in unprotected waters, the forces may be determined depending on expected highest wave:

for $\beta << \lambda$, values as for cranes with unrestricted operation in unprotected waters apply;

for $B \sim \frac{1}{2} \lambda$

S'_p = 0.03 G h 9.81 [kN],
S''_p = 1.17 G 9.81 [kN],
S'_w = 0.015 G h 9.81 [kN],
S''_w = (1.21 G + 0.015 G l) 9.81 [kN].
at $B \sim \lambda$
S'_p = 0.015 G h 9.81 [kN],
S''_p = 1.09 G 9.81 [kN],
S'_w = 0.01G h 9.81 [kN],
S''_w = (1.15 G + 0.01 G l) 9.81 [kN].

When determining loads, forces due to rolling may not be combined with the forces due to pitching including heaving. Each of the forces may be combined with the load due to wind pressure and due to waves impact.

2.5.3.5 Loads Due to Wave Impact

Besides the forces due to wind pressure (see 2.5.3.1), loads due to wave impact shall be considered in calculations, taking the following values of water head acting on the crane structure:

P_w = 25 kN/m^2, at the main deck level,

P_w = 0 kN/m^2, at a height of at least 2.5 m and above the main deck level.

For components situated between the said levels, intermediate values of water head shall be assumed.

2.5.3.6 Loads of Platforms, Stairs, Ladders and Handrails

Calculations for platforms, ladders, stairs shall take into account equally distributed loads amounting to 3 kN/m^2 or a concentrated mobile force equal to 1.5 kN. The handrails shall be calculated for lateral force equal to 0.5 kN/m.

The above loads shall not be taken into account in calculations of the structure load-bearing elements.

2.5.4 Exceptional Loads

Exceptional loads include the loads generated during:
- proof load test, being in accordance with table 10.3.4;
- installation works, depending on the method and technique of crane installation;
- contact with a fender beam;
- cargo breaking (see also 2.2.5.1).

2.6 Stress Calculation

2.6.1 Maximum loads acting on the crane load-bearing structure and in particular components of gear may be determined by means of the diagram of forces or by calculations. At determination of the loads, angles of heel and trim given in 2.5.2.3 shall be taken into account.

This *Part* of the *Rules* does not specify the method of loads calculation, in particular cases, however, PRS may demand that the calculation method applied shall be to the satisfaction of PRS.

In justified casus, strength and stability calculations of lifting appliances may be, at PRS consent, carried out according to valid national or international standards.

Computer calculations shall be performed by means of PRS approved software. The principles of approval of calculation programs are specified in PRS *Publication No. 14/P – Principles of Approval of Computer Programs*.

2.6.2 Each node of lifting appliance load-bearing structure shall be calculated for such position at which movable components are subject to the greatest stresses.

2.6.3 At the calculation of compression bars and combined compression-bending bars, the effect of eccentric action of longitudinals forces and execution curvature on the values of stresses shall be regarded.

2.6.4 Losses due to frictional resistance in sheave bearings and due to ropes winding on sheaves shall be assumed equal to 5% for each slide bearing sheave and 2% for the rolling bearing sheave.

Change of forces acting in structural components of the lifting appliance, due to frictional resistance in sheave bearings and ropes winding on blocks shall be taken for such a movement or movement combination (lifting and lowering of boom cargo) which is most unfavourable for the component considered.

2.6.5 In the case of complex stress combination in the load-bearing structure components, equivalent stresses shall be determined according to strength hypothesis assumed for this stress combination.

2.6.6 Each component of the load-bearing structure shall be calculated for the highest loads of the lifting appliance existing at the following cases:

2.6.6.1 Base loads – I load case. The case pertains to the system of base loads of working condition, no additional loads included (see 2.5.2).

2.6.6.2 Base and additional loads – II load case. It applies to the system of base loads of working condition, including additional loads (see 2.5.2 and 2.5.3).

2.6.6.3 Exceptional loads – III load case. It applies to the load system in voyage standstill condition, taking into account wind pressure and load combination during proof load test.

The above base and additional loads shall be assumed as acting simultaneously, except the loads due to see waving, in accordance with 2.5.3.3 and due to wave impact according to 2.5.3.5, which may not be taken as simultaneous. Other exceptions may be allowed.

2.7 Permissible Stresses

2.7.1 For the load-bearing structure components and their connections, the design strength shall be calculated from the formula:

$$R_o = \frac{235}{k\nu}, \quad \text{[MPa]} \qquad (2.7.1\text{-}1)$$

where:
R_o – design strength, [MPa],
k – material factor,
ν – safety level taken from tables 2.7.1-1 and 2.7.1-2, depending on the load case.

The material factor shall be determined from the formula:

$$k = \frac{295}{R_e + 60} \qquad (2.7.1\text{-}2)$$

where:

R_e is material yield stress, in MPa, selected in accordance with instructions given in Chapter 3 of this *Part* of the *Rules*.

The material factor k applies only to steels, whose relation $R_e/R_m < 0.83$, where R_m is material tensile strength, in MPa.

When two steel grades of various mechanical properties are combined, the permissible design stresses of weld joints R_{os} shall be determined with regard to steel having lower permissible stresses R_o.

Table 2.7.1-1

Safety level v for the load-bearing structure component					
Steel structure component	Kind of stress and load		Load case		
			I	II	III
Plates, corrugations	Compression, compression at bending, where checking the buckling, bulging or torsion strength is required		1.60	1.40	1.28
	Tension and tension at bending, compression, compression at bending, where checking the buckling, bulging or torsion strength is not required		1.40	1.20	1.12
	Shearing		2.40	2.10	1.92
	Reduced stresses		1.40	1.20	1.12
Fitted screws	Shearing:	Single-shear	2.70	2.35	2.16
		Multi-shear	2.00	1.75	1.60
	Hole pressure:	Single-shear	1.10	0.95	0.88
		Multi-shear	0.80	0.40	0.64
	Axial tension		2.50	2.15	2.00
Non-fitted screws	Shearing		3.40	3.00	2.70
	Hole pressure		1.50	1.30	1.20
	Tension		2.50	2.15	2.00

Table 2.7.1-2

Safety level v_s for welded joints					
Weld	Performance	Load type	Load case		
			I	II	III
Butt – K	Normal special [1]	Compression and compression at bending Tension and tension at bendig	1.40	1.20	1.12
	normal	Tension and tension at bendig [2]	1.60	1.40	1.28
Fillet	normal	Tension and tension at bendig [2] Compression and compression at bending	2.00 1.70	1.70 1.45	1.60 1.36
All types	Any	Shear transverse and longitudinal against the weld axis Reduced stresses	2.00 1.40	1.70 1.20	1.60 1.12

1) Permitted exceptionally.
2) Permissible tensile and tensile at bending stresses perpendicular to rolling plane may be accepted only when the joined items are resistant to delaminations.

2.7.2 The safety level of steel wire ropes shall be deteremined from the below formula:

$$k\chi \geq \frac{S_{rwz}}{S_{nk}} \qquad (2.7.2)$$

S_{rwz} – guaranteed breaking strength of a rope [kN],
S_{nk} – greatest force acting in a rope for I load case (see 2.6.6.1), without considering coefficients ψ and φ (see 2.5.2.4), however, taking into account frictional resistance of sheaves and rewinding resistance of ropes on sheaves (see 2.6.4) [kN],
k – permissible safety factor acc. to table 2.7.2,
χ, – load factor; $\chi = 1.0$, for the coefficient ψ in table 5.1.3.6.5 equal to, or less than, 1.45; where the factor ψ is above 1.45, then $\chi = \frac{\Psi}{1.45}$.

Table 2.7.2

Steel wire ropes	Safety factor k at the appliance SWL, [t]:		
runners, span ropes and guy tackle ropes, ropes of hoisting and derricking mechanisms for derricks, hoists	10 and less	11 – 160	161 and more
	5	$\frac{10^4}{8.85SWL + 1910}$	3
for submersible handling systems	6 y/1.45	$\frac{10^4 y}{6.1 SWL + 1317}$	3.6 y/1.45
Shrouds and stays, guy pendants, preventer guys, Loose gear ropes	10 and less	30	50 and more
	4	3.5	3

y – hoist load coefficient value, for y>1.45, if y<1.45 than y=1.45 (2.6.6.1)

Intermediate values shall be determined by interpolation.

2.7.3 The safety factor for natural fibre ropes, related to the rope full breaking load, shall be not less than this specified in table 2.7.3, while for synthetic fibre ropes – not less than 10.

Table 2.7.3

Rope nominal diameter [mm]	Rope safety factor
12	12
14 – 17	10
18 – 23	8
24 – 39	7
40 and more	6

2.7.4 Safety factor for span rope, runner, preventer chain cables and cargo loose gear, related to their breaking load, shall be not less than 4.

In case of manually powered winches, the safety factor of calibrated chain cables operating on chain cable wheels shall not be less than 3.2. For mechanically powered winches, the safety factor of chain cables operating on chain cable wheels will be in each case separately considered by PRS.

2.8 Strength Analysis

2.8.1 Fatique strength of the load-bearing structure components of lifting appliances shall be verified with the number of load cycles greater than $2 \cdot 10^4$.

The calculations may be performed in accordance with the requirements of relevant national and international standards, such as *DIN 15018 sheet 1* or using finite elements method.

2.8.2 For the load-bearing structure components subject to compression forces, calculations proving their adequate buckling, twisting and bulging stability shall be submitted.

The bar slenderness ratio shall be not higher than 200.

Components of variable moment of inertia and variable cross-sectional area shall be calculated considering deformation effect on stresses. The random eccentric f_o consequent upon tolerance of manufacture and installation shall be taken from table 2.8.2, where l_w is a component length.

Table 2.8.2

Compressed component	f_o
Simply supported on both ends	$\frac{1}{400} \cdot l_w$
Fixed on one end	$\frac{1}{250} \cdot l_w$

2.8.3 Pipes without rib stiffenings of wall thickness $s > 15$mm shall be checked for bulging as specified below:

.1 Ideal bulge stress

$$\sigma_{ki} = 1.21E\frac{s}{D} \quad \text{[MPa]} \tag{2.8.3-1}$$

E = $2.06 \cdot 10^5$ – elasticity modulus [MPa],
s – wall thickness [mm],
D – external diameter [mm]

.2 Reduced bulge stress

$$\sigma_{SP} = R_e\left(1.277 - 0.555\sqrt{\frac{R_e}{\alpha_w \sigma_{ki}}}\right) \quad \text{[MPa]} \tag{2.8.3-2}$$

R_e – wall material yield stress depending on its thickness [MPa],

$$\alpha_w = \frac{0.8\sqrt{\frac{s}{56}}}{\sqrt{1 + \frac{D}{200g}}}$$

.3 Bulge reliability level

$$\nu_w = \frac{\sigma_{SP}}{\sigma_o} \tag{2.8.3-3}$$

σ_o – existing stresses [MPa].

This stress shall be lower than $R_o = \frac{235}{1.4k}$ (see 2.7.1). The bulge reliability level shall not be less than 1.35.

2.9 Calculations of Basic and Replaceable Components and Mechanisms

2.9.1 Derrick manufacturer shall submit to PRS calculations of a slewing circle assembly proving its adequate static and service strength.

Screws securing the slewing circle assembly shall be checked for maximum forces due to external load.

The force acting in the most loaded screw may be calculated from the formula:

$$S_{sr} = \frac{4M}{nd_{sr}} - \frac{V}{n} \quad \text{[kN]} \tag{2.9.1}$$

M – design load tipping moment [kNm],
V – axial load [kN],
$d_{śr}$ – diameter of screws circle [m],
n – number of screws.

Permissible stresses in screws shall be determined in accordance with 2.7.1.

2.9.2 Structure and strength dimensions of loose gear shall be so chosen that the appliance under proof load specified in 10.2.1 is not subject to permanent deformations, and the appliance under boundary load specified in 10.2.9 does not suffer damage. The gear manufacture in accordance with PRS accepted standards is considered as fulfilling the above requirements.

For the permanently attached standard gear, permissible stresses shall be assumed not higher than these for steel structures (see 2.7.1).

2.9.3 At the design of loose gear, with the purpose to define the component parameters, i.e. for initial determination of its strength, permissible stresses shall take the values of combined stresses not higher than calculated from the formula:

$$k_r = 0.80 R_e \frac{SWL}{P_{pr}}, \quad \text{[MPa]} \tag{2.9.3}$$

k_r – permissible tensile stress [MPa],
R_e – design material yield stress [MPa],
SWL – safe working load [t],
P_{pr} – proof load, (see subchapter 10.2) [t].

Stress values may be taken higher than calculated from the above formula or gear may be designed on the basis of empirical formulae, provided the requirements for tests, specified in 2.9.2, are complied with.

2.9.4 With reference to loose gear manufactured in small amounts, PRS may dispense with the requirement of performance of a test under boundary load in accordance with 10.2.9. It applies also to the gear with considerable value of SWL, as performance of such test for such equipment would be impractical due to load amount.

2.9.5 At calculation of the lifting appliances mechanisms, the below requirements shall be considered:

.1 no permanent deformations or other deficiencies shall occur due to mechanism being subject to proof load,

.2 the design loads for mechanisms shall be determined taking into account crane loads and conditions of determining forces acting in the load-bearing structure components (see subchapter 2.5 and chapter 5);

.3 strength safety factors of a part of mechanisms shall be not less than these provided for the load-bearing structure of the lifting appliances (see subchapter 2.7).

3 MATERIALS, HEAT TREATMENT, WELDING

3.1 Materials and Heat Treatment

3.1.1 General Requirements

3.1.1.1 Materials intended for the manufacture and repair of the load-bearing structure components and mechanisms of the lifting appliances shall comply with the requirements of the *Rules for the Classification and Construction of Sea-Going Ships, Part IX – Materials and Welding* and the requirements of this *Chapter*.

PRS may agree to the use of materials complying with standard requirements and technical specifications, etc, if considers them equivalent to materials specified in this Chapter.

3.1.1.2 Except the cases specified in 3.1.5 and other Chapters of this *Part*, all load-bearing components of the lifting appliances shall be manufactured from killed steel.

3.1.1.3 Enclosures of blocks for the natural fibre ropes and synthetic fibre ropes may be manufactured of wood, however, only the I grade one.

3.1.1.4 Material of the I and II group load-bearing structure components shall be manufactured under PRS supervision. PRS may give consent for the manufacture of II group components made in series according to requirements of appropriate standards, using materials having steelmill certificates.

3.1.2 Steels

3.1.2.1 The load-bearing structure components included into group I or II, acc. to 2.1.8, shall be manufactured from the below given hull steels with PRS survey:

– of normal strength, $R_{emin} \geq 235$ MPa, grades A, B, D and E;
– of higher strength:

$R_{e\,min} \geq 315$ MPa grades AH32, DH32, EH32, FH32;

$R_{e\,min} \geq 355$ MPa grades AH36, DH36, EH36, FH36;

$R_{e\,min} \geq 390$ MPa grades AH40, DH40, EH40, FH40;

Hull steel grades of higher strength are marked in table 3.1.2.3 with symbols AH, DH, EH, FH.

3.1.2.2 Upon agreement with PRS, the manufacture of the load-bearing structure components included into group II from steels which fulfil the requirements of standards and are provided with steelmill certificate, is allowed. The rolled components of thickness up to 12.5 mm may be made of semi-killed steel.

3.1.2.3 PRS may require that welded components of the load-bearing structure loaded upon material thickness, shall be manufactured of "Z" type steel, with average reduction of area not less than 25% (e.g. E – Z 25, EH 36 – Z 25 etc.).

Table 3.1.2.3

	Minimum service temp.	0 °C	-10 °C	-20 °C	-30 °C	-40 °C	-50 °C
	Steel grade						
I group of load-bearing structure components	A	20	10	x	x	x	x
	B	25	20	10	x	x	x
	D	35	25	20	10	x	x
	E	50	50	50	40	30	20
	AH	25	20	10	x	x	x
	DH,	45	40	30	20	10	x
	EH	50	50	50	40	30	20
	FH	Requires special agrement with PRS					
II group of load-bearing structure components	A	30	20	10	x	x	x
	B	40	30	20	10	x	x
	D	50	40	30	20	10	x
	E	50	50	50	50	45	35
	AH	40	30	20	10	x	x
	DH	50	50	45	35	25	15
	EH	50	50	50	50	45	35

Notes:

1. For intermediate temperatures, material thickness may be determined by interpolation.
2. For abbreviated designations of steel grades, see 3.1.2.1.
3. x – Not applicable.

3.1.2.4 Steels shall be selected according to table 3.1.2.3, depending on the group of the load-bearing structure component, design service temperature and material thickness (see 2.1.8.1).

3.1.3 Steel Forgings

3.1.3.1 The steel forgings applied in the manufacture of the load-bearing structure components of the lifting appliances shall meet the requirements of the *Rules for the Classification and Construction of Sea-going Ships, Part IX – Materials and Welding*.

PRS may agree to the use of steel forgings manufactured in accordance with the requirements of appropriate standards.

3.1.3.2 Repair of faults by welding is possible, as a rule, only when the forging is made of steel of carbon content not exceeding 0.23% and manganese content at least 2.5 x C.

The repair conditions, procedure and control method shall be agreed each time with PRS.

3.1.3.3 Forgings intended for load-bearing structure components of group I shall be subject to relevant non-destructive examinations.

3.1.4 Steel Castings

3.1.4.1 Steel castings applied for the manufacture of the load-bearing structure components of the lifting appliances shall comply with the requirements of the *Rules for the Classification and Construction of Sea-going Ships, Part IX – Materials and Welding.*

PRS may agree to the use of steel castings manufactured in accordance with the requirements of appropriate standards.

3.1.4.2 Castings intended for the load-bearing structure components of group I shall be subject to relevant non-destructive examinations aimed at detection of faults which can significantly influence the structure strength.

3.1.4.3 Except the cases permitted by this Chapter, the use of steel castings for the manufacture of lifting gear requires special consideration by PRS.

3.1.4.4 The possibility of repairing castings faults shall be each time agreed with the PRS Surveyor.

3.1.4.5 Welding repair of faults, as well as gas flame cutting and removing the weld surplus, shall be performed before the final heat treatment.

3.1.4.6 Castings joined with other load-bearing components of a lifting appliance by welding shall be cast from steel of good weldability.

3.1.5 Cast Iron

3.1.5.1 Nodular iron, grey iron and malleable iron castings intended for the manufacture of the load-bearing structure components of the lifting appliances shall comply with the requirements of the *Rules for the Classification and Construction of Sea-going Ships, Part IX – Materials and Welding.*

3.1.5.2 Cast iron may be used for the manufacture of:

.1 toothed wheels, wormwheels and road wheels of manually-powered lifting appliances;
.2 the wormwheels with bronze rim;
.3 drums and heads of winches, reduction gear bodies and block sheaves;
.4 brake blocks and stanchions of drums and bearing bodies.

3.1.5.3 PRS may allow for the use of nodular iron instead of cast steel, provided:
- the component is not from the group I of the load-bearing structure items;
- the casting will not be joined with other parts by welding;
- the casting is made of nodular iron with $A_5 \geq 12\%$.

PRS may demand non-destructive examination to be performed for nodular iron castings.

3.1.5.4 It should be taken as a rule that iron castings are not allowed to be repaired by welding.

3.1.6 Screw Joints

Pre-tensioned screws in the load-bearing screw joints shall be made of carbon and low-alloyed steels of properties given in table 3.1.6.

Table 3.1.6

Class of mechanical properties of screws	6.8	8.8	10.9	12.9
Screw material tensile strength, [MPa]	600	800	1000	1200
Screw material yield stress, [MPa]	480	640	900	1080
Class of mechanical properties of nuts	6	8	10	12

The steel grade for the screw joint components depending on the class of mechanical properties, product heat treatment, as well as testing programme shall be in accordance with the requirements of the ISO – 898 Standard.

Each screw shall be examined and magnetic particle tested. No cracks are allowed.

3.1.7 Interchangeable Gear and Loose Gear

Each item of interchangeable gear, loose gear and of a chain cable shall be made of the same material grade.

Material used for chain cables is divided into 5 grades, according to table 3.1.7. These grades comply with the requirements of ISO 1834 Standard.

Material grades used for the manufacture of steel components of the interchangeable gear and loose gear shall also be in accordance with table 3.1.7.

Table 3.1.7

Steel grade designation acc. to ISO 1834	Steel grade	Mean stress for a defined minimum load, [MPa]
L	Normal strength	315
M	Higher strength	400
P	Alloy steel	500
S	Alloy steel	630
T	Alloy steel	800

3.1.8 Steel Wire and Synthetic Fibre Ropes

Steel wire and synthetic fibre ropes intended for the lifting appliances shall comply with the requirements of the *Rules for the Classification and Construction of Sea-going Ships, Part IX – Materials and Welding.*

3.2 Welding

3.2.1 General Requirements

3.2.1.1 The requirements of this Chapter may be applied at designing, construction, modernization and repair of the load-bearing steel structure components of the lifting appliances installed onboard PRS supervised vessels.

3.2.1.2 Welding works applied for the manufacture of the load-bearing structure shall comply with the general requirements of the Rules for the Classification and Construction of Sea-going Ships, Part IX – Materials and Welding.

3.2.1.3 Welding works during manufacture, modernization and repairs of the lifting appliances may be performed only by Companies having valid PRS approval for the performance of welding works.

3.2.2 Technological Requirements

3.2.2.1 Preparation of plate edges for welding shall be in accordance with the requirements of the Rules or the standards, depending on the weld thickness, welding procedure and welded material.

3.2.2.2 During welding in an open space, at low air temperature and considerable humidity, appropriate measures shall be applied ensuring good welding quality., Depending on the kind and thickness of welded materials and ambient temperature, preheating before welding shall be agreed with PRS.

3.2.2.3 Welding of components made by cold bending from hull steel or an equivalent one is permitted if the internal bending radius is higher than three times plate thickness.

3.2.2.4 The butt welds of structure components (e.g. of a web, an I-bar web) shall be displaced one to another i.e. may not be coplanar in the plane perpendicular to longitudinals axis of joined components.

3.2.2.5 Butt welds shall be avoided at joining rolled shapes (especially I-bars and channel-bars of major cross-sections), where a weld transmits tensile stresses.

3.2.2.6 Butt welds with additional doubling plates are not recommended.

3.2.2.7 Components of full circular cross-section are not to be joined by electric welding. These components shall be joined by flush-butt welding.

3.2.2.8 One-side butt welds, as well as butt welds on base metal backing, perpendicular to the direction of forces acting in the load-bearing structure components of group I, shall not be applied. This requirement does not apply to the butt welds made on the backing removed after welding (e.g. a ceramic, copper, flux, etc one) where such welding procedure has been approved by PRS on the basis of performed examinations, according to a programme agreed with PRS.

3.2.2.9 Intermittent and plug welds shall not be applied in the joints of structures included into group I of the load-bearing structure components.

3.2.2.10 Parallel welds, irrespective of their direction, shall be spaced by not less than:
- 200 mm – for butt welds;
- 75 mm – for a fillet and a butt weld.

3.2.2.11 Fillet weld dimensions shall not exceed the values resulting from strength calculations or technological conditions.

3.2.3 Control of Welded Joints

3.2.3.1 Control of welded joints during construction process shall be performed by the works control units. The works shall keep a record of control results according to a scheme agreed with PRS and maintain it for at least one year from the date of structure putting into use. The works shall submit the data to PRS Surveyor, at request. The laboratory carrying out welded joints control shall have PRS approval.

3.2.3.2 The control of welded joints shall be performed in accordance with table 3.2.3.3-1. The non-destructive control shall not be made before 48 hours have passed from the end of welding works or from the end of heat treatment, if required.

3.2.3.3 Methods of non-destructive testing, its scope and the requirements on the quality of welds shall be specified in the documentation approved by PRS, depending on the group of the load-bearing structure components, on the basis of recommendations given in tables 3.2.3.3-1 and 3.2.3.3-2.

Table 3.2.3.3-1
Scope of non-destructive testing of structure welded joints

Group of structure components	Joint	Scope of testing(%)		
		visual (VT)	Magnetic particle (MT) or penetrant (PT)	radiographic (RT) or ultrasonic (UT)
I group	butt welds fillet welds	100 100	20 20	20 –
II group	butt welds fillet welds	100 100	(2)	(2)

(1) May be in part or wholly replaced by an ultrasonic examination,
(2) Up to 5%, at spots indicated by the Surveyor.

Table 3.2.3.3-2
Quality levels of welded joints

Examination type	Method of fault classification	Group of the load-bearing structure component	
		I group	II group
Visual (VT)	acc. to PN-EN 25817 Standard	B	C
Penetrant (PT)	acc. to PN-EN 25817 Standard	B	C
Magnetic particle (MT)	acc. to PN-EN 25817 Standard	B	C
Radiographic (RT)	acc. to PN-EN 25817 Standard	B	C
Ultrasonic (UT)	acc. to *Publication No. 10/P* or *PN-EN 25817 Standard*	B	C

3.2.3.4 Heavy loaded joints along the thickness shall be ultrasonic examined for detection of possible laminar cracks.

3.2.3.5 If during the non-destructive testing of structure welded joint any non-permissible faults are detected, the PRS Surveyor may demand extension of the examination beyond the scope given in an approved documentation.

In the case of any serious faults such as cracks, lack of penetration, all the joints performed in the procedure the quality of which is claimed, shall be subject to inspection within their whole length.

3.2.3.6 The documentation of the whole scope of the non-destructive testing shall be prepared so that the testing spot could be explicitly identified within each stage of production process and after its completion on the basis of testing report.

3.2.3.7 The structure non-destructive testing shall be performed on the basis of the PRS Rules, standards and an approved documentation containing the programme for welded joints examination.

3.2.3.8 The structure non-destructive examination shall be performed by qualified operators, accepted by PRS in accordance with *PRS Rules*.

4 BOOM DERRICKS

4.1 General Requirements

4.1.1 The requirements of this chapter apply to boom derricks of conventional structure, which operate:
- with a single boom;
- with booms in union purchase;
- with twin span boom;
- with powered boom.

Booms of special structure shall be subject to special consideration of PRS.

4.1.2 Schemes of typical boom rigging are given in chapter 1, in figures 1.2.1 to 1.2.3.

4.1.3 Rotation axes of the boom heel bearing and of the span rope column bracket shall, in general, coincide with the same vertical. Possible displacement of the span rope bracket in relation to the boom heel will be separately considered by PRS.

4.1.4 Safe and reliable voyage securing of booms shall be provided. Where during voyage booms shall be positioned vertically at the column and the span rope system is not capable of positioning the boom this way, a separate device shall be provided for this purpose.

4.1.5 Opendable blocks may not be used for leading runner and span ropes.

4.1.6 If a boom derrick lifts and lowers the cargo and boom with use of one common engine, and when during cargo lifting and lowering by means of the boom a ratchet locked in the span drum is used, then the ratchet – drum coupling gear shall have efficient locking device, to prevent the ratchet disengagement before the engine is coupled with the span drum drive.

4.1.7 For each boom derrick, except derricks equipped with own span drum and own drive, a span drum complying with relevant requirements (see 4.3.3) shall be provided, where possible.

Where installation of a span drum is not reasonable or not possible, a chain span rope shall be used connected with span rope with use of a triangular plate.

4.1.8 The chain span rope shall be attached to the deck or column bracket. If a rope is used instead of chain, it shall be properly secured on the span winch drum or span drum. Span ropes, guy and preventer ropes are not allowed to be secured using devices applying friction forces (rope locks, buffers, bollards, cleats).

4.1.9 Change of horizontal position of a boom which is inclined to maximum with use of guys is allowed when the vessel's heel is not more than 5° or a trim not more than 2°.

4.1.10 Span or runner rope length shall be so selected that, at all possible positions and movements of the boom during cargo handling operations, at least 3 rope coils shall remain on the drum, whereas for the voyage position of the boom one rope coil is allowed on the span drum.

4.1.11 The boom bearings shall be mounted above the deck at the height of winches location, so that they don't disturb proper runner reeling on the drum and don't impair device operation.

4.1.12 Each boom derrick of SWL up to 20 t shall be provided with at least two rotating guys and each derrick of SWL higher than 20 t – with three rotating guys, to maintain the boom position.

4.1.13 At the loss of tension in the runner rope, no free hanging of lead block under own weight shall occur. Therefore, a buffer or any limiting device shall be provided where the block is secured to a ring mounted on a bearing pin.

4.1.14 Foundations for heavy boom bearings shall be of adequate strength and stiffness. A deck in place where foundations are installed shall be reinforced and the bearing provided with draining holes.

4.1.15 The gear of boom derricks, either the permanently attached or the loose one, shall comply with the requirements of Chapter 9.

4.2 Calculations

4.2.1 When determining forces acting in components of the lifting appliance operating with a single boom, the following angles of the boom inclination to horizontal shall be taken: 15º – for SWL ≤ 20 t and 30º for SWL ≥ 20 t.

If the lowest angle of boom inclination in actual service conditions is more than the above specified angles, this lowest angle may be taken for calculations. In such case it is advisable to take the inclination angle of 30º and 45º, respectively. Calculation of forces for the internal sheave of the block and the blocks for the runner parallel to the boom shall be performed at possibly highest boom inclination angle expected in service, however not less than 60°.

4.2.2 The maximum angle of boom inclination to horizontal shall not be more than 70º.

4.2.3 The maximum angle of boom swinging overboard in relation to symmetry plane shall not be greater than 75º.

4.2.4 Determination of SWL of booms in union purchase and determination of forces acting in the union purchase booms rigging shall be performed for such booms positions, where the forces acting in booms and their rigging, take the maximum values for the given range of operation.

As a rule, forces acting in booms, runners and span ropes during the union purchase operations, shall not be higher than the forces acting during single boom operation. If a force acting in the appliance component (e.g. axial force in the boom) during the union purchase operation is higher than the force acting during single boom operation, the component shall be selected taking the higher force..

4.2.5 Position of booms and arrangement of preventer guy brackets on deck or bulwark shall prevent the boom from self-moving onto the mast (its capsizing) for any boom position and cargo location.

In order to prevent the boom self-moving onto the mast, use of additional internal guys is permitted. Rotating guys may be applied in this case.

The condition for preventing the boom self-movement onto the mast is presence of positive force acting in the boom span rope, calculated including cargo load only and not including boom dead weight.

4.2.6 When calculating forces acting in components of the twin span derricks, the requirements of 4.2.1 may be applied, however, the force acting in the span rope shall be determined at the greatest boom swing to the side opposite to the span rope considered.

At the design shift of the boom bearing in relation to vertical plane joining the span rope brackets, the requirements of 4.2.9 may be applied.

4.2.7 The twin span boom derricks shall be protected against the automatic loss of stability in horizontal plane, at the greatest boom swing overboard, counting from the centre position. For heavy boom derricks, heel and trim angles specified in 4.2.10 shall be taken into account.

Horizontal component of the force acting in the span rope, perpendicular to boom plane and equal to at least 0.1 of SWL, is assumed as contributing to protection against the loss of stability.

4.2.8 In the case two or more light boom derricks operate installed on one mast, such arrangement of the booms shall be taken for calculations at which the highest stresses in the mast cross-sections and the highest forces in the boom standing rigging occur.

Where there are no specific requirements, the value of 1/2 of the rope breaking load shall be assumed as the pre-tension of the standing rigging.

4.2.9 In the case of design shift of the boom heel from the vertical passing the span rope bracket, by the value exceeding 0.025 of the height of the span rope bracket above the boom heel – the forces acting in the boom, span rope and guys shall be determined by calculations, taking into account the limitations regarding distribution of guys and extreme positions of the booms (see 4.1.4).

4.2.10 Load not less than 0.25 the boom derrick SWL force shall be taken as the design load of a guy.

In case of heavy booms, the load value shall be checked by calculations at the heel of 5°, trim of 2° and the highest boom swing overboard. Where, in service conditions, the angles of heel or trim are greater, actual values of these angles shall be taken for calculations.

If means are provided aimed at reducing angles of inclination during the operation of a heavy boom, e.g. ballasting, they may be taken into account in determining loads in guys.

As a design load of a schooner guy or tackles joining derrick heads of union purchase operation, the load not less than 0.1 of the boom derrick SWL force at single operation shall be taken.

4.2.11 The losses due to resistance of friction assemblies in block sheaves and due to rope winding on sheaves shall be assumed to be equal to 5% for each sheave on a slide bearing and 2% on a rolling bearing.

Change of forces acting in structure components of the lifting appliance, due to frictional resistance in sheaves and rope winding in blocks shall be assumed for the cases of movement or movement combination (lifting, lowering of cargo and boom) which is the least favourable for the given component.

4.2.12 Where another boom positions are possible, the calculations shall be performed individually for each boom position. Permissible angles of boom inclination shall be specified in the test certificate.

4.2.13 At the calculation of compression bars and combined compression-bending bars, the effect of eccentric action of longitudinals forces, execution curvature and the deflection due to dead load force on the values of stresses shall be regarded with sufficient accuracy.

4.2.14 SWL forces shall be taken as a design load of boom derricks.

If the boom weight amounts to, or exceeds, 20% of SWL, gravity force due to boom dead load shall be included in calculation of forces (except the calculation for union purchase operation).

For special, non-pipe structure of booms, the load from wind pressure shall be considered – as for derricks (see 2.5.3.1).

At determining forces acting in rotating guys of heavy boom derricks, angles of heel and trim shall be considered, in accordance with 4.2.10.

4.2.15 Bending moments acting in horizontal plane exerted by guys or preventers may be neglected.

4.2.16 At calculation of booms with a spreader, bending and torsional moments due to unequal forces in purchases shall be considered.

4.2.17 Each span rope shall be of such strength as to withstand the SWL force and the force due to the boom dead load at its maximum swinging overboard. Where it has been proved that loss of tension in any span rope is not possible, the span rope strength shall be not less than 2/3 of combined force in a tackle.

4.2.18 Steel wire or synthetic ropes being the internal guys between boom heads during union purchase operation, shall withstand a force of 20% of the SWL force, however, not less than 10 kN.

4.2.19 Where non-typical components have been used for boom derrick construction, PRS reserves itself the right to demand supplementary calculations and/or tests of these components.

4.3 Single Boom Derricks

4.3.1 Loading Masts

4.3.1.1 These requirements apply to cargo handling masts with or without standing rigging.

4.3.1.2 The distance between the mast top and the deck which supports the mast in the longitudinal and transverse plane of the vessel, shall be assumed as a mast length.

4.3.1.3 The minimum external diameter of the mast at a height of its supporting deck shall be not less than L/27. The value shall be maintained up to the height of slewing pin mounted on the mast. For the masts with standing rigging, their minimum external diameter between the lowest stay and the deck where it is attached shall be not higher than L/30.

4.3.1.4 The thickness of the mast wall shall be not less than the highest value taken from those given in table 4.3.1.4.

Table 4.3.1.4

Plates	Minimum thickness, [mm]
Bent	$0.32\frac{d\sqrt{kR_e}}{350+2SWL}$ or $\frac{d\sqrt{k}}{100}$ or 6.5
Flat	$0.32\frac{d\sqrt{kR_e}}{220+2SWL}$ or $\frac{b\sqrt{k}}{60}$ or 6.5

d – maximum external diameter of the considered cross-section of a mast [mm];

For non-circular cross-sections, the diameter of a circle circumscribed on the section is taken as the maximum diameter.

b – width of the plate [mm], however, not less than 60% of the mast width in this point, measured parallel to the plate;

R_e – material yield stress [MPa];

SWL – safety working load [t];

k – working stress to permissible stress ratio.

4.3.1.5 The cargo handling masts shall be fixed in at least two decks or in two supports of adequate stiffness.

4.3.1.6 The wall thickness of the cargo handling masts in non-accessible spaces shall be not less than 5.0 mm, while the wall thickness of masts arranged in open spaces – not less than 6.5 mm.

The wall thickness of masts internally accessible shall be not less than 5.0 mm.

Masts housing ventilation ducts shall have wall thickness not less than 6.5 mm.

4.3.1.7 Abrupt change in the cross-section of cargo handling masts shall be avoided. At places of stress and/or forces concentration, location of manholes or lighting holes, etc shall be avoided.

If they are unavoidable there, they shall be adequately rounded, and their edges appropriately strengthened.

4.3.1.8 Forces for calculation of cargo handling masts shall be determined at such position of the boom or their combination, where the highest forces are exerted.

4.3.1.9 Design of a mast and its components shall prevent collection of condensed water in inaccessible spaces. All components, except the closed one, shall be capable of being checked, cleaned and painted.

4.3.1.10 Stays shall be so arranged that they do not disturb boom or running rigging operation. Fixing stays to the mast traverse is not recommended.

4.3.1.11 Ropes of standing rigging shall be provided with turnbuckles. Shroud and stay brackets shall be adequately fixed to the vessel's hull. The arrangement of bracket planes shall meet the requirements of 9.2.9. Fixing two or more ropes with the use of one fixing device (e.g. a shackle) is not allowed.

4.3.1.12 The mast height to boom length ratio $\frac{L-a}{l}$ (see Fig. 4.3.1.12) shall be not greater than 1.0.

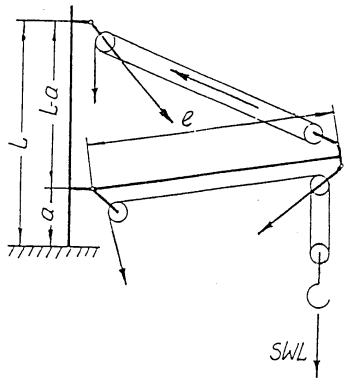


Fig. 4.3.1.12

4.3.2 Booms

4.3.2.1 The present requirements apply to cylindrical section booms with cone or stepped ends.

4.3.2.2 Interrelations of cone and stepped dimensions shall be such as shown in Fig. 4.3.2.2. Use of other structure is allowed, provided that the same values of the boom compression forces are ensured.

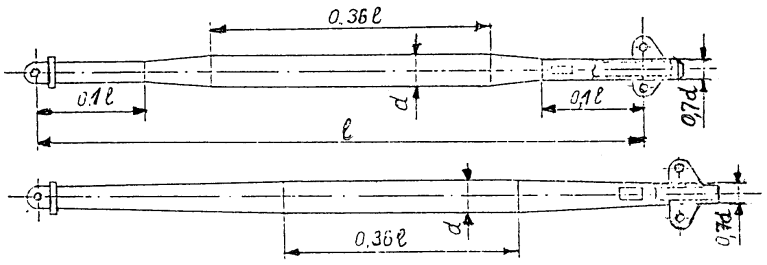


Fig. 4.3.2.2

4.3.2.3 The minimum wall thickness in the middle part of boom shall be greater than $\frac{d}{70}+2$ but not less than 4 mm (d – boom external diameter, mm).

4.3.2.4 No transverse butt weld joints shall be present in the middle part of boom. The distribution of such joints shall be in accordance with PRS recognized standards.

4.3.2.5 The greatest permitted execution curvature of boom axis shall not exceed 1/1500 of its length, both in the plane of suspended load and in the perpendicular plane.

4.3.2.6 The guy boom brackets shall be placed possibly close to the runner and span rope block brackets.

4.3.2.7 Where a (block) sheave is built in the boom, adequate boom reinforcement shall be provided there, to achieve strength of the boom with the sheave equal to the strength of boom without sheave.

4.3.2.8 Booms shall be air-tight, in order to reduce internal surface corrosion to a minimum.

4.3.2.9 After completion of all welding works, the boom internal surfaces shall be, where possible, anticorrosion protected.

4.3.3 Winches and Drums

4.3.3.1 Cargo and span winches used for the change of boom under load position shall comply with general technical requirements. Their drives shall have brakes developing braking moment 1.5 times higher than the necessary minimum moment.

4.3.3.2 In guy winches of heavy-lift single span booms, provision of safety means protecting against excessive guy tension forces is recommended, to prevent exceeding permissible stresses in the boom and the span rope.

4.3.3.3 Span and guy drums with own drive shall be provided with a brake self-acting at the drive switching on or off, or at setting the control lever to neutral.

The brake shall maintain the torque by 1.5 times greater than the maximum service torque, due to crane loading.

4.3.3.4 Drums driven with the use of a rope shall be divided by a flange into two parts: a part for the service rope and the one for the driving rope. Reliable fixing of the driving rope to the span drum and to the driving winch drum or head, shall be provided.

4.3.3.5 Span winches and drums with a smooth surface shall be so arranged that the angle between the rope running to the drum and the plane perpendicular to the drum longitudinal axis is not greater than 4°.

4.3.3.6 Natural or synthetic fibre ropes may not be used as driving ropes (see also 9.5.1).

4.3.3.7 Coupling devices (ratchet wheels and ratchets) shall transmit the torque, at least 1.5 times higher than the maximum torque, due to forces from the maximum load of boom derrick.

4.3.3.8 In boom derricks of SWL higher than 3 t, span drums driven by a rope from the cargo winch shall not be applied.

4.4 Boom Derricks Rigged in Union Purchase

4.4.1 The construction and arrangement of boom derricks rigged in union purchase shall provide the possibility of their use also for single operation.

4.4.2 The equipment of booms immobilized for operation with runners in union purchase shall include:

- **.1** preventers of sufficient strength and their deck and boom head lashing equipment;
- **.2** runner coupling means (including devices for control of the angle between the runner ropes);
- **.3** a means for checking, in service, the extreme positions of booms and preventers attachment, resulting from performed calculations, and checking the angle between runners. A visual check of booms position or of maximum cargo hoisting level is possible if in existing service conditions sufficient reliability may be provided using such control method (e.g. where the range of operational area or set schemes of booms position are limited by such ship structures as hatch coamings, superstructures, deckhouses, etc.). The use of permanently installed indicators of the boom position in relation to the horizontal and to longitudinal plane of ship, is recommended. Where reliable visual control of maximum boom positions and the angle between runners is not possible, such means as marking span ropes, preventers, preventer brackets or other applicable means shall be provided. Preventer fixing points and their lengths shall be designed.
- **.4** a schooner-guy or inner boom guys, for securing the boom against swinging towards preventer.

4.4.3 Installed boom derricks for union purchase shall be capable of being used on any ship side.

4.4.4 In any operational conditions the below requirements shall be observed:

- **.1** the minimum angle of inclination of each boom shall not be lower than 15°; it is recommended that such angle shall not be lower than 30°;
- **.2** the maximum angle between the runner ropes, at the point of equalization of angles between any rope and vertical, shall not exceed 120°;
- **.3** the minimum lifting height shall be such as to ensure free cargo carrying over the upper edge of bulwark or of hatch coaming;
- **.4** the boom overboard radius shall be not less than 4 m.

4.5 Two-span Boom Derricks

4.5.1 The design and installation of two-span boom derricks shall prevent self-movement of the boom along vertical plane towards the mast, with the boom swung to extreme positions. Where necessary, design means shall be provided to restrict the angle of rotation of a span rope or a boom (see also 4.2.6).

4.5.2 Two-span derricks shall have separate span reeving systems fixed directly or by means of a rocker arm to the boom head and to the mast traverse, or to separate pillars.

4.5.3 In order to ensure the boom stability, the span ropes shall be so arranged that the maximum distance between the vertical passing the pin rotation axis and the span rope is not less than 0.11 of the boom length (see Fig. 4.5.3):

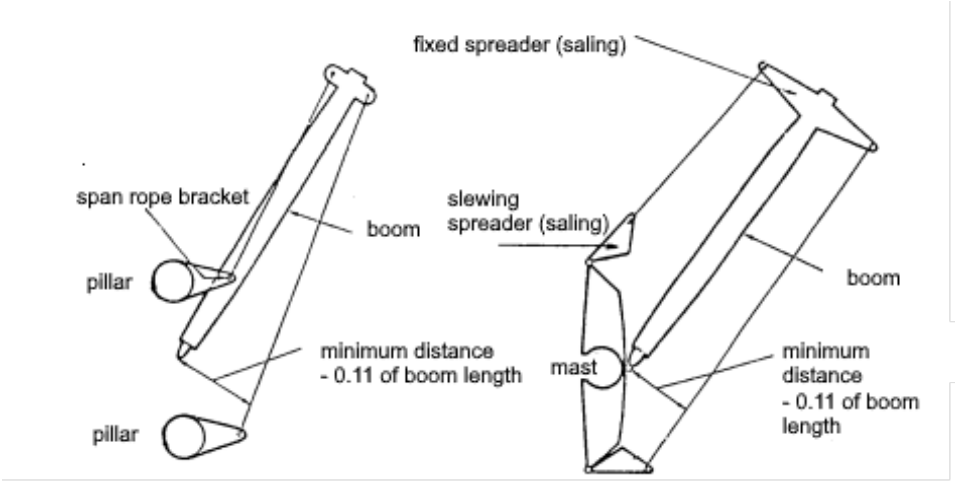


Fig. 4.5.3

The above condition shall be met by:
- restricting the boom slewing angle;
- installation of limiting device on the boom head;
- installation of stop buffers on the pillar or the mast traverse.

4.5.4 Restricting the slewing angle shall be effected by displacing the bracket fixing the span reeving system on the pillar head. The drive limit switches may also be used.

4.5.5 Restricting the slewing angle by means of stiff fender guards is not allowed, as it causes excessive bending moments.

4.5.6 Strength and stability of two-span derricks shall be proved by calculations or by model testing.

4.6 Powered Boom Derricks

4.6.1 The powered boom derricks shall be equipped with automatic switches for disconnecting derricking and slewing mechanisms in extreme positions and in justified cases also with other safety devices.

Installation of safety devices in powered derricks rigged for union purchase is subject to special consideration by PRS.

5 CRANES

5.1 General

5.1.1 Application

The present Chapter applies to cranes and similar lifting appliances installed onboard vessels and on constructions in unprotected waters, intended for loading, lifting and moving cargo.

5.1.2 General Calculation Guidelines

5.1.2.1 It is assumed that vessels to be equipped with cranes have adequate stability. Stability of vessels with cranes which significantly affect their stability shall be proved by calculations, for the moment due to crane proof load.

5.1.2.2 In calculations, environmental conditions in service region and seasonal weather changes shall be considered.

5.1.2.3 At calculation of strength and safety of cranes installed on vessel, their longitudinals and transverse inclinations shall be considered respecting the navigation area and operation conditions. Minimum inclinations to be used in calculations are given in 2.5.2.3.

5.1.2.4 At calculation of cranes operating on open decks, wind pressure shall be considered for both working and non working conditions.

5.1.2.5 Special and supplementary service conditions for individual types of cranes have been specified in subchapters 5.2÷5.7.

5.1.2.6 The loads to be considered in calculations are given in subchapters 2.5, 5.1.3 and in Annexes 1 and 2.

The minimum values of parameters are given there. In justified cases, higher or lower values can be taken in agreement with PRS.

5.1.2.7 Calculations may be omitted if the load-bearing structure components or particular crane items have been manufactured to the standards accepted by PRS and selected in respect to their rated permissible load.

5.1.3 Design Loads

5.1.3.1 The design loads of vessel's deck cranes are divided into basic, additional and exceptional, in accordance with Chapter 2.5.

5.1.3.2 The basic loads of a crane in respective case are:

- the load due to dead load, SWL load;
- component load due to hull list and/or trim;
- component load due to SWL loaded rope swing from vertical;
- vertical mass forces due to SWL and/or crane movements in service;
- mass forces due to vessel's movements in unprotected waters;
- horizontal inertia forces due to crane rotation;
- centrifugal forces;
- components of a mass force perpendicular to the jib due to derricking;
- forces due to initial stress;
- load by ladders and stairs.

5.1.3.3 The additional loads of cranes in particular case are:

- loads due to wind;
- loads due to ice;
- loads by wave impact;
- horizontally acting axial forces on driven wheels;
- forces due to breaking, impact and stroke.

5.1.3.4 The exceptional loads in particular case are:

- proof loads;
- loads due to exceeding permissible load;
- striking the fender guard;
- mass forces due to cargo breaking up.

5.1.3.5 Depending on the location of the vessel, its navigation area and the crane working condition, table 5.1.3.5 specifies relations of loads and associated categories of permissible loads for cranes, obligatory for their various types.

Table 5.1.3.5

No. of load combinations	Vessel on waters	Operational condition	Load case	Loads combinations and resulting load cases																						Crane location	No. of load combination
				Basic loads														Additional loads						Exceptional loads				
				Load components due to																								
				ϕ_{SW}x force due to dead load	ϕ_{SW}x force due to dead load	Ψ_1x force due to SWL	Ψ_1x force due to SWL	vessels heels and trims	permissible deflection of runner from	vessels movements	shift	rotation movement	centrifugal forces	mass forces at derricking	initial stresses	carriage of people and materials	wind pressure	icing	wave impact	skew beveling	breaking and other forces	proof load	permissible overload	striking the fender guard		
1	protected	operates	I	x	–	x	–	x	x	–	x	x	x[1)]	x[1)]	–	–	–	–	–	–	–	–	–	–	open deck	1
2			II	x	–	x		x	x	–	x	x	x[1)]	x[1)]	x	x[2)]	x	x	–	x	x	–	–	–	open deck	2
3			III	–	x	–	–	x	–	–	x	x	–	–	x	x[2)]	–	–	–	–	–	x	–	–	open deck	3
4			III	–	x	–	–	x	–	–	x	x	–	–	x	x[2)]	–	–	–	x	–	–	x	–	open deck	4
5			III	–	x	x	–	x	–	–	–	–	–	–	x	x[2)]	x	x	–	x	–	–	–	x	open deck	5
6			I	x	–	x	–	x	x	–	x	x[3)]	–	–	x	x[2)]	–	–	–	x	–	–	–	–	under deck	6
7			II	x	–	x	–	x	x	–	x	x[3)]	–	–	x	x[2)]	–	–	–	x	x	–	–	–	under deck	7
8			III	–	x	–	–	x	–	–	x	x[3)]	–	–	x	x[2)]	–	–	–	–	–	x	–	–	under deck	8
9		out of work	I	–	x	–	–	x	–	–	–	–	–	–	x	x[2)]	–	–	–	–	–	–	–	–	under deck	9
10			I	–	x	–	–	x	–	–	–	–	–	–	x	x[2)]	x	x	–	–	–	–	–	–	open deck	10
11	unprotected		I	–	x	–	–	x	–	x	–	–	–	–	x	x[2)]	–	–	–	–	–	–	–	–	under deck	11
12			III	–	x	–	–	x	–	x	–	–	–	–	x	x[2)]	x	x	x	–	–	–	–	–	open deck	12
13		operates	I	–	x	–	x	x	x	x	x	x	x[1)]	x[1)]	x	x[2)]	–	–	–	–	–	–	–	–	open deck	13
14			II	–	x	–	x	x	x	x	x	x	x[1)]	x[1)]	x	x[2)]	x	x	–	x	x	–	–	–	open deck	14
15			III	–	x	–	–	–	x	x	x	x	–	–	x	x[2)]	–	–	–	–	–	x	–	–	open deck	15
16			II	x	–	x–	x	x	x	x	x	–	–	–	x	x[2)]	–	–	–	x	x	–	–	–	under deck	16

Notes to table 5.1.3.5:

1) x – part of a load, which if any, shall be regarded in strength calculations;
2) – part of a load not existing or omitted or considered in another way;
3) I, II, III – designation of the load case in accordance with 2.6.6;
4) φ_{sw} – hoist load coefficient due to gravity force of dead load, acc. to table 2.5.2.4.1.
5) φ_{sw*} – after proving increased or reduced values of movement acceleration of a crane and/or a vessel, modified hoist load coefficient due to gravity force of dead load (see subchapters 5.2 to 5.7);
6) Ψ_i – hoist load coefficient due to SWL force acc. to table 5.1.3.6.5, for normal operation of crane in protected waters;
7) Ψ_{i*} – modified hoist load coefficient due to SWL force after proving increased or reduced values of crane/ship movement acceleration;
8) [1] – taken into account at special request of PRS, only;
9) [2] – only basic load for each component or its connection to load-bearing structure;
10 [3] – applies only to movable cranes operating in ships' spaces.

5.1.3.6 Explanations to basic load calculations.

5.1.3.6.1 Crane dead loads shall be determined in accordance with 2.5.2.1.

5.1.3.6.2 SWL shall be determined in accordance with 2.5.2.2.

5.1.3.6.3 For all kinds of cranes included in Chapter 5, design loads components due to object inclination due to static forces and/or dynamic forces in protected or unprotected waters in service or laid-up conditions, shall be determined. It shall be performed in accordance with 2.5.2.3.

5.1.3.6.4 Vertical mass forces due to:
- starting and braking during lifting and lowering of permissible load and at raising and lowering the jib,
- striking during movement of crane, load-bearing structure or cargo winch,
- striking during crane slewing;
- hull movements in protected waters when cranes are in operation,

shall be considered by multiplying SWL or dead load by hoist load coefficients.

5.1.3.6.5 The hoist load coefficient Ψi is given in table 5.1.3.6.5, depending on service group of crane Ki.

Table 5.1.3.6.5

Item	Crane service group K_i	Definitions and explanations	Coefficient Ψ_i
1	K_{11}	K_{11} applies to cranes provided with steel wire ropes, not intended for cargo handling, the hoisting speed of which $V_p \leq 1.5$ m/s	$\Psi_{11} = 1.1 + 0.132\ V_p$
2	K_{11a}	As in K_{11} , however, with hoisting speed $V_p > 1.5$ m/s	$\Psi_{11a} = 1.30$
3	K_{12}	K_{12} includes cranes not provided with ropes intended for cargo handling	$\Psi_{12} = 1.15 + 0.2\ V_p$
4	K_{13}	K_{13} includes cranes provided with steel wire ropes not intended for operation with grabs and with SWL not greater than 100 t, operating at a speed of $V_p \leq 1.5$ m/s	$\Psi_{13} = 1.0 + 0.066\ V_p$
5	K_{13a}	As in K_{13}, however with hoisting speed $V_p > 1.5$ m/s	$\Psi_{13a} = 1.10$
6	K_{21}	K_{21} includes cranes provided with steel wire ropes, intended for handling general cargo and containers or for the carriage of cargo of mass < 60 t with hooks, or with SWL > 100 t with grabs. In all cases the hoisting speed ≤ 1,5 m/s. These cranes in operation are often loaded with SWL and permanently operate at 0.33 to 0.67 SWL, however, in work period, the number of load changes shall not exceed $6 \cdot 10^5$	$\Psi_{21} = 1.2 + 0.264\ V_p$

Item	Crane service group K_i	Definitions and explanations	Coefficient Ψ_i
7	K_{21a}	As in K_{21}, however, at hoisting speed of V_p > 1.5 m/s	Ψ_{21a}= 1.60
8	K_{22}	As in K_{21} or K_{21a}, however, the cranes are not provided with ropes	Ψ_{22} = 1.25 + 0.33 V_p
9	K_{31}	K_{31} includes cranes with SWL <60 t, which during cargo handling operations are normally loaded with SWL and whose number of load changes during work period is higher than $6 \cdot 10^5$. These cranes may be used for loading cargo to deck or operation by grabs, at hoisting speed $V_p \leq$ 1.5 m/s.	Ψ_{31} = 1.3 + 0.396 V_p
10	K_{31a}	As in K_{31}, however, at hoisting speed V_p > 1.5 m/s	Ψ_{31a}= 1.90
11	K_{32}	As in K_{31}, as regards SWL, number of load changes and hoisting speed. The cranes are, however, intended for operation with grabs for the time exceeding 75% their work time.	Ψ_{32} = 1.4 + 0.528 V_p
12	K_{32a}	As in K_{32}, however, at hoisting speed V_p > 1.5 m/s	Ψ_{32} = 2.20

5.1.3.6.6 The hoist load coefficient of the dead load φ is given in table 2.5.2.4.1.

5.1.3.6.7 Cranes intended for operation onboard vessels in unprotected waters shall have PRS calculations and acceptance for such service.

Mass forces present in such service due to hull motion in waves shall be included together with data given in subchapters 5.2 to 5.7 for particular kinds of cranes.

5.1.3.6.8 For cranes present in unprotected waters and being out of service, mass forces due to hull motions in waves shall be considered. If the mass forces which have not been agreed with stability calculations are not measured, the load components may be determined acc. to 2.5.3.4.

5.1.3.6.9 The horizontal mass forces due to shift and braking or accelerating and stopping the rotating components of structure shall be determined in accordance with 2.5.2.4.2.

5.1.3.6.10 The centrifugal forces and the mass forces due to jib raising and lowering, perpendicular thereto, shall be determined in specific cases upon agreement with PRS.

5.1.3.6.11 Initial stress forces acting permanently in the load-bearing structure (screw connections, tense items) shall be calculated by the manufacturer and controlled during installation.

When calculating stresses, their maximum values shall be considered.

5.1.3.7 Explanations for calculation of additional loads

5.1.3.7.1 Effect of the wind pressure on crane components shall be determined in accordance with 2.5.3.1.

Wind pressure on the permissible load shall be not more than that given in table 2.5.3.1–3.

5.1.3.7.2 The load due to icing shall be taken into account in accordance with the requirements of subchapters 5.2, 5.3, 5.4 and 5.7 for special kinds of cranes and operational conditions. The load value shall be determined in accordance with 2.5.3.2.

5.1.3.7.3 For cranes being out of service on the vessel's open deck, or on similar object or on a pontoon floating on unprotected waters, the load due to wave impact P_S onto the main deck plane shall be considered up to the height 2.5 m above the deck. The load shall be determined according to 2.5.3.5.

5.1.3.7.4 Horizontal axial forces acting during movement at the lower edge of driven wheels shall be considered for two-rail bridge cranes or crane cars.

If only two driven wheels or balance elements run on one running rail, then horizontal axial forces applied to one pair and having one moment may be approximately calculated from the below formula:

$$S_{ax} = \chi S_r \quad [\text{kN}] \qquad (5.1.3.7.4)$$

where:

S_{ax} – horizontal axial force acting in one driven wheel or balance element [kN];
S_r – the greatest force acting onto a wheel or balance lever on the rail [kN];
χ – skew factor acc. to table 5.1.3.7.5.

Table 5.1.3.7.4

Item	Ratio of running wheel width s to distance a between axles of wheel pairs	Skew factor χ
1	$s/a < 2$	0.05
2	$2 \le s/a \le 8$	$0.025 \cdot s/a$
3	$s/a > 8$	0.20

Where more than two driven wheels or balance levers are provided on one rail, then the horizontal axial forces shall be determined using agreed methods.

5.1.3.7.5 If for special cranes in normal service destructive impact loads occur, which are higher than the permissible loads and resulting mass forces acting during lifting and lowering, the above given forces shall be determined (by measurement) and considered individually.

Impact forces, acting during normal operation with grabs, electromagnetic or vacuum grabs, are already taken into account in hoist load coefficients determined in subchapters 5.2-5.7.

5.1.3.8 Explanations to calculation of exceptional loads

5.1.3.8.1 Loads existing at overload tests, as specified in subchapter 10.3 during initial and periodical surveys, are assumed as special loads not existing in normal operation and considered at strength calculations for the assumed proof load conditions. Hoist load coefficients and mass forces may be determined at the tests of speed, acceleration and deceleration of proof load and mobile components of crane. At lowering the test weight, sharp braking shall be performed.

Hull inclinations shall be considered in each case, in accordance with the requirements of 2.5.2.3. Loads due to wind pressure may be neglected.

5.1.3.8.2 If in special cases (e.g. during assembly works or counterweights modifications) exceeding the permissible load range is allowed, strength checking as at proof load test is obligatory.

In no case, the sum of exceeded and permissible load shall be more than the proof load value specified in table 10.3.4. Values of speed, acceleration and deceleration of permissible load and crane components shall not be higher than permissible values at proof load tests.

5.1.3.8.3 For cranes running on rails, the effect of strike against buffers on the load-bearing structure and permissible load movements shall be considered. The rated speed of crane movement shall be taken into account as a calculated movement starting speed.

Where, simply taken, the buffers shall absorb the general movement energy, then the movement starting speed may be assumed by 10% less.

5.1.3.8.4 For cranes having considerable effect on (transverse and longitudinal) stability of the vessels they are installed on, effect of breaking cargo on maintaining sufficient stability or on jib easing out shall be considered. If specified checks have not been performed, then negative value of factor ψ_i = – 0,3 shall be taken (see also 2.2.5.1).

5.1.4 Calculations

5.1.4.1 Stresses existing in parts and connections of the load-bearing structure, welded joints of parts, shall be calculated including:
- loads according to subchapter 5.1.3, table 2.7.1–1 and table 2.7.1–2;
- load cases according to 2.6.6;
- load combinations for particular types of cranes in subchapters 5.2 ÷5.7.

Calculated stress values shall not be more than the given permissible stress values in formula 2.7.1-1.

5.1.4.2 As a rule, the basic and additional loads act simultaneously, as specified in 2.6.6.1, with the exception of special cases.

Under agreement with PRS, other load combinations may be allowed after submitting special instructions and explanations concerning the crane operation and securing.

In each case, the assumed loads and load combinations shall conform to operation regime and load case.

5.1.4.3 For materials of other type and strength, permitted for crane manufacture, permissible stresses shall be agreed with PRS.

5.1.4.4 If not specified otherwise for particular types of cranes, fatigue strength shall be checked in accordance with 2.8.1.

Cranes division into categories regarding load change frequency and loading condition, into groups of cranes and groups of stresses, and into hoisting classes shall be carried out in agreement with PRS.

5.1.4.5 For hazardous stability components, sufficient stability shall be proven in accordance with 2.6.3, 2.8.2, 2.8.3 or, upon agreement with PRS, in accordance with national or international standards.

5.1.4.6 For travelling cranes, respectively to crane type, its place of installation onboard and vessel's location, the crane sufficient safety shall be proven against:
- capsizing;
- crawling;
- skew

The above calculations may be carried out according to requirements contained in Attachments Nos. 1 and 2 to this *Part* of the *Rules* if they are not performed according to national or international standards accepted by PRS.

5.1.4.7 If the jib is not secured against the loss of stability at minimum radius by a spring buffer having an elastic force sufficient for jib return movement at any possible angles of its inclination in operation, then it shall be proven by calculations that the jib will not self-capsize or loose

stability. The condition of securing against the loss of stability is positive force existing in the jib rope system for all positions in the whole radius range.

The above shall be calculated with the below assumptions:
- permissible load on hook;
- execution of necessary normal movements by cargo and crane;
- inclination of the crane to the side opposite to the crane reach by the possibly highest angle during vessel's operation;
- load by wind pressure acting on the load and crane in an inclined position opposite to the crane reach;
- taking into account frictional forces acting in the jib articulations.

5.1.5 General Requirements for Structures

5.1.5.1 The crane with a jib suspended on ropes shall be so constructed that no stability loss shall occur during the jib movements within the radius range (see 5.1.4.7).

5.1.5.2 Parts that require technical servicing, shall be readily and safely accessible.

Mechanical systems, the load-bearing structure nods and components shall be so designed that service and repair works, as well as visual examinations can be performed with low amount of work.

5.1.5.3 Easily accessible movable parts in walking areas of the servicing and maintenance personnel shall be properly enclosed.

Inspection and maintenance openings shall be provided with covers.

Opening of hinged covers or enclosures shall be possible without tools.

5.1.5.4 Parts and materials which may corrode shall be designed so that corrosion prevention and their efficient maintenance is ensured. The components shall be corrosion protected.

5.1.5.5 Empty non-planar structures, such as box-type beams, pipe beams, which are hermetic (air-tight) and have no holes for entry or examination, shall be internally preserved during assembly, provided they are clean and dry.

5.1.6 Load-bearing Structure and Counterweights

5.1.6.1 Taking into account the requirements for the load-bearing structure contained in this Part of the Rules, the structure may be designed and manufactured according to PRS accepted standards, which can be used upon special approval by PRS.

5.1.6.2 At the selection of material category, the requirements of paragraphs 1.5.1.3 and 2.2.4, and the accepted type of component joints shall be considered.

5.1.6.3 The thickness of steel sections and plate walls is determined based on the strength and stability requirements. However, in the load-bearing components, the minimum thickness of walls shall not be less than:
- for air-tight structures: 6 mm
- for structures easily accessible for inspection and maintenance: 6 mm
- for air-tight pipes: 6 mm
- for structures in enclosed spaces of normal humidity and temperature: 6 mm
- for non-enclosed boxes or pipe elements inaccessible for inspectionand maintenance: 7 mm

For passages, platform handrails and non-loaded structure components, the minimum wall thickness shall not be less than 3 mm.

5.1.6.4 The web width of riveted or bolted rolled sections shall not be less than 50 mm, while for welded sections – not less than 40 mm.

Welded stiffening ribs shall be not less than 40 mm in height.

5.1.6.5 Cuts in the load-bearing structures made for passage, examination, maintenance, assembly of pipelines, cables, etc. shall be rounded with appropriate radius, and their edges strengthened with use of stripes and frames, taking into account strength and stiffness requirements.

5.1.6.6 Cold bent sections shall be made of killed steel. At the selection of material grade and bending radius, it shall be considered that the cold bent and welded material will not be brittle and breakable even at the lowest working temperatures. The bending radius R shall be in accordance with the requirements of 3.2.2.3.

5.1.6.7 Welded joints shall be performed in accordance with the provisions of subchapter 3.2. If practicable, undisturbed flow of forces shall be ensured, without internal or external undercuts, non-resistant stiffness, and tension restrictions. It applies also to welding of normally non-weldable parts adjacent to the main assembly to freely distributed strip edges. Structure items are not to be welded and fixed to the highly-tensed components, unless special consideration is given to fatique strength during calculations.

5.1.6.8 Riveted and bolted joints of the load-bearing nods and structure components shall be performed in accordance with PRS accepted standards.

Moreover, the below provisions shall be considered:
- diameter d of rivets and bolts in joint shall not be less than 12 mm;
- the maximum length of tightened riveted joints with semi-countersunk headed rivet, shall not be higher than 0.2 d^2;
- the number of rivets and bolts, which are in one joint or are located on one side of the contact, shall not be less than 2;

5.1.6.9 Design arrangement and distribution of nods and components consisting of non-air-tight items shall ensure drainage of sea, rain and condensed water. For non-air-tight spaces, ensuring sufficient air circulation is recommended.

5.1.6.10 Design of the crane counterweight shall prevent the change of set mass in service. Particular masses in counterweights shall be fixed so that to prevent their shifting. Counterweights, their fixing devices and enclosures shall be so manufactured that weather, wear or other similar reasons do not influence their mass.

5.1.6.11 Movable counterweights shall move automatically with the crane derricking or shall be provided with easily visible indicator of counterweight position in relation to the crane radius. Jamming of a movable counterweight shall not be possible during its shifting.

5.1.7 Mechanical Parts

5.1.7.1 The mechanical parts of cranes shall be manufactured according to PRS accepted standards.

5.1.7.2 Where mechanical parts of cranes are required to be made of higher strength steels or steels heat treated for a defined range of service temperature, it is to be ensured that the material for components loaded for tension, bending and shearing, after final treatment has at ambient temperature the elongation of not less than A_5 = 12%.

5.1.7.3 Steel castings may be used for the bodies of travel wheel bearings, rope and fairlead sheaves. The rope and fairlead sheaves may be made of cast iron.

5.1.7.4 Axles, pins and rollers shall be forged.

5.1.7.5 For rope and deflection sheaves and their axles and pins, the forces acting in a rope may be taken as for the load in 2.7.2. Permissible stress value acc. to 2.7.1 may be reduced if the hoist load coefficient ψi for the given crane acc. to table 5.1.3.6.5 is higher than 1.45. The value of 1.45/ψi shall be used as a reduction factor. The value of a permissible unit pressure between fixed steel parts shall not be more than 80% of the permissible compressive stress in the component.

5.1.7.6 In rope sheaves and fairlead sheaves on roller bearings and in working travel wheels, the ratio of the maximum permissible static load to the radial load during proof load test, shall not be less than 1:10.

5.1.7.7 Thrust and sling structure of a rolling bearing shall be accepted for use in cranes onboard vessels. For applied supporting structure of cranes their statical and dynamical load capacity shall be proved by calculations or by experiment. The boundary load diagram, together with data on their determination shall be agreed with PRS.

5.1.7.8 At the selection of thrust and slingstructure for the given crane, features specific at designed load provided in subchapters 5.2 to 5.7 for particular types of cranes shall be considered. Screw connections shall be determined taking into account provisions of 2.9.1.

5.1.7.9 Where protection against ropes falling off the sheaves is not ensured by sheaves arrangement, rope sheaves shall be provided with special protecting devices. Clearance between sheave edge and a device protecting rope from falling of shall not be greater than 0.20 dk (dk is a diameter of the rope sheave). At the mobile (swinging) arrangement of rope sheaves, appropriate means shall be applied to prevent rope sliding off the sheave boss.

5.1.7.10 Driving wheels and rollers provided also for lateral move of cranes on traffic rails, shall be provided on both sides with flanges. Flange dimensions shall not be less than those given in table 5.1.7.10.

Table 5.1.7.10

Item	Dimension	Minimum values
1	Flange height	$h = 0.0133\ d_k + 11.7$
2	Flange width	$b = 0.02\ d_k + 15$
d_k – diameter of a driving wheel or a roller		

Driving wheels and rollers are recommended to be manufactured with use of materials capable of being surface hardened.

5.1.7.11 The lubrication system of mechanical elements shall ensure good lubrication in all operational conditions. At least one lubricating point of tested structure shall be provided to each bearing with grease.

At least three lubricating points uniformly distributed on the circumference shall be provided on each ring bearing for each row of rolling components.

5.1.8 Ropes and Loose Gear

5.1.8.1 Ropes and loose gear for onboard cranes shall comply with the requirements given in subchapters 1.5, 2.6, 2.7, 9.3 i 9.4 (ropes and chain cable drives, see 5.5.3).

5.1.8.2 After agreement with PRS, the below ropes may also be used in cranes:
– steel wire ropes of tensile strength of wire more than 1770 MPa;
– steel wire ropes without organic core;
– steel wire ropes made of stainless wires.

5.1.8.3 The length of ropes for cranes shall be so chosen that at the lowest position of a load-handling device (a hook, etc) or at maximum radius in case of jib lowering, three reserve rope coils remain on the drum.

5.1.8.4 Runner diameter is recommended to be chosen not less than 12 mm and the guy-rope diameter not less than 18 mm. It does not apply to ropes for cranes from service groups K11 and K11a in table 5.1.3.6.5. If the cranes are installed on an open deck, the minimum diameter of a rope may be less than 10 mm.

5.1.8.5 In grab cranes, where also an electromagnetic safety stop or a hook are applied, ropes may be connected with use of turned out rope connectors provided with a cone sleeve, if such detachable fixtures may pass rope sheaves.

5.1.8.6 Ropes attachment and arrangement shall prevent their falling off the drums or sheaves, and their wear due to rope chaffing by another rope or by crane structure. Rope ends, also those of non-loaded ones, shall be properly attached to the drum, to structure, etc. (see 1.5.1.8). The attachment shall be selected for the highest static proof load.

5.1.8.7 Cranes of SWL ≤ 20 t, which are intended to be used for cargo handling with hooks, shall be provided with cargo hooks, which do not touch protruding structure items during lifting and shall prevent falling slings off the hook throat.

In other cases, simple and ramshorn hooks, see 9.3.5.2, and upon agreement with PRS, also special structure hooks may be used.

5.1.8.8 Permissible load of loose gear manufactured in accordance with PRS accepted standards or determined by calculations, shall be chosen for the expected SWL of a crane, taking into account the load factors χ given in 2.7.2.

5.1.8.9 The loose gear not manufactured in accordance with PRS accepted standards shall comply with the requirements of subchapter 5.1.7, including the requirements of 2.9.2, 2.9.3, 9.3.3.2 and 9.3.3.3.

5.1.8.10 The dead load of the loose gear operating with a hook shall be so selected that the runner rope is not loosening at the non-loaded hook.

5.1.8.11 The loose gear used together with a crane shall have clear and well visible marking.

5.1.9 Mechanisms

5.1.9.1 Selection of material and design of deck cranes mechanisms, as well as determining dimensions of the loaded components shall comply with the requirements of subchapters 5.1.9 to 5.1.14 and 2.9.5, as well as applicable requirements of subchapters 5.1.2 to 5.1.8, and subchapters 5.2 to 5.7. The above provision refers also to bodies and components connected to the load-bearing structure.

5.1.9.2 Where an auxiliary hoisting mechanism is fitted, a lock shall be provided to prevent simultaneous use of both, main and auxiliary, mechanisms. However, where both winches shall operate at once, and the load-bearing structure is designed for simultaneous operation of both devices, such lock is not necessary.

5.1.9.3 The manufacture and arrangement of rope drums shall fulfil requirements of subchapter 1.5.2.

5.1.9.4 The number of rope coils remaining on the drum, excluding the attachment coils, shall not be less than three for the smooth drum, and not less than two for a grooved drum. The rope ends shall be attached to the drum by means of wedge sockets or by at least two sockets secured by bolts, see also 1.5.1.8.

End attachment of the rope shall withstand the maximum static load of rope corresponding to the proof load. The attachment shall be such that the rope does not touch sharp edges and does not detach accidentally.

5.1.9.5 With manual drive supported by a crank, the below shall be considered:
- permissible force of 160 N per each operator;
- crank radius 350 mm;
- permitted number of crank turns 30 ±1;
- the same directions of crank turns for all gears;
- rolling sleeve on the crank handle;
- protection of removable cranks against inadvertent take off;

Brakes and locks for manually operated winches are referred to in 1.5.3.12.

5.1.9.6 In crane winches designed not only for mechanical drive, but for manual drive as well, both drives shall be provided with sufficient locking arrangements preventing their simultaneous use.

5.1.9.7 Cranes moving along transverse axis of the hull shall be driven with the use of a toothed gear or a leading gear. Use of such arrangement for cranes moving along the vessel's hull length may be required by PRS after the anti-creep means are considered necessary.

5.1.9.8 The travel speed of cranes controlled by walking operators shall not exceed 0.5 m/s.

5.1.10 Brakes

5.1.10.1 Clutched mechanisms for lifting and derricking shall be provided with a non-separable kinematic connection between the brake and the rope drum.

5.1.10.2 Mechanically driven thrust and slewing mechanisms shall be equipped with brakes if the mechanism gear is not self-braking. Brakes shall be so selected that having considered the most unfavorable loads according to subchapter 5.1.3, the rotating part of the crane can be properly stopped and held. This shall be also ensured in shut-off condition if appropriate arrangements locking the rotating part of crane are not provided. For cranes which shall be operated in unprotected waters, the required braking moment shall be not less than 1.5 of the moment due to load on the brake shaft.

5.1.10.3 Controlled open brakes of the slewing mechanism shall be provided with a stopping device in order to prevent automatic rotation of the crane rotating part in a tightened position.

5.1.10.4 Power driven movable cranes, winches and travel mechanisms of lifting appliances shall be provided with brakes.

Brakes of travel mechanism shall be self-acting and normally tightened, except the travel mechanisms for car cranes. During crane operation, devices for uniform or periodical braking are allowed.

5.1.11 Safety devices

5.1.11.1 Cranes installed on vessels shall be provided with appropriate safety devices which shall be durably attached to the crane structure and shielded as a protection from mechanical damages.

The devices shall be resistant to weather, dirt or breaks (spring break).

Possibility of checking the safety devices shall be ensured.

5.1.11.2 Self-acting limit stops stopping the driving mechanisms before the crane reaches its limit position, shall be installed thereon. After the limit stop operates, the crane move in opposite direction shall be possible after normal start. Application of sensor self-acting switches is demanded.

Switches shunting the limit switches shall be accessible to authorized persons only.

5.1.11.3 Lifting mechanisms shall have limit stops for upper and lower position of a load-handling device. Limit stops shall be provided also for the lower position when the operator can not monitor the cargo movements and the crane operation is not assisted from a watch point. In each case, for a tackle, the limit stop shall be provided for the deepest position. After agreement with PRS, the limit stops in hydraulic lifting mechanisms may be omitted, provided that an overflow valve of the lifting system prevents damage to the structure when the load-handling device reaches its limit position.

5.1.11.4 The lifting movement limit stops for multi-engine mechanisms (e.g. in cranes with grabs) shall simultaneously shut off all drives, when one of mechanisms reaches its limit position.

5.1.11.5 The derricking mechanisms shall be provided with limit stops self-acting at both extreme positions of the radius range. Shunting may be applied for the lower limit, where the jib is laid below the lower working position. Shunting during crane operation shall not be allowed.

5.1.11.6 If the lowered jib comes up the load-handling device, disconnecting the lowering mechanism shall be accompanied by disconnecting the derricking mechanism at downward movement.

5.1.11.7 Cranes with limited slewing angle shall be provided with self-acting limit stops to be used for stopping the mechanism at exceeding the radius range in both directions.

5.1.11.8 The power driven travel mechanisms of cranes, winches and hoists shall be provided with limit stops for both extreme positions.

The limit stops shall be so arranged that the crane, after action of the limit stop and braking the powered mechanism, is not able to run into the buffer. Where collision with the buffer is unavoidable, the buffers shall be not squeezed more than it is expected.

5.1.11.9 Where several cranes or winches move on one track, they shall be provided with stops preventing collision.

5.1.11.10 The jib cranes, whose stability is proved, shall be provided with load moment limit stops which eliminate any working movements at exceeding the permissible load moment, except lowering cargo and reducing load tipping moment. In slewing jib cranes (where the cargo does not move horizontally), the derricking mechanism shall be capable of being disconnected for both directions. The limit stop of the load moment shall operate at least when the permissible load moment is exceeded by 10% at designed operation range.

5.1.11.11 The load moment limit stops shall be so designed and arranged that their premature operation is not possible at permitted load for the given position, during normal cargo and crane movements. Re-connecting the mechanism drive conditioned by inclination after operating the limit stop shall not pose any hazard.

5.1.11.12 Cranes which may not be used with permissible load within the whole operating range shall be equipped with moment limit stops, where the jib inclination will change under load.

If the jib inclination change is possible only without load on hook, it is sufficient to install a jib inclination indicator well visible from the control position. The load permissible for the given radius visible on the panel, shall be given. Determination of permissible SWL for jib radius or for jib inclination angle is equally important.

5.1.11.13 If the cranes may be used only in association with the devices limiting hull inclination, the devices shall be self-acting or so installed that its operator is able to observe the operation of all cranes. The devices shall be accepted or means adopted to ensure safe and proper transferring surveyor's orders to the crane operator and the device operator.

5.1.11.14 In cranes with a jib suspended on ropes, sufficient span ropes pull shall be ensured in all operational positions. At the drop of rope pull, installation of switches and/or tensioning rollers is allowed.

5.1.11.15 Cranes operating in parallel and situated either on one common ring slewing bearing or separately, shall be provided with a self-acting switching-off device which disconnects all operations with crane and cargo, after any faults of the crane synchronization system. They shall at least be provided with sound signals warning of the existing faults.

Such cranes shall be provided with a system ensuring control of both cranes. Where any of limit stops operates, both cranes shall be disconnected.

5.1.11.16 For grab winches, it is recommended to provide rated capacity limiters which disconnect the winch drive when the rope force is by 10% higher than normal value for the grab.

5.1.11.17 Driving systems of cranes shall be protected against overload by adjusted safety devices (such as maximum fuses, maximum pressure valves, protecting friction clutches). After power supply break, drives shall not start automatically.

The devices shall be set so that they automatically disconnect the power supply, if the current, pressure and moment values necessary for proper operation of crane (permissible hull load and inclination, rated speed and expected working cycles and their continuation) increase by more than 10%.

5.1.11.18 Where at the operation of higher number of cranes it is not possible to avoid their overload, an overload indicator able to show also the load of other cranes shall be provided at the control position.

5.1.11.19 Cranes, whose stability calculations shall take into account the wind pressure, shall be provided with a signal device operating when the wind reaches design boundary speed for operational conditions.

The wind speed indicator shall be so installed that it is not obstructed by the crane structure or ship's hull.

5.1.11.20 Powered onboard cranes moving on rails shall be equipped with a signaling device self-acting during crane travel. If such device may also give sound signals, it shall be independent of, and acoustically differ from, the operator controlled sound signal (see 5.1.12.3).

5.1.11.21 A device for indicating hull inclination angle shall be provided on the car crane control position or in a place well visible from the control position. If the crane supports are not controlled from the control position, the hull inclination indicators shall be also placed in the control position for supports.

5.1.11.22 For cranes with a jib suspended on ropes, spring limiting resisting devices (spring fenders) shall be provided for the minimum radius.

5.1.11.23 Cranes travelling on rails shall be provided with strong permanent rail holders or revolving rollers.

5.1.11.24 Movable cranes, winches or appliances shall be provided with anti-creep devices. The devices shall be capable of operating in cranes mounted on open deck, in each point of the travel track. It is recommended that the devices shall have mechanical drive and control from the crane control position.

In other cases, any devices, which may be capable of functioning, at appropriate design and for shut-off condition, as an anti-creep device, are allowed to be arranged (see also 5.1.15).

5.1.11.25 Frames of movable cranes and cargo winches shall be equipped with resisting elements situated at a distance not more than 20 mm above the rails, to protect cranes from capsizing in case of the crack of travel wheel or its axis. The elements shall be calculated for the highest possible load.

5.1.11.26 Cranes moving on deck rails shall be provided with track cleaning devices, unless crane design prevents falling foreign particles under crane wheels. Where appropriately designed, the rail cleaning devices may fulfil the function of resisting devices against wheel crack.

5.1.11.27 Cranes, winches and hoists driving machinery moving on rails or beam webs shall be provided with elastic buffers.

Such buffers may also be arranged on fenders which resist movements.

5.1.11.28 At the ends of travel tracks of cranes or winches, fenders shall be installed calculated for impact of a crane, winch or hoist moving with the highest working load and at rated speed.

5.1.11.29 Doors and entrances on revolving (movable) parts of cranes intended for crane crew passage shall be provided with locking devices preventing actuating the crane appliance movement mechanisms at open doors.

5.1.12 Control, Monitoring and Warning Devices

5.1.12.1 Control positions and devices shall be so designed and arranged that the sitting operator can follow the whole operation and indicators. The operator shall have unobstructed view of cargo or the signaling device for each position of jib and crane.

5.1.12.2 Control devices shall prevent simultaneous use of more than two mechanisms if the appliance is not designed for that.

5.1.12.3 Cranes provided with permanent control position situated either on the crane or onboard vessel, and with remote radio control shall be equipped with a sound warning device capable of being actuated by the operator at any time.

The sound warning signal shall be well-audible and distinguishable from other sound signals and work or other noises (see also 5.1.11.20).

5.1.13 Electrical and Electronic Equipment

5.1.13.1 The electrical equipment of a crane installed on a vessel shall comply with the provisions of subchapter 1.5 and applicable requirements of the Rules for the Classification and Construction of Sea-Going Ships, Part VIII – Electrical Installations and Control Systems.

5.1.13.2 In cranes installed onboard vessels, program electronic control systems and safety systems may be used, upon agreement with PRS.

5.1.14 Crane Foundations

5.1.14.1 Cranes, rail track substructures and beams shall be connected to the vessel's load-bearing structure ensuring the same strength and safety factors as required for the crane steel structures in subchapters 5.1.2 to 5.1.4 and in subchapter 5.1.7 for the ring and thrust bearing.

5.1.14.2 Crane supporting foundations shall be so executed that additional loads of the crane steel structure due to hull distortion shall be avoided if practicable, to such extent that such loads can be neglected in strength calculations.

In doubtful cases, PRS may demand foundations distortion and strength calculations.

5.1.14.3 Crane rails and rail track substructure beams shall be so fitted that the resistance surface for the rail contact surface of crane wheels and rollers is parallel to the base plane of non-inclined hull.

5.1.14.4 Decks and their parts, which are used for the travel of car cranes and supporting foundations or which are used for temporary storage of heavy cargo shall be dimensioned and designed respectively to existing maximum loads (e.g. pressure on wheels or pressure from supporting foot).

5.1.14.5 With the purpose to transmit horizontal forces due to skew in way of connecting one pipe of crane column to deck, the connection length may be assumed equal to 0.65 the pipe diameter at both sides of crane column.

5.1.15 Resistance Structures, Anti-creep Devices and Rope Attachments

5.1.15.1 For out-of-service condition, movable cranes and crane movable parts shall be secured by resistance structures, anti-creep devices or rope attachments, both in protected and unprotected waters, taking into account expected environmental factors for the given navigation region.

5.1.15.2 Resistance structures, anti-creep devices and rope attachments, as well as associated components of crane and vessel structure shall be dimensioned, taking into account loads of out-of-service cranes given in subchapter 5.1.3 and with the use of permissible stresses given for load case III.

When selecting steel wire ropes, a minimum breaking strength reserve of 2.5 shall be taken. The rope attachments may be determined applying the provision of 1.5.1.10.

5.1.16 Warning, Prohibiting and Informing Marks and Plates

5.1.16.1 Cranes shall be provided with plates to show clear and durable inscription on accepted crane permissible load.

5.1.16.2 Well-visible plates to inform on specific operational and/or environmental conditions the crane may be operated in, based on the documentation, shall be attached on the crane, in well-visible place.

5.2 Shipboard Deck Cranes

5.2.1 General and Special Provisions

5.2.1.1 The requirements of this chapter apply to shipboard deck cranes with power drive.

5.2.1.2 Shipboard deck cranes shall be divided into service groups K_i given in table 5.1.3.6.5, depending on defined criteria, such as:
- designation;
- structural properties;
- limitation on permissible load and lifting speed;
- kind of load-handling device;
- number of operation hours per a year, switch-on time, operational regime.

Cranes are accepted for service taking into account service group K_i which was the base for the crane manufacture and testing.

5.2.1.3 After agreement with PRS, in exceptional cases, cranes may be used according to regime of the service group one degree higher than above mentioned, if the SWL is reduced for the time regarding hoist load coefficients ψi specified in table 5.1.3.6.5.

5.2.1.4 If a crane shall be operated according to one degree higher service group regime, new acceptance concerning this service case shall be requested.

The request shall be supplemented by respective technical documentation on crane fitness for such service.

5.2.1.5 The jib cranes of service groups K11, K11a, K12 not provided with load moment limit stops, are accepted only for one permissible load for the whole range of unloading.

5.2.1.6 No permanent overboard gangways or stairs with their access region shall be present in permitted region of unloading by shipboard deck cranes.

5.2.2 Calculations

5.2.2.1 If not specified otherwise, strength, stiffness and stability calculations for shipboard deck cranes shall be performed in accordance with the requirements given in Chapter 2, and subchapters 5.1.2 to 5.1.4 and in Attachment to this Part.

5.2.2.2 Depending on the kind of crane, its purpose and mounting location and on the vessel location during crane operation, appropriate load combinations in accordance with table 5.1.3.5, Nos. 1, 2, 3, 4, 5, 10, 12, 13, 14, shall be considered during strength calculations of shipboard deck cranes.

5.2.2.3 The dynamic factors of crane dead load φ are given in table 2.5.2.4.1. For load combinations Nos. 3, 4, 10 and 12, from table 5.1.3.5, a modified dead load factor φ_{SW^*} = 1.0 may be taken. For combination No. 5, increasing the factor value appropriately to the values of existing mass forces, is possible. For combinations Nos. 13 and 14, provisions of 5.2.24 apply.

5.2.2.4 The hoist load coefficients ψi are given in table 5.1.3.6.5 depending on the crane service group Ki. The requirements of 5.2.1.4 and 5.2.1.5 shall also be considered. For cranes operating in unprotected waters (Nos. 13 and 14), only for wind pressure 2 and wave pressure 1 (according to instructions), a modified hoist load coefficient ψi* = ψi may be adopted. If cranes are intended to be operated in more unfavourable wind and waving conditions, they may be treated, upon agreement with PRS, as provision cranes (subchapter 5.7).

5.2.2.5 If the shipboard deck cranes shall be operated in unprotected waters at wind force up to 2 and wave pressure 1, the mass forces due to hull movements shall be additionally considered.

If cranes are intended to be operated in unprotected waters at more unfavourable weather conditions and the vessel they are installed on, is fit for such service, the cranes may be treated, upon agreement with PRS, as provision cranes, in accordance with subchapter 5.7.

5.2.2.6 For shipboard deck cranes, the loads due to icing shall be considered only when the cranes are installed onboard ships permanently or often operating in arctic or antarctic regions or sailing in such or adjacent zones (e.g. icebreakers, arctic ships, fishing vessels).

5.2.3 Construction and Equipment

5.2.3.1 The construction and equipment of shipboard deck cranes shall comply with the requirements given in 5.1.5 and 5.1.9 to 5.1.16 of this *Chapter*.

5.3 Floating Cranes

5.3.1 General and Special Provisions

5.3.1.1 The below requirements applicable to floating cranes apply also to elevating and crane vessels if they are considered practicable.

5.3.1.2 Floating cranes which use hook or grab cargo handling systems in port are classed as cargo handling cranes. They shall be considered as shipboard deck cranes, according to chapter 5.2.

5.3.1.3 Floating cranes that handle bulk cargo in a roadsted, with a grab, are classed as lighter cranes. They shall be treated as shipboard deck cranes used in unprotected waters (see also 5.2.2.5).

5.3.1.4 Floating cranes are classed as construction cranes if they may be used either in protected waters or in unprotected waters, for:
- assembly works;
- providing assistance to damaged vessels;
- wreck salvage;
- hydrotechnical building works;
- special tasks, etc.

Taking into account the below provisions, they shall be considered as the shipboard deck cranes used in unprotected waters (see also 5.2.2.3 to 5.2.2.5).

5.3.1.5 Floating cranes shall have special PRS acceptance for the carriage of cargo on hooks in unprotected waters.

5.3.1.6 Pontoons of floating cranes with a hoist under permissible load shall maintain for the lowest deck edge a freeboard of 0.5 m at operation in protected waters and 1 m in unprotected waters (see 2.5.2.3).

5.3.1.7 Accommodation and service spaces in floating cranes may not be arranged in the cargo handling region.

5.3.2 Calculations

5.3.2.1 Unless determined otherwise, the load-bearing structure strength and stability calculations for the floating crane, and for crane and elevating vessel shall be performed according to the requirements of Chapter 2 and subchapters 5.1.2 to 5.1.4.

5.3.2.2 At calculation of the load-bearing structure strength of a floating crane hoist, the below load combinations shall be taken into account according to table 5.1.3.5, depending on the purpose and location of the vessel during crane operation:

Nos. 1, 2, 3, 4, 10, 12 13 and 14.

5.3.2.3 The dead load and permissible load values shall be determined (so far as it is adequate) as for shipboard deck cranes, according to 5.2.2.3 and 5.2.2.4.

Hoist load coefficients ψ_i for floating cranes of 60 t ≤ *SWL* ≤ 100 t shall be determined by linear interpolation taking the values of coefficient pairs of one lifting speed category, given in table 5.3.2.3.

Table 5.3.2.3

Hoist load coefficient ψ_i for floating cranes						
with SWL	Without a grab		With a grab			
≥ 60 t	ψ_{21}	ψ_{21a}	ψ_{31}	ψ_{32}	ψ_{31a}	ψ_{32a}
≤ 100 t	ψ_{13}	ψ_{13a}	ψ_{21}	ψ_{21}	ψ_{21a}	ψ_{21a}

5.3.2.4 For particular kinds of load of the crane load-bearing structure or for shut-off condition, PRS may demand increasing the dead load factor and hoist load coefficient.

5.3.2.5 Values of inclination given in 2.5.2.3 shall be also considered for lowered jib, transversely to inclination direction, at calculation of respective components of horizontal force.

5.3.2.6 If a floating crane is intended to be used in unprotected waters, loads due to hull movements shall be determined as for shipboard deck cranes according to 5.2.2.5, assuming that the floating crane has sufficient buoyancy stability in expected service conditions.

5.3.2.7 If a floating crane is to be transported or anchored in unprotected waters, the mass forces due to hull movements shall be considered in accordance with 5.1.3.6.8 and wave impact effect in accordance with 5.1.3.7.4. Dynamic wind pressure for the loads due to wind shall be assumed 1500 Pa. It is assumed that sufficient floating stability exists in unprotected waters and that the crane is properly fixed during voyage.

5.3.3 Construction and Equipment

5.3.3.1 The construction and equipment of the crane load-bearing structure shall comply with applicable requirements of subchapters 5.1.5 and 5.1.6, as well as the below provisions.

5.3.3.2 Floating cranes with variable radius or variable SWL shall be provided with diagrams and devices for continuous monitoring of the jib radius or its inclination, in accordance with 5.1.11.12.

5.3.3.3 For floating cranes used in unprotected waters, requirements of 5.1.15.1 shall be regarded.

5.3.3.4 In order to avoid overload of steel structure of a crane during lifting cargo from the water bottom, means or devices shall be provided for control of rope pull force or hull immersion during lifting. Installation of overload protection devices is recommended.

5.4 Dock Cranes

5.4.1 General and Special Provisions

5.4.1.1 The requirements of this chapter apply to dock cranes intended for transfer of cargo on floating docks.

5.4.1.2 Carriage of people in a basket by dock cranes may be allowed upon special permit given by PRS.

5.4.1.3 Dock cranes shall be divided into service groups K_i as for shipboard deck cranes, see 5.2.1.3 to 5.2.1.5.

5.4.2 Calculations

5.4.2.1 Unless determined otherwise, the strength, stiffness and stability calculations for the dock cranes shall be performed according to applicable requirements of Chapter 2 and subchapters 5.1.2 to 5.1.4, as well as in Attachments 1 and 2 to this Part of the Rules.

5.4.2.2 At calculation of the steel load-bearing structure strength of a deck crane the below load combinations shall be taken into account, if appropriate, in accordance with table 5.1.3.5: Nos. 1, 2, 3, 4, 5 and 10.

5.4.2.3 The dead load and hoist load coefficients shall be determined (so far as it is adequate) as for shipboard deck cranes, according to 5.2.2.3 and 5.2.2.4.

5.4.2.4 For all dock cranes used north of 60° north latitude, loads due to icing shall be considered. In special cases, PRS may demand taking into account the load due to icing, depending on local climate.

5.4.2.5 For movable dock cranes, their stability and resistance to creep and skew shall be proved by calculations. The calculations may be performed in accordance with Attachments 1 or 2 of this *Part* of the *Rules*.

5.4.3 Construction and Equipment

5.4.3.1 The construction and equipment of the dock cranes shall comply with applicable requirements of subchapters 5.1.5 to 5.1.16 of this Chapter, as well as the below provisions.

5.4.3.2 Movable dock cranes shall be provided with reliable and always ready for use and/or accessible devices to protect stability, prevent creep and rolling (see also 5.1.11.23 and 5.1.11.24) and their pontoons – with fenders and buffers.

5.4.3.3 The construction and equipment of dock cranes used also for the carriage of passengers in baskets shall be specially agreed with PRS

5.5 Under-deck Cranes

5.5.1 General and Special Provisions

5.5.1.1 The requirements of this charter apply to cranes installed permanently in ship spaces or on rail tracks and these which may be driven manually.

5.5.1.2 Unless specified otherwise, the under-deck cranes are divided into service groups Ki in accordance with principles for shipboard deck cranes given in 5.2.1.3 to 5.2.1.5.

5.5.1.3 Manually driven hoists are not divided into service groups (see also 5.5.2.3). They may be considered as interchangeable gear or loose gear components, and they may be so treated for determining their size and construction and during tests and documentation approval.

5.5.1.4 At proof load tests of the under-deck cranes, specific provisions of subchapter 10.3 and space conditions of the place of use may apply. In each case, the proof load tests shall be performed at manufacturer's works or on test stand.

5.5.2 Calculations

5.5.2.1 Unless specified otherwise, the calculations of strength, stability and capsize prevention for the under-deck cranes shall be performed in accordance with applicable requirements specified in Chapter 2 and subchapters 5.1.2 to 5.1.4, as well as in Attachments to this Part of the Rules.

5.5.2.2 At strength calculations of the steel load-bearing structure ot the under-deck cranes, the below load combinations according to table 5.1.3.5 shall be considered: Nos. 6, 7, 8, 9, 11 and 16. Combinations Nos. 9 and 11 are provided only for checking the guiding and locking devices. Combination No. 16 shall be considered only when the crane will be used also in unprotected waters.

5.5.2.3 The dead load and hoist load coefficients of the mechanically powered under-deck cranes shall be determined, so far as possible, as for the shipboard deck cranes, in accordance with 5.2.2.3 and 5.2.2.4. Where the cranes are driven manually, the value of both coefficients may be assumed 1.0.

5.5.2.4 The hoist load taken for calculations in combination No. 16 may be less than in combinations Nos. 6 and 7. It may not, however, be less than the highest mass or SWL, which will be needed for lifting at the damage repair of main propulsion when the vessel is in unprotected waters. For auxiliary under-deck cranes (e.g. workshop overhead cranes), the same principles apply if they are operated in the same conditions.

5.5.3 Construction and Equipment

5.5.3.1 The construction and equipment of the under-deck cranes shall comply with applicable requirements of subchapters 5.1.5 to 5.1.16, and the below provisions.

5.5.3.2 In the under-deck cranes, steel wire ropes made of high-strength wires and non-galvanized ones, as well as those without organic core, may be applied.

5.5.3.3 Use of jibs provided with high-strength, round link, welded chain cables is allowed. The chain cables shall comply with the requirements of PRS Rules or PRS accepted standards. They shall have a test certificate issued by a firm approved for chain cable manufacture and testing.

5.5.3.4 The construction of manually driven hoists shall comply with the requirements of 1.5.3.12. The chain wheel shall have at least 5 sockets; the chain cable shall be connected in at least two sockets. The chain blocks shall be equipped with devices securing proper run of the chain cable over blocks and preventing chain cable deflecting off the blocks or chain cable axis.

5.5.3.5 Structures required in 5.1.9.7 for movable under-deck cranes of SWL ≤ 1.5 t, may be replaced, upon agreement with PRS, with an unloading appliance (tackle, reeving system) or a fixing device always in motion, if during testing it can be proved that the chain cable and mechanism is in proper order when used at hull inclinations and movements.

5.5.3.6 In service spaces where during vessels navigation heavy machinery components are carried, means shall be provided in appropriate places, of strength adequate to securing auxiliary equipment for control of cargo carriage. For all operational cases, fixed devices used for lowering and fixing heavy cargo shall be provided.

5.5.3.7 Appropriate devices for securing dynamometer shall be provided in appropriate points of ship's structure for carrying out load tests.

5.6 Car Cranes and Car Hoists

5.6.1 General and Special Provisions

5.6.1.1 Requirements of this chapter apply to car cranes and hoists manufactured in series for land-based operation, to be applied, however, on vessels and installed there permanently.

5.6.1.2 Car cranes and hoists intended to be installed onboard shall be examined and accepted by PRS. Type approval by PRS is possible after relevant application submitted by the manufacturer. Car crane or hoist type approval for land-based application made by competent supervision bodies helps and simplifies examination of usability or acceptance for shipboard application.

5.6.1.3 The examination of usability or acceptance of car cranes and hoists shall be performed taking into account applicable requirements of subchapters 1.1 to 1.4.

5.6.1.4 Unless specified otherwise, the car cranes, as regards the place of their use, shall be considered as shipboard deck cranes or shipboard under-deck cranes (see also subchapter 5.2 or 5.5).

5.6.1.5 For car cranes, which operate as stationary shipboard deck cranes and are not provided with travel mechanism, requirements as for shipboard deck cranes apply without limitations.

5.6.1.6 For car cranes provided in service with travel mechanism, a simplified method of examination of their shipboard usability may be taken, which shall include:

.1 submission of strength and stability calculations for loaded and non loaded condition, and for fixed condition;

.2 submission of crane overview drawing;

.3 submission of a written confirmation by the manufacturer that only materials resistant to ageing have been used in the manufacture of components to be subjected to loads, approved welding materials have been used in welded structures, and the crane may be inclined, according to 2.2.2.1;
.4 carrying out the initial survey at manufacturer's works by an approved expert;
.5 acceptance of test results and test certificate;
.6 submission of test results and issue of test certificate.

The initial survey carried out prior to crane approval for use onboard ships and any supplementary examinations and tests shall be performed by, or under supervision of, PRS surveyor.

5.6.1.7 Hoists shall be considered similar as load-bearing structures or movable mechanisms, upon them they are installed.

5.6.1.8 The procedure for examinations of usability or acceptance of hoists for use onboard ships shall include:
.1 submission technical documentation appropriate to the requirements of subchapter 1.4 to PRS, including strength and stability calculations;
.2 issuing recommendations in result of consideration of technical material;
.3 determining of performance usability for use onboard ships for hoist manufacturer;
.4 tests of the first hoists to be accepted, by PRS surveyor and issue of test certificate by the surveyor;
.5 granting the manufacturer the right to test the hoists and issue of Company's certificate on PRS tests.

Supervision of hoists installed onboard vessels is executed within supervision of systems in which they are installed.

5.6.2 Calculations

5.6.2.1 If not otherwise specified in subchapter 5.6.1 and below, the calculations for car cranes shall be carried out regarding navigation area as for shipboard deck and under-deck cranes, as specified in subchapters 5.2.2 or 5.5.2.

5.6.2.2 Car cranes which shall be provided with travel mechanism, shall be capable of being used safely at not less than 8° inclination (vessel's trim or heel, and also structure crowns and steps).

5.6.2.3 Hoists shall be calculated as lifting mechanisms according to subchapter 5.1.9. When selecting ropes and gear, applicable requirements of subchapter 5.1.8 shall be considered.

5.6.3 Construction and Equipment

5.6.3.1 The construction and equipment of car cranes and hoists shall comply with the applicable requirements of subchapters 5.1.5. to 5.1.16 and of 5.5.3.2, as well as the below provisions.

5.6.3.2 Internal combustion engines and electric motors without explosion protection are not permitted as drives for car cranes intended to be used in explosion-hazardous zones and spaces.

5.6.3.3 Use of fuel of ignition temperature lower than 60° is forbidden.

5.6.3.4 On a car crane and onboard a vessel, devices for crane voyage securing during navigation in unprotected waters shall be provided.

5.7 Offshore Cranes

5.7.1 General and Special Provisions

5.7.1.1 Part requirements apply to offshore cranes intended for handling cargo.

5.7.1.2 Use of offshore cranes for the carriage of people in baskets or equivalent arrangements requires special PRS approval.

5.7.1.3 For floating cranes, cranes installed onboard crane ships, operating in unprotected waters, requirements and provisions of Chapter 5.3 apply.

5.7.1.4 Supervision over offshore cranes and determining their technical safety shall be performed in accordance with applicable requirements and provisions of subchapters 1.1 to 1.4.

5.7.1.5 Offshore cranes installed on open decks of vessels and intended for cargo handling between water surface and vessels' open deck are called provision cranes. Taking into account the below requirements and provisions they shall be treated as deck cranes, see subchapter 5.2. The provision cranes shall be included into service group K31 or K31a, in accordance with table 5.1.3.6.5.

5.7.1.6 The offshore cranes installed on open deck of an object or a vessel, which due to their location may not be used as provision cranes, are defined as deck working cranes. Taking into account the influence of service and environmental conditions on the cranes as well as their supporting structure motion parameters, they shall be considered as shipboard deck cranes operating in unprotected waters and thus they shall be included into service groups for cranes, in accordance with table 5.1.3.6.5.

5.7.1.7 The offshore cranes intended to be installed in vessel's machinery spaces are called machinery room cranes. Considering influence of service conditions on the cranes as well as their supporting structure movement parameters, they shall be considered as shipboard under-deck cranes operating in unprotected waters and thus they shall be included into service groups for cranes, in accordance with table 5.1.3.6.5.

5.7.1.8 The offshore cranes intended for special purposes only or those which shall operate only in special service conditions are called special cranes.

5.7.1.9 Cranes installed onboard vessels which are intended to be used during construction of objects and platforms floating in unprotected waters, shall be considered as construction cranes, according to 5.3.1.4.

5.7.1.10 If the offshore cranes are multi-purpose appliances, their dimensions, construction and equipment shall fit their use.

5.7.2 Calculations

5.7.2.1 Unless specified otherwise in subchapter 5.7, the strength and stability calculations and anti-creep and anti-skew protection of the offshore cranes shall be executed in accordance with applicable requirements of Chapter 2, subchapters 5.1.2 to 5.1.4, as well as of Attachment 2 to this *Part* of the *Rules*.

5.7.2.2 Strength calculations of the load-bearing structure of the off-shore cranes, shall take into account the following relevant load combinations, according to table 5.1.3.5: Nos. 11, 12, 13, 14, 15 and 16.

5.7.2.3 For the case considered, the dead load and hoist load coefficients shall be determined as for the shipboard deck cranes, in accordance with 5.2.2.3 and 5.2.2.4 (see also 5.7.2.4 and 5.7.2.5).

5.7.2.4 For the provision cranes provided with shock absorbers or equivalent devices absorbing dynamic loads due to wave movements, the effective hoist load coefficient $\psi 31$ or $\psi 31a$ shall be taken for calculations. Shock absorbers or equivalent absorbing devices shall be with PRS approval.

5.7.2.5 In calculations of the provision cranes not fitted with shock absorbers or equivalent absorbing devices, the effective hoist load coefficient ψ_H shall be taken for non-absorbed dynamical loads due to wave movements, applied instead of ψ_{31} or ψ_{31a}, if calculated value of the former coefficient exceeds ψ_{31} or ψ_{31a}.

ψ_H is determined according to below formula

$$\Psi_H = k_o \left[1 + 0.9 \left(V_h + V_p \right) \sqrt{\frac{C_k}{g S_{SWL}}} \right] \qquad (5.7.2.5)$$

where:

ψ_H – effective hoist load coefficient for non-absorbed dynamic loads;
V_h – hook speed [m/s];
V_p – vertical components of provision vessel hull speed, due to wave movement, in the place of cargo attachment and detachment, in accordance with 5.7.2.6 [m/s];
C_k – crane modulus of elasticity, acc. to 5.7.2.7 [kN/m];
g – acceleration of gravity [m/s^2];
S_{SWL} – SWL force [kN];
k_o – supporting structure coefficient, acc. to table 5.7.2.5.

Table 5.7.2.5

Item	Supporting structures for provision cranes	Supporting structure coefficient k_o
1	Fixed platform	1.0
2	Semi-submersible platforms	1.05
3	Pontoon	1.15
4	A ship similar vessel	1.10
5	Ship	1.10

5.7.2.6 If the vertical component of hull speed is not precisely defined, its value may be adopted depending on characteristic wave height $H_{1/3}$, according to table 5.7.2.6.

Table 5.7.2.6

Item	Characteristic wave height $H_{1/3}$ [m]	Vertical component of hull speed, acc. to 5.7.2.5 V_p [m/s]	Mean period T_o [s]
1	0.5	0.3	3.0
2	1.0	0.6	4.0
3	2.0	1.2	5.3
4	3.0	1.8	6.3
5	4.0	2.6	7.0
6	6.0	3.4	8.2
7	8.0	4.2	9.2
Intermediate values to be determined by linear interpolation.			

5.7.2.7 The elasticity modulus Ck refers to vertical travel of a hook and is calculated taking into account only rope and jib under static load. Where no precise data exist for round strand ropes, design elasticity modulus equal to 100 GPa may be taken. Deformations of ropes of the cargo travel tackle compensation system increasing vertical shifts of hook, are not considered in these calculations.

5.7.2.8 For the provision cranes installed on vessels respectively to their kind, the dead load coefficient shall be multiplied by the supporting structure coefficient ko , given in table 5.7.2.5.

5.7.2.9 Dimensions of the provision cranes shall be determined for characteristic (effective) wave height, not less than 0.5 m. If the crane shall operate in such effective wave heights which are not taken for calculations of its components, its SWL shall be appropriately reduced.

5.7.2.10 At calculation and dimensioning of the supporting structure of provision crane ring bearings, the effective hoist load coefficient for the considered crane shall be increased by 50%. For this joint, it is to be taken not less than 2.0.

5.7.2.11 For provision cranes, possibility of runner rope deflection from vertical to a defined angle in any direction shall be considered.

This angle shall be taken not less than the sum of the vessel inclination angle, in accordance with 2.5.2.3, and the angle γ due to provision ship motions, which shall be taken not less than that calculated from the below formula:

$$tg\gamma = \frac{H_{1/3}}{h} \qquad (5.7.2.11)$$

$H_{1/3}$ – characteristic wave height [m];
h – distance between the centre of runner rope sheave on the jib point and water surface [m];

The numerical value of characteristic wave height $H_{1/3}$. may be assumed as numerical value of angle γ.

5.7.3 Construction and Equipment

5.7.3.1 The construction and equipment of the offshore cranes shall comply with applicable requirements of 5.1.5. to 5.1.16 of this Chapter, as well as the below provisions which refer only to provision cranes.

5.7.3.2 The speed of the provision crane hook shall not be less than determined from the below formula:

$$V_{g\min} = 1.2\frac{H_{1/3}}{T_0} \quad \text{[m/s]} \qquad (5.7.3.2)$$

V_{gmin} – minimum hook speed [m/s];
$H_{1/3}$ – characteristic wave height [m];
T_0 – mean period [s]; in case of missing precise data, table 5.7.2.6 can be used

It is recommended to take the minimum hook speed possibly by 10% higher.

5.7.3.3 The provision cranes shall be equipped with a prolonged warning visual signal system for operator's use, which operates at reaching 90% of permissible runner rope force. A supplementary system shall be provided in the form of prolonged sound signal system, which warns the operator and service crew of dangerous reaching 100% of permissible runner rope force.

5.7.3.4 It is recommended to provide for the provision cranes a warning system operating at exceeding permissible load moment.

5.7.3.5 If a force acting in the provision crane runner reaches 110% of the permissible value, only control operations shall be possible, leading to reduction of the load (lowering cargo, reduction of radius, etc.).

5.7.3.6 For variable or jib angle, the safety systems referred to in 5.7.3.3 to 5.7.3.5 shall be self-adjusting.

5.7.3.7 Where on the basis of efficient wave height provision is made for the change of permissible load (see 5.7.2.9), the safety systems mentioned in 5.7.3.6 shall be capable of being additionally switched.

5.7.3.8 Where the permissible load is variable depending on the effective wave height, an overview diagram of permissible load shall be provided in the operator's cabin in well-visible place.

5.7.3.9 An emergency switch for uncoiling runner rope to full length shall be provided in operator's cabin. The switch shall have enclosure protecting it from inadvertent operation.

5.7.3.10 The construction and equipment of the offshore cranes intended also for the carriage of people in baskets or in equivalent arrangements, require special agreement with PRS.

5.8 Use of Cranes for Personal Transportation

5.8.1 General

5.8.1.1 Lifting of persons may be effected using all types of cranes. General requirements for the given crane type are specified in previous chapters. This chapter contains additional requirements for cranes used for transportation of persons.

5.8.1.2 The below requirements define the conditions of lifting persons by means of cranes and do not apply to lifts and specialized personal winches and other specialized equipment.

5.8.1.3 Additional requirements subject to PRS approval apply to the following elements:
- the winch for lifting hook and jib, engines and hydraulic cylinders used for lifting the hook and jib,
- gears and brakes (used at transmission of braking force for lifting the hook and jib).

5.8.1.4 The safety working load (SWL) of the equipment for lifting persons may nor exceed 50% of the SWL of equipment for lifting cargo at actual wave height and crane working range. This information shall be given on a working range diagram also for the lifting persons working mode.

5.8.1.5 Hook and jib lifting winches shall be equipped with two brakes which are mechanically and functionally independent.

5.8.1.6 The possibility shall be checked of separate examination of each brake efficiency, by ensuring the ability of disconnecting/locking one of them.

5.8.1.7 Mechanical brakes shall fulfil requirements applicable for brakes, as given in 1.5.3 for actual load cases. Instead of the safety working load the rated load for lifting persons will be used, provided that the brake is used in operational mode intended only for lifting persons.

5.8.1.8 Isolating (pressure) hydraulic valves may be considered one of the two required brakes, provided that their rated load does not exceed 50% the permitted rated load SWL for lifting cargo.

5.8.1.9 When the isolating (pressure) hydraulic valve is used as a brake, the below provisions apply:
- the hydraulic engine shall be equipped with a closing valve located at the high pressure (load) connection on this engine,
- the closing valve shall close at pressure drop on the low-pressure connection (inflow connection during lowering). This function shall be executed by direct connection between the closing valve and low-pressure connection.
- The hydraulic engine shall always have sufficient amount of working liquid, it applies also to the case of failed supply, eg. gravitation supply.

5.8.1.10 Where hydraulic cylinders are used for lifting the jib, each of them shall be provided with an isolating valve.

5.8.1.11 If the jib movement during lifting persons is executed using two independent cylinders, each of the cylinders is required to hold the rated load.

5.8.1.12 The minimum safety factor of steel ropes used for lifting persons shall be 8, while of chains – 6, in respect to rated load.

5.8.1.13 In order to ensure safety, in the control system, the working mode intended only for lifting persons shall be considered. The control system shall be equipped with manual switch of working mode for lifting persons. The switch shall be capable of being closed in both positions with removable key and of visual signaling in continuous way operation of this working mode. In the case of selecting the working mode intended only for lifting persons, the below control functions shall be fulfilled:
- all brakes are set automatically, when the control levers are in neutral position or when the emergency switch is off,
- when automatic overload protection (AOP) system has been applied, its operation shall be blocked,
- where movement compensators, that means systems tensioning the rope depending on sea state, have been used, their operation shall be blocked,
- where systems for emergency release of cargo have been installed, their operation shall be blocked irrespective of the position of emergency switch for release or hold,
- the manual overload protection system (MOPS) is blocked and its activating in this working mode is not possible.

5.8.1.14 The below limitations for crane operation at lifting persons apply:
- average wind speed: up to 10 m/s,
- wave height: up to 2 m,
- visibility: day light or lighting ensuring equivalent visibility.

The above limitations do not apply in case of taking activities for ensuring ship safety or the rescue of life at sea.

5.8.1.15 The construction and equipment of the offshore cranes which are also intended for transportation of persons in baskets or equivalent devices shall be specially agreed with PRS.

6 LIFTS

6.1 General Requirements

6.1.1 Requirements of this chapter apply to trunk lifts with electrical propulsion mentioned in 1.3.2, permanently fitted onboard ships and intended for the carriage of passengers, passengers and goods as well as goods and vehicles, with one car (platform), suspended on ropes and moving on guides.

Lifts of other types shall be considered separately by PRS.

6.1.2 Requirements of this chapter apply to lifts structures, their components, equipment items and to the methods of their installation onboard.

6.1.3 Requirements of this chapter apply in full scope to lifts whose technical documentation has been submitted to PRS for consideration after the date of entry into force for this *Part* of the *Rules*.

In other cases, the requirements of this chapter shall be applied to such scope as it is possible and practicable.

6.1.4 The lifts electrical equipment within the scope not covered by special requirements of this chapter shall comply with the requirements contained in the *Rules for the Classification and Construction of Sea-Going Ships*, *Part VIII – Electrical Installations and Control Systems*.

6.1.5 Operational conditions for lifts:

.1 Each lift, its propulsion, structure and safety devices shall be adapted for safe operation at:
- heel of 5°,
- trim of 2°, taking into account coexistence of heel and trim.

.2 Additionally, passenger lifts and goods and passenger lifts, their driving machinery, structure and safety devices shall be adapted for safe sea operation considering ship characteristics:
- permanent vibrations – peak-to-peak amplitude 2 mm of frequency 0 to 25 Hz,
- rolling – ±10° of a period 10 s,
- pitching – ±5° of a period 7 s, taking into account coexistence of rolling and pitching,
- heaving – amplitude $A \leq 3.8$ m of a period 10 s, derived from the below relation:

$$A = 3.8 - 0.01\,(L - 250), \qquad (6.1.5.2)$$

where L is the ship length in meters, measured between verticals passing extreme points of the highest subdivision load line.

.3 Goods lifts and vehicle lifts shall be adapted only for operation in port or in protected waters.

.4 Other angle values than those given in .1 and .2 may be taken after agreement with the Client. In each case, these values shall be specified in the lift operation manual.

.5 At calculation of lifts, the following loads shall be considered: lift SWL, mass of car (platform) and counterweights, and components of forces existing in lift operational conditions defined in 6.1.5.1 and 6.1.5.2.

6.1.6 Lifts shall not be located in dangerous and explosion-hazardous spaces and zones, see the Rules for the Classification and Construction of Sea-Going Ships, Part VIII – Electrical Installations and Control Systems.

6.1.7 The lift SWL shall be determined by the manufacturer in agreement with the Client. The passenger lift SWL shall not be less than specified in table 6.1.7.

Table 6.1.7

Car floor area, [m²]	Car SWL, [kg]	Maximum number of persons carried in the lift car
0.45	160	2
0.65	250	3
0.85	320	4
1.05	400	5
1.25	500	6
1.43	560	7
1.60	630	8
1.78	720	9
1.90	800	10
additionally 0.12 m²	additionally 80 kg	additionally 1 person

6.1.8 Lifts of rated travel speed exceeding 1 m/s are not recommended to be used.

6.1.9 During the travel, acceleration and deceleration shall not exceed 1.5 m/s2 for a passenger lift and 2 m/s2 for lifts of other types.

6.1.10 All screw, groove or cotter joints shall be protected against self-loosening and disconnecting.

6.1.11 Immovable axles used as support for drums, sheaves and other parts rotating on them, shall be securely fastened.

6.2 Lift Trunks

6.2.1 The lift trunk shall be fully enclosed along its whole height by means of permanent, continuous enclosure.

Trunk construction shall comply with the requirements of the *Rules for the Classification and Construction of Sea-Going Ships*, *Part V – Fire Protection*.

The elastic strain of trunk walls shall not exceed 10 mm at applied force of 490 N.

The trunk bottom shall be of sufficient strength to prevent damage to machinery located below the trunk in case of breaking off the lift car or counterweights.

Trunks of special purpose goods lifts (e.g. for the carriage of vehicles) shall be considered individually by PRS.

6.2.2 The height of a safety space in the trunk head space, counting from the car roof to trunk ceiling (when the car of a drum lift rests on a buffer in the trunk head space and the counterweight of a friction type lift rests on a buffer in the trunk pit), shall not be less than 750 mm.

6.2.3 The height of a safety space in the trunk pit, counting from the trunk bottom to the lowest part of the lift car, excluding guides and a protective shield (when the car rests on a hard buffer or fully pressed flexible buffer) shall not be less than 500 mm. Bottom area of this space shall not be less than a rectangle 1700x500 mm or two rectangles 900x500 mm and 400x500 mm adjoining so that the 400 mm side is an extension of the 500 mm side.

Where the dimensions are not met, a durable and visible notice warning of that entering the trunk pit is permitted only after mechanical securing of the car against its downward movement, shall be placed at the entry to the trunk pit.

6.2.4 The height of the safety operation space counting from permanent parts in the trunk pit or trunk head-space, however, excluding buffers, to the most protruding elements of the lift car or the counterweight (where the car or counterweight rests on the buffer) shall not be less than 150 mm.

6.2.5 The trunk pit of depth over 1750 mm shall be provided with key-closed doors not able to be open inwards. The doors shall be provided with a safety switch.

Where the trunk pit is of depth less than 1750 mm and is not provided with doors, step irons shall be provided to facilitate entry into the space. The irons shall not impede operation of the lift car or counterweights acceding the buffers.

6.2.6 No recesses nor protrusions shall be present on the internal side of the trunk wall housing the doors to the lift car, on the whole width of trunk doors and along the whole lift travel depth.

6.2.7 If two or more lifts are installed in one trunk, the car and counterweight of each lift shall be separated from other lifts by a steel plate along the whole depth of trunk. Wire nets are not allowed for this purpose.

6.2.8 The car and counterweight shall be located in the same trunk.

If the counterweight is located in an other trunk, the trunk walls shall be provided with openings fitted with key-lockable doors, for counterweight and its guides maintenance purposes.

The openings shall be spaced by not more than 3 m.

6.2.9 Step irons or a ladder shall be mounted in one of internal walls of the trunk, to provide emergency exit from the lift car to lift trunk doors or to an evacuation casing having the area of at least 0.24 m^2 and side length not less than 350 mm (see 6.18.6). Doors of the evacuation casing shall open outwards.

6.2.10 Internal surfaces of the trunk walls shall be smooth, vertical and parallel to each other.

Deflections from vertical are allowed only for the trunk exterior, and:
- the deflection value for the walls with lift trunk doors shall not exceed 10 mm,
- the deflection value for other walls shall not exceed 30 mm.

6.2.11 The trunk shall not constitute a part of ventilation ducts, but shall be ventilated by an independent system.

6.2.12 Cables hanging inside the trunk shall be protected from damage. The protective enclosure may be made in the form of an iron gutter of smooth internal surface. The clear width of the gutter shall enable housing freely hanging cable loops. The enclosure shall have a gap with rounded edges, where the cables running to the lift car can move freely.

6.2.13 The trunk shall be protected from water and splashes.

6.3 Driving Machinery Rooms

6.3.1 Driving machinery and upper rope sheaves of the lift shall be located in rooms specially appropriated for them.

6.3.2 The height of driving machinery room shall be at least 1800 mm.

6.3.3 The driving machinery room shall be sufficiently spacious so that to ensure easy access to the winch, engine and electrical equipment, in particular:

.1 the horizontal distance between the end of winch shaft on which the shaft manual rotating device is mounted and the opposite wall (perpendicular to shaft axis) shall not be less than 500 mm;

.2 the horizontal distance between the foundation or protruding parts of engine-winch assembly and at least one of the walls parallel to this assembly axis shall not be less than 500 mm;

.3 access path to the front surface of the electrical switchboard shall not be less than 500 mm in width;

.4 access path to each rope sheave shall not be less than 500 mm in width.

6.3.4 The driving machinery room shall have full, not openwork, floor.

6.3.5 Rope openings in the floor of the driving machinery room shall be of such size that the rope in its extreme deflection shall be clear of the opening edge by not more than 50 mm. At least 50 mm high curbs shall be provided around the openings.

6.3.6 Doors to the driving machinery room shall be key-lockable.

6.3.7 Access path to the driving machinery room shall be sufficiently wide so that to allow for transferring the lift component parts.

Access to driving machinery and sheaves room shall be provided directly from the nearest level. No manholes, ladders and step irons are accepted as permanent access means.

6.3.8 The air conditioning system of the driving machinery room shall ensure temperature in the range +10° C to +40° C.

6.4 Trunk Doors

6.4.1 All entry and cargo openings in a trunk shall be provided with doors.

Trunk doors leading to an open deck shall be watertight.

6.4.2 Trunk door frames shall be made of steel.

6.4.3 Lift trunk doors, i.e. the doors used for the passage between lift stops and the car, shall be automatically or manually closed.

6.4.4 In the self-service passenger lift, a knob, a handle or a key shall be used for opening the lift trunk door.

6.4.5 The lift trunk doors of a goods lift and a goods-passenger lift provided with push-button reversible control device, shall be fitted with a safety lock, and additionally with a door latch that can be opened from the lift trunk platform by a key or a removable handle.

6.4.6 The lift trunk doors may be of sliding or swing type. The swing doors shall open only outwards the trunk.

6.4.7 Internal surface of lift trunk doors shall be in one plane with the internal surface of this trunk wall which houses the door. This requirement does not concern sliding doors consisting of at least two parts fitted in two planes.

6.4.8 The lift trunk door wings shall be made of steel or of an solid material fitted in a steel frame. Their elastic strain shall not exceed 5 mm with the force of 340 N applied at any place of the wing.

The requirements contained in the *Rules for the Classification and Construction of Sea-Going Ships*, *Part V – Fire Protection*, shall also be considered.

6.4.9 The lift trunk doors may have openings (sight glasses) glazed with thick hardened glass, if it conforms to the requirements of the *Rules for the Classification and Construction of Sea-Going Ships*, *Part V – Fire Protection.* The opening shall have a minimum width of 150 mm, and its glass thickness shall be at least 5 mm.

For automatically closing doors or those provided with a signal indicating car presence on the stop, sight glasses need not be used.

Car movement shall not initiate lift trunk doors closing or opening.

Doors shall be fitted with a device preventing their opening and slamming under ship movements.

6.4.10 No hand grips shall be fitted on the internal side of the lift trunk doors of goods lifts.

6.4.11 The manually, vertically moved lift trunk doors may be used only in a goods lift. In such case:

.1 the doors shall be balanced;
.2 the doors shall be capable of being moved with a force not exceeding 150 N;
.3 ropes or chain cables the doors are suspended on, shall be calculated including at least tenfold safety factor;
.4 elastic pads shall be fitted on respective door edges.

6.4.12 All parts of two–wing doors or multi-wing doors shall be so correlated or safeguarded that the lift car shall be capable of being operated only after closing the whole door opening.

6.4.13 Self-closing lift trunk doors shall be so arranged that their move may be stopped using a force not exceeding 150 N, applied to the door wing,.

6.4.14 The lift door opening shall be at least 1850 mm high.

Where the deck span and ceiling structure allow that, it is recommended that the door opening height shall be at least 2000 mm.

All doors shall be of equal height.

6.4.15 For a passenger and passenger goods lift, the lift trunk door width shall be at least 650 mm. For all lifts, the lift trunk door width shall be not less than the width of car doors, and not greater than the car width.

6.4.16 Each trunk door shall be provided with a safety switch (see 6.14.5) and each lift trunk door – additionally with a safety lock (see 6.15.5). Safety locks and switches shall be so arranged or protected that they are not accessible from outside the trunk when the doors are closed. For trunk doors, the safety locks shall be capable of being opened from inside of the trunk with the lift car immobilized.

6.4.17 For a passenger lift, the lift trunk doors shall be provided with a device which, when it is needed, enables door unlocking from outside with any position of the car in the trunk. Keys of special shape may serve this purpose.

6.4.18 The deck areas near the entries to lift trunk shall have a non-slip covering.

6.4.19 The lift trunk doors shall be so arranged that they do not give direct access to machinery spaces or dangerous spaces, which are covered with special requirements.

6.5 Guide Rails

6.5.1 Car and counterweight guide rails shall be made of shapes or corrugated plates.

6.5.2 Guide rail length shall be such that the lift car and the counterweight can run over their limit positions with the guide shoes remaining on the guide rails.

6.5.3 Guide rail contact ends shall be protected against shift.

6.5.4 Car and counterweight guide rails installation in the trunk shall ensure maintaining their span and rectilinearity; the deflection of car guide rails axles plane distance from:
- the wall with trunk doors, shall not exceed +10 mm;
- the opposite wall, shall not exceed +20 mm.

6.5.5 Along the whole length of trunk, the guide rail span shall not exceed the rated value ±2 mm.

6.5.6 The highest buckling span of guide rail attachments shall be determined from the below formulae:
- for the car guide rails:

$$l_{\max} = \sqrt{\frac{2.1 \cdot 10^5 \, \pi^2 \, I_{\min}}{5 \frac{m}{2} \left(S_{SWL} + S_{Gk} \right)}}, \quad \text{[mm]} \qquad (6.5.6\text{-}1)$$

- for the counterweight guide rails:

$$l_{\max} = \sqrt{\frac{2.1 \cdot 10^5 \, \pi^2 \, I_{\min}}{5 \frac{m}{2} \left(S_{SWL} + S_{Gp} \right)}}, \quad \text{[mm]} \qquad (6.5.6\text{-}2)$$

S_{SWL} – SWL force, [kN];
S_{Gk} – a force due to car mass, [kN];
S_{Gp} – a force due to counterweight mass, [kN];
m – a coefficient depending on the kind of safety stops, determined according to table 6.10.4;
I_{min} – the lowest moment of inertia of the guide rail section, [mm^4].

6.5.7 At the assumed span of attachments, deflection of car (platform) guide rails, caused by forces due to cargo eccentric distribution, shall be checked.

Guide rail deflection at the eccentric distribution of cargo shall be determined from the formulae below:
- in *x-x* axis plane

$$f_x = \frac{S_{SWL} \, Xl^3}{48 h \, 2.1 \cdot 10^5 \, \pi^2 \, 2 I_x}, \quad \text{[mm]} \qquad (6.5.7\text{-}1)$$

- in *y-y* axis plane

$$f_y = \frac{S_{SWL} \, Xl^3}{48 h \, 2.1 \cdot 10^5 \, \pi^2 \, 2 I_y}, \quad \text{[mm]} \qquad (6.5.7\text{-}2)$$

S_{SWL} – SWL force, [kN];
l – guide rails attachment devices span, [mm];
h – distance between upper and lower guide shoes, [mm];

X – assumed eccentricity of cargo distribution along the car width, [mm];
Y – assumed eccentricity of cargo distribution along the car depth, [mm];
I_x, I_y – guide rail section inertia moments, [mm^4].

6.5.8 Guide rails deflection at the load resulting from the requirements of 6.1.5 shall not exceed the value of $\frac{l}{400}$ mm or 3.0 mm, whichever is less.

l – distance between guide rail attachments, [mm].

6.6 Winches

6.6.1 Each lift winch shall be provided with an electrically controlled brake (see 6.16.11). No strap brakes shall be applied.

Where one of discs of the clutch coupling the engine shaft and the winch shaft is used as a brake disc, the brake shall be mounted on the disc fitted on the winch shaft.

The electrically controlled brake shall be capable of being paid out manually and after releasing the pay-out device, the brake shall be capable of self-tightening.

6.6.2 Friction discs of friction winches shall have grooves so shaped that the rope pressure onto the groove does not exceed permissible values specified in 6.7.7 and the rope friction contact force meets defined values.

6.6.3 Drums of drum winches shall have circumference screw grooves for a rope. The grooves shall be semicircular and have dimensions corresponding to rope diameter. Drums shall have rims.

6.6.4 Diameters of a drum, friction discs or rope sheaves shall be not less than that determined from the formula:

$$D = e\,d, \quad \text{[mm]} \tag{6.6.4}$$

D – diameter of a drum, friction disc, or a rope sheave, measured from the axis of a coiled rope, [mm];
e – coefficient from table 6.7.6;
d – rope diameter, [mm].

At determining the drum length, the requirements of 6.7.4 shall be considered.

6.6.5 The winch shall be equipped with a whole wheel for manual rotating friction disc or drum. If the wheel is removable, its pin shall be provided with a shield.

Rotation directions corresponding to lift car travel up and down shall be marked on a winch or engine. The markings shall be placed so that to be visible from the point of manual rotating the winch.

6.6.6 In the vicinity of a friction winch, a device shall be placed to enable, if needed, increasing the force of rope friction contact with the friction disc.

6.7 Ropes

6.7.1 If not covered with special requirements of these *Rules,* the lift ropes, shall comply with the general requirements contained in the *Rules for the Classification an Construction of Sea-Going Ships*, *Part IX – Materials and Welding*.

For (car and counterweight) ropes of passenger and goods passenger lifts, elastic steel wire ropes of high quality (category I) shall be applied. In other cases, steel wire ropes of category II shall be applied.

6.7.2 The lift ropes diameter shall amount to at least 8 mm. The driving rope of a speed governor may be of less diameter, however, it shall amount to at least 6 mm.

6.7.3 The car and counterweight of a passenger lift or a goods passenger lift and such goods lift to which people have access for cargo handling operation, shall be suspended from at least two ropes of the same diameter, structure and design rope breaking load.

The goods lift car which cannot be entered while loaded or unloaded may be suspended from one rope.

6.7.4 The length of a rope wound onto the drum shall be such that at least three coils of a rope remain on the drum when the car and counterweight are in their lowest positions (the car or counterweight rest on a wholly compressed buffer).

6.7.5 Ropes shall be fastened to drums by means of at least two rope sockets or by a self-locking wedge socket.

Different rope ends may be fastened together by one of the below methods:

.1 splicing the free end into a rope on a rope thimble on the length equal to at least 20 rope diameters, however, not less than 300 mm;
.2 use of a self-locking wedge socket of an angle within the range of 6° to 16°;
.3 pouring with appropriate alloy the unspliced and bent rope wires in a cone end;
.4 use of rope connectors – it applies only to goods lifts.

6.7.6 The lifting ropes shall be so selected that the safety factor (i.e. ratio of a load breaking a rope in full to the highest load acting in the rope) is not less than that given in table 6.7.6.

Table 6.7.6

Kind of		Rope speed, [m/s]	*e*	Minimum safety factor
lift	winch			
goods	drum	up to 0.25	30	5
	drum	above 0.25 up to 0.50	30	7
	drum	above 0.5 up to 0.75	30	8
	friction	up to 1.0	40	10
passenger and goods passenger	drum	up to 0.75	35	9
	friction	up to 1.0	40	12

The driving rope of the speed governor shall be calculated with the safety factor not less than 8.

The maximum force acting in ropes shall be determined from the below formulae:

– for the lift car rope

$$S_k = \frac{S_{SWL} + S_{Gk} + S_{Gl}}{\eta n} \cdot A, \quad [\text{kN}] \qquad (6.7.6\text{-}1)$$

– for the counterweight rope

$$S_p = \frac{S_{Gp} + S_{Gl}}{\eta n} \cdot A, \quad [\text{kN}] \qquad (6.7.6\text{-}2)$$

S_k – maximum force acting in a rope holding the car, [kN];

S_p – maximum force acting in a rope holding the counterweight, [kN];
S_{SWL} – SWL force, [kN];
S_{Gk} – a force due to car mass, [kN];
S_{Gp} – a force due to counterweight mass, [kN];
S_{Gl} – a force due to mass of lifting ropes of appropriate length, [kN];
n – number of lifting sections in ropes;
η – efficiency of rope system;
A = 1.15 – dynamic waving effect coefficient.

In the case equalizing or tensioning ropes are used, additional forces shall be considered.

6.7.7 Maximum working pressure of a rope onto friction disc groove shall not be more than respective values given in table 6.7.7.

Table 6.7.7

Rope speed, [m/s]	The highest permissible rope pressure onto a groove, [MPa]	
	semicircular	wedge-shaped
up to 0.75	0.09	0.11
above 0.75 up to 1.0	0.08	0.095

Maximum working pressure of a rope onto friction disc groove shall be determined from the below formulae:

– for semicircular non-undercut grooves

$$k_n = \frac{S_{Gk} + S_{SWL} + S_{Gl}}{ndD} \frac{8}{\pi}, \quad \text{[MPa]} \qquad (6.7.7\text{-}1)$$

– for semicircular undercut grooves

$$k_p = \frac{S_{Gk} + 1.5 S^3_{SWL} + S_{Gl}}{ndD} \frac{8 \cos \frac{\alpha}{2}}{\pi - \pi \frac{\alpha}{180} - \sin \alpha}, \quad \text{[MPa]} \qquad (6.7.7\text{-}2)$$

– for wedge-shaped grooves

$$k' = \frac{S_{Gk} + S_{SWL} + S_{Gl}}{ndD} \frac{5.0}{\sin \frac{\gamma}{2}}, \quad \text{[MPa]} \qquad (6.7.7\text{-}3)$$

k_n, k_p, k' – maximum rope pressure onto friction disc groove, [MPa];
SWL – lift SWL, [kg];
SWL' – calculation SWL, [kg];
equal to SWL when $SWL \geq 0.5\ G_k$ or equal to 0.5 SWL when $SWL \leq 0.5\ G_k$;
S_{Gk} – a force due to lift car mass, [kg];
S_{SWL} – SWL force, [kN];
S'_{SWL} – calculated SWL force, [kN];
S_{Gl} – a force due to mass of ropes of length corresponding to the lifting height for a top winch, [kN];
for a bottom or side winch it is to be assumed that $S_{Gl} = 0$;
G_k – mass of lift car, [kN]

n – number of lifting sections in ropes;
d – rope diameter, [mm];
D – friction disc diameter measured between points of axis of the rope wound on the disc, [mm];
α – central angle of the semicircular undercut groove, [grades];
γ – vertical angle of the wedge-shaped groove, [grades].

6.8 Lift Cars

6.8.1 Height of the car of a passenger lift or a goods passenger lift and such goods lift to which people have access for cargo handling operation, measured clear from the floor to the ceiling, shall be at least 2000 mm. If intermediate lighting has been applied in top corners, the height of car sides may amount to 1900 mm.

6.8.2 The car walls shall be whole, made of steel plates or of other PRS approved material having elastic strain not more than 10 mm under force of 490 N.

Non-whole or openwork walls may be applied in goods lifts only. The design of such walls is subject to separate consideration by PRS.

6.8.3 The lift car shall be provided with a roof. The roof shall withstand the load of two persons standing on it

Where the car roof is not designed for such load, a permanent platform shall be installed over the car, to withstand the load of two persons.

6.8.4 The car shall have a permanent floor. Mobile floor may be applied where it serves as a control device. A mobile car floor shall be provided with a safety connector and constitute one plate together with a sill.

The safety connector of the mobile car floor shall prevent calling the car if the floor load exceeds 20 kg.

6.8.5 The car sill shall be provided over its whole width with a protective shield at least 200 mm high.

6.8.6 Clear distance between vertical bars of sliding car doors shall be not more than 100 mm for a passenger lift and 150 mm for other lifts.

6.8.7 Cars of passenger and goods passenger lifts (except unmanned goods lifts) shall have whole doors provided with a device preventing their opening and slamming under ship movements.

The car doors shall be provided with a safety connector.

6.8.8 Self-closing car doors shall be so arranged that their movement can be stopped with use of a force not exceeding 150 N.

6.8.9 The height of car doors shall not be less than the height of the lift trunk doors, whereas their width not more than that of the lift trunk doors.

6.8.10 The lift car shall be equipped with dismountable guide shoes (see 6.8.17).

6.8.11 The car of a passenger lift or a goods passenger lift provided with whole doors shall have ventilation openings.

6.8.12 The car of a passenger lift or goods passenger lift shall have in its roof an escape flap with a minimum area of 0.24 m^2, the length of its side being not less than 350 mm, which provides escape from the car.

Escape flap when open may not project beyond the outline of the car.

Escape flaps need not be used in cars of floor area less than 1 m^2, provided other, agreed with PRS, method of escape from damaged car is ensured.

6.8.13 The lift car shall be provided with handrails, iron steps or other similar arrangements for emergency escape from the car through the manhole in the car roof and from the roof to lift trunk doors.

6.8.14 The car dimensions and installation shall be such that for the car travelling or standing, the clear distance:

.1 between car doors and internal surface of the trunk wall housing the lift trunk doors:
- is at least 25 mm and not more than 125 mm, for swing doors;
- is at least 25 mm and not more than 200 mm, for sliding doors with coplanar wings;
- is at least 25 mm and not more than 250 mm, for sliding doors, their wings being located in two planes;

.2 between internal sill edge of a car provided with doors and the lift trunk doors or the trunk wall – does not exceed 40 mm;

.3 between protruding parts of a car, except its sill and guide shoes, and trunk wall or protruding items fixed to the trunk wall – is at least 25 mm;

6.8.15 The distance between the car floor plane and the trunk stop floor plane shall be not more than ± 50 mm.

6.8.16 Lift cars floors shall be of anti-slip design.

6.8.17 Cars and counterweights shall be provided with emergency guide shoes, irrespective of working guide shoes. It may be effected by fixing an independent plate who will take proper position in relation to guide rails in case of damage to a working guide shoe.

6.9 Counterweights

6.9.1 The counterweights shall be made of steel or a material of equivalent strength. The weights filling the counterweight shall be securely fixed inside a steel frame. No concrete weights are allowed.

6.9.2 The dimensions and arrangement of the moving or standing counterweight shall be such that a clear distance:

.1 between protruding parts of the counterweight and protruding items of the trunk or its wall, is at least 25 mm;

.2 between protruding parts of the counterweight and protruding parts of the car is at least 100 mm;

6.9.3 The counterweight shall be provided with guide shoes able to be dismounted (see 6.8.17).

6.10 Safety Stops

6.10.1 For a passenger and goods passenger lift, its car and counterweight shall be provided with safety stops.

6.10.2 Safety stops shall ensure stopping and keeping on guide rails a fully loaded car undergoing free fall (i.e. simultaneous break of all lifting ropes) or subject to reduced travel safety (i.e. excessive elongation or break of one lifting rope or exceeded rated speed).

Safety stops shall not operate at breaking one of lifting ropes or their excessive elongation if the car is suspended from at least 4 ropes. In such case, immediate stop of a winch is sufficient by a rope sling acting on the rope sag connector.

Safety stops of a counterweight shall ensure stopping it on its guide rails in case of a break of lifting ropes.

6.10.3 No safety stops holding the car travelling upwards shall be applied.

6.10.4 Depending on the rated speed of travelling car, self-sizing safety stops of immediate braking or self-sizing safety stops of slide (friction) braking may be used, in accordance with table 6.10.4.

Counterweight safety stops may be of immediate braking.

Design of safety stops shall enable replacement of worn items.

Table 6.10.4

Rated speed of lift, m/s	Applied safety stops	Coefficient *m*
$v \leq 0.75$	self-sizing of immediate braking	5
$0.75 < v \leq 1.0$	self-sizing of slide (friction) braking	2

6.10.5 Braking items of safety stops shall be so fitted that they do not touch guide rails during normal operation of lift.

6.10.6 Reducing tension of the speed governor cord and loosening lifting ropes after car stop shall not affect operation of safety stops.

6.10.7 Safety stops shall be provided with a safety switch.

6.11 Speed Governors

6.11.1 Passenger lifts, goods passenger lifts and such goods lifts which can be entered, shall be provided with speed governors.

6.11.2 After transgressing by the car (counterweight) rated speed by at least 20% (however by not more than by 40%), the speed governor shall:

.1 disable the winch by opening its own safety switch, irrespective of travel direction;

.2 enable the safety stops if the car travels downwards.

6.11.3 Each speed governor shall be equipped with a weight with guide shoes laid in guide rails. Their design shall be such that the rope – governor sheave frictional contact force is sufficient for proper operation of the speed governor.

6.11.4 The speed governor shall be located ready for checking its operation and its maintenance.

6.11.5 Where it is impossible to reach the car or counterweight speed necessary for checking operation of the speed governor, the governor shall be provided with appropriate arrangement (e.g. an additional sheave of a reduced diameter) to facilitate testing its operation at working speed of car or counterweight.

6.12 Buffers

6.12.1 A lift shall be provided with buffers able to stop the car or counterweight when the limit switches fail to fulfil their duty.

6.12.2 A lift shall be provided with bottom buffers of the car or counterweight located in a trunk pit, while the lifts with drum winches shall be additionally equipped with top buffers placed in the head-space.

6.12.3 In a lift travelling with the speed more than 0.5 m/s, the bottom buffers shall be flexible. In other cases hard buffers or similar may be used.

6.12.4 Hard buffers shall be equipped with an elastic or wooden strap. The wooden strap thickness shall be at least 100 mm.

Oil or spring buffers may be used as the flexible type. Spring buffers may be used only for the lift speed not exceeding 1.0 m/s.

6.12.5 Deceleration at the car or counterweight stopping by the flexible buffer shall not exceed 2.5 g (where g – the acceleration of gravity).

6.12.6 Each oil buffer shall be provided with a safety switch and an oil level indicating device, which can not be made of glass.

6.12.7 The top buffers shall be so positioned that after car or counterweight is stopped by the limit switch it can not touch the buffers and that in the case the car or counterweight has stopped on buffers, the requirements pertaining to safety room in the head-space are complied with (see 6.2.2).

6.12.8 The bottom buffers shall be so positioned that the requirements concerning the safety room in the trunk pit complied with (see 6.2.3) and so that in case of use of hard buffers the car loaded with mass equal to SWL (or the counterweight with the car not loaded) stopped by the limit switch does not touch the buffers. Partial deflection of flexible buffers while stopping such car or counterweight by limit switch is allowed.

6.12.9 Each flexible car buffer shall be tested at a manufacturer's works for deceleration equal at least 2.5 g, at the initial speed of 115% the lift speed. Tests shall be performed twice; first time – by dropping onto the buffer the weight of mass of an empty car, for the second time – by dropping onto the buffer the weight of mass of an empty car plus SWL.

6.12.10 Each flexible buffer of the counterweight shall be tested so as the car buffers (see 6.12.9). The test shall be performed only once by dropping onto the buffer the weight of counterweight mass.

6.12.11 Additionally to tests specified in 6.12.9 or 6.12.10, aach oil buffer shall be tightness tested under pressure of 1.25 design pressure.

6.13 Supply of Electrical Installation

6.13.1 The rated voltage of the lift electrical installation shall not exceed:

.1 400 V at alternative current of frequency 50 Hz or 440 V at alternative current of frequency 60 Hz – in power circuits and in basic control circuit;

.2 220 V at direct current – in power and control circuits;

.3 220 V at direct current and 230 V at alternative current of frequency 50 Hz or 250 V at alternative current of frequency 60 Hz – in signaling and lighting circuits;

.4 24 V in alarm circuit and in plug socket on the car roof.

6.13.2 In the lift electrical circuits, marine cables shall be applied for fixed connections and flexible lift conductors for non-fixed connections.

Connections of power circuits shall be made using separate cables, while control, signaling, lighting and alarm circuits may be made with the use of common multi-conductor cable or a tyre cable.

Means shall be provided to prevent the possibility of damage to non-fixed conductor led to the car, in service conditions specified for the car, in particular at rolling, heel and trim of the ship.

6.13.3 The power circuit shall be provided with two switches arranged in series: main switch and lift switch.

The main switch shall be located in the driving machinery room in the vicinity of doors or in main switchboard.

The lift switch shall be located at the most frequently used lift stop, in readily accessible place, near the lift doors. The switch shall be shielded to prevent its accidental switch-on, however, it shall be accessible in a need without use of special tools.

On each switch shield, an informative notice shall be placed.

6.13.4 The lift switch shall connect the power circuit, electromagnetic brake circuit and control systems circuits for all phases and poles. The switch shall not be applied for disconnecting supply of alarm, signaling and lighting circuits.

The main switch located in the main switchboard shall connect all the above mentioned circuits, except alarm circuit, and when located in driving machinery room it shall comply with requirements of 6.13.5.

6.13.5 Signaling and lighting circuits shall be provided with dipolar switch located near the main switch.

6.13.6 No switches disconnecting power supply shall be fitted in alarm and emergency lighting circuits.

6.14 Limit Switches and Safety Switches

6.14.1 A lift shall be equipped with limit switches stopping the lift by disconnecting the power supply in power circuit when the lift car reaches the end space of trunk.

Limit switches may be so constructed that after withdrawing the car from the end space of trunk power supply circuit can self-activate.

6.14.2 Limit switches of a drum type lift shall be initiated directly by the car movement and shall cause opening all power circuit phases.

6.14.3 Limit switches of a friction type lift shall be initiated directly by lift car movement, and they can directly open all power circuits in all phases or open it by a control circuit.

6.14.4 Main switch or lift switch shall not be used as limit switches.

6.14.5 A lift shall have appropriate safety switches for the equipment items provided, considering the below equipment:

.1 car doors;
.2 trunk doors;
.3 door safety locks;
.4 mobile car floor;
.5 car roof manhole;
.6 safety stops;
.7 sagged lifting ropes;
.8 rope weight;
.9 speed governor;
.10 oil buffers.

6.14.6 Safety switches shall be of positive action, i.e. shall not be spring activared. Switches mentioned in 6.14.5.5 to 6.14.5.9 shall be pawl operated switches, that means they shall not automatically return to initial position after loss of the activating force.

6.14.7 Shunting safety switches may be effected only by means of other safety switches.

6.14.8 The safety switch of car doors shall preclude travel of loaded car with non-fully closed doors.

This requirement does not apply to access travel of lift car with access speed not exceeding 0.25 m/s.

6.14.9 The safety switch of lift trunk doors shall prevent car travel with non-fully closed doors. This requirement does not apply to access travel of lift car with access speed not exceeding 0.25 m/s. The safety switches shall not be used as stop switches.

Safety switches of trunk doors shall be so constructed and enclosed that shorting their contacts is not possible while working with screwdrivers, keys and similar tools.

6.14.10 Safety switches of door locks shall prevent closing direction contactors, or direction relays in case of access correction, until the bolt enters the bolt opening of lift trunk doors for the required depth.

6.14.11 Safety switch of the mobile car floor shall be located in the car door switch shunting circuit. It shall start shunting when the car floor is loaded with a mass of 20 kg and more and end shunting after removal of the load.

6.14.12 Safety switch of the car roof manhole shall prevent car travel with non-fully closed manhole cover. When the manhole was opened, the car shall be able of being operated after closing the manhole cover and setting the safety switch to start position.

6.14.13 Safety switch of safety stops shall open the control circuit at activating the safety stops. Re-connecting shall be possible not before setting the safety stops home.

6.14.14 Safety switch of the lifting ropes sag shall open the control circuit at excessive extension (loosening, breaking) of at least one of fitted lifting ropes.

6.14.15 Safety switch of a rope weight shall stop the car on the trunk stop at excessive lowering of the weight.

6.14.16 Safety switch of a speed governor shall open the control circuit when the car or counterweight reaches the speed limit.

6.14.17 Safety switch of an oil buffer shall open the control circuit when the buffer piston shifts by more than 30% of its total move length.

6.15 Safety Buttons and Locks

6.15.1 If control buttons are fitted in the lift car, then also a safety button shall be installed there, connected to main control circuit. Pressing this button shall result in stopping the car.

The safety button shall be placed on the control button panel (see 6.16.4). It shall be of red color and be marked with „STOP".

6.15.2 After pressing the button „STOP", the lift re-start shall be possible from the car by pressing the control button, and from the lift trunk platform by:

.1 pressing the external control button – for the lift with mobile car floor, when the car is under load and the safety switch of the car roof manhole is closed,

.2 opening and closing the lift trunk doors, which are in front of the car in the unlocking zone – for cars with immovable floor.

6.15.3 Locks of lift trunk doors shall be so constructed that their opening is possible only when the car is in front of the given door (safety locks are preferable; see also 6.15.4 to 6.15.6). For passenger and goods passenger lifts, safety locks shall be provided with a safety switch, located in main control circuit of the lift.

6.15.4 In case of a lift with dipolar engine, whose car moves with access speed not higher than 0.25 m/s, a safety lock for lift trunk doors may be capable of being opened from inside also within the given unlocking zone.

6.15.5 For goods passenger lift travelling with the speed of up to 0.5 m/s, a safety lock for lift trunk doors may be capable of being open from inside also within the given unlocking zone.

6.15.6 For goods lift of travelling speed up to 0.5 m/s, a safety lock for lift trunk doors may be capable of being open from outside also within the given unlocking zone.

6.15.7 The bolt cross-sectional area in the safety lock shall be at least 150 mm^2.

6.15.8 The lock safety switch shall close not before the lock bolt enters the bolt opening at least 7 mm deep.

6.16 Control and Control Devices

6.16.1 A lift shall be provided with button controls.

Persons in the lift car shall know what stop is reached by the lift by well-visible inscriptions or signals.

6.16.2 Floor switch shall automatically disconnect external control devices while the floor is loaded with the mass of 20 kg and more and connect them at the load removal (see 6.8.4).

6.16.3 Control system shall disconnect external control devices for a defined time-period, after completion of each travel and after each closing lift trunk doors. This time-period shall be specified in the lift operating manual. It shall be no shorter than 3 seconds.

6.16.4 Car control buttons shall be grouped in one common panel and placed vertically one over another in order of stops and they shall be marked with numbers or letter abbreviations.

6.16.5 Pressing any control button during lift travel, except the STOP button, shall not result in disconnecting previously set travel programme.

6.16.6 Simultaneous pressing two or more control buttons during lift starting or travel shall not cause short circuit in control or power supply circuit, nor lead to other failures in the system operation.

6.16.7 Control buttons shall automatically return to initial position after pressure removal.

6.16.8 Lift car with reversible control devices (i.e. such which enable lift operation from the car or from outside) shall be equipped with inspection switch, located on the car roof, which serves disconnecting control devices and connecting inspection buttons providing control of inspection travel in both directions.

The inspection buttons shall connect control circuit only when they are pressed. They shall activate only the engine access speed.

6.16.9 The lift shall stop after activating any safety switch during lift travel, and all controls shall return to home position.

6.16.10 Switches for speed governor, doors of lift pit and head space, rope weight and buffers may be connected to auxiliary control circuit including auxiliary limit switches.

6.16.11 Each disconnecting of supply to driving engine, except the breaks due to change from working speed to access speed, shall result in disconnecting electromagnetic release device, and thus brake activation.

6.17 Lighting and Signal Systems

6.17.1 The lift car shall have electrical lighting of luminance not less than 20 lx. The lighting shall self-activate when:

.1 the lift trunk doors are opened, for all lift types;

.2 the car is loaded during the lift travel or stop, for passenger and goods passenger lifts.

The lift car, trunk and machinery room shall be equipped with emergency lighting, self-activated in case of power decay in main supply network. This emergency lighting shall be supplied from emergency source of power.

6.17.2 Plug sockets used for supply of portable lamps shall be fitted on the car roof and in driving machinery room.

6.17.3 The passenger and goods passenger lifts shall have sound signaling system.

An alarm bell or an other alarm signal shall be installed in permanent watch room.

The button activating alarm signal shall be installed in the car at the bottom of control button panel (see 6.16.4) and marked with “ALARM”.

The alarm system shall be supplied from emergency network.

6.17.4 Instead of sound alarm system required in 6.17.3, a telephone may be placed in the lift car to enable communication with the permanent watch room. Near to telephone, information shall be placed on how to connect to the watch room.

6.17.5 The lift shall be provided with a signal on the car occupation or on car position. Indicators shall be located in the vicinity of the lift trunk doors.

6.18 Escape Means

6.18.1 The lift shall be so constructed that, in case of a danger, rescue of passengers from the car is possible and the lift crew can escape from the car by own capacity.

6.18.2 A ladder shall be provided to facilitate entering through an escape flap from the car roof into the car (see 6.8.12). The ladder shall be kept in watch room or in a room accessible only to authorized persons.

6.18.3 The escape flap (see 6.8.12) in the cars intended exclusively for passengers shall be provided with a latch with a grip only from outside.

6.18.4 The escape flap (see 6.8.12) in the cars intended exclusively for the crew shall be provided with a latch with grips from both sides (outside and inside).

6.18.5 Opening the escape flap, referred to in 6.18.3 and 6.18.4 shall open the control circuit and in consequence cause the car stop. The control circuit shall remain open until closing the escape flap. Operation may only be restored by manual and intentional activating the circuit on the car roof.

6.18.6 For lifts intended for the crew, a ladder or similar arrangement shall be permanently fixed in the lift car. In the trunk, an escape hatch shall be provided (see 6.2.2). The escape hatch shall be opendable from inside without a key. The hatch shall be opendable from outside only by a special key, available in emergency, and placed in a box in the vicinity of the hatch. If escape from the hatch leads to spaces accessible only to passengers, the key shall be available e.g. after breaking the box glass.

Opening the escape hatch shall cause opening the control circuit, which shall remain open until closing the hatch. Operation may only be restored by manual and intentional activating the control circuit.

6.18.7 In the below places, notices in at least two relevant languages and pictographs describing the escape route shall be permanently placed:
- inside the car;
- on the car roof;
- inside the trunk at each exit;
- in machinery room.

6.19 Requirements for Simplified Goods Lifts

6.19.1 The simplified goods lifts shall comply with relevant requirements of other chapters of this *Part* of the *Rules*, unless this chapter specifies otherwise.

Simplified goods lifts need not comply with the requirements of 6.1.7, 6.2.2, 6.2.3, 6.2.5 ÷ 6.2.8, 6.3, 6.4.16, 6.6.5, 6.6.6, 6.7.2, 6.8.4, 6.8.5, 6.8.8, 6.9, 6.10.6, 6.11, 6.13.3 ÷ 6.13.6, 6.14.3, 6.14.5, 6.14.6, 6.14.12 ÷ 6.14.17, 6.15.7, 6.16.2 ÷ 6.16.4, 6.16.8, 6.16.10 and 6.17.

6.19.2 Maintenance of height of a trunk safety space, as specified in 6.2.2 and 6.2.3 is not required, however, at the entrance to the lift pit, a warning notice shall be placed to inform that the pit may be entered only after mechanical securing the car against its downward movement.

6.19.3 A separate room for driving machinery is not required, provided the machinery items are duly protected and well-accessible. The space where the machinery items are installed shall be isolated from the trunk by a whole shield.

6.19.4 Instead of safety locks in lift trunk doors (see sub-chapter 6.15), key-opened latches may be applied.

6.19.5 Drum or electric winches shall be used in simplified goods lifts. Winch drums shall have rims.

6.19.6 No counterweights shall be used in a simplified goods lift.

6.19.7 Baskets may be used instead of a car. Neither the car not the basket shall be provided with electric appliances. The car or the basket shall be suspended on a rope of the diameter not less than 6 mm. Safety factor of the lifting ropes shall be at least 5.

6.19.8 At the calculation of drum or rope sheave, coefficient e (see 6.6.4) shall be taken not less than 22, while at the calculation of an equalizing sheave as not less than 15.

6.19.9 The lift trunk doors shall be equipped with safety switch.

6.19.10 Each control panel shall be provided with a safety button of red color marked with a "STOP" notice.

6.19.11 On the lift trunk doors, a notice shall be placed to inform that doors are allowed to be open only at the car or basket stop.

6.20 Materials and Welding

6.20.1 Materials used for the construction of the load-bearing parts of lifts shall comply with the requirements of the Rules for the Classification and Construction of Sea-Going Ships, Part IX – Materials and Welding.

6.20.2 All load-bearing parts of a lift shall be, as a rule, made of steel. Use of cast iron – see 6.20.3; use of other materials shall be considered separately by PRS.

6.20.3 Cast iron may be applied for the manufacture of:
- **.1** drums, friction discs and gear bodies for winches;
- **.2** wormwheels having bronze rim;
- **.3** brake blocks and drum and bearing body stanchions;
- **.4** rope sheaves.

6.20.4 Steel intended for welded load-bearing parts shall be weldable to sufficient degree (see the Rules for the Classification and Construction of Sea-Going Ships, Part IX – Materials and Welding, paragraph 2.10). Unless specified otherwise based on weldability test results, the boundary carbon content in a steel shall not exceed 0.22%.

6.20.5 Welding of the load-bearing parts of a lift shall be effected in accordance with the requirements given in chapter 23 of the *Rules for the Classification and Construction of Sea-Going Ships, Part IX – Materials and Welding*.

6.21 Supervision of Lifts Manufacture and Installation

6.21.1 A lift and its components intended to be installed onboard ship shall be manufactured under PRS supervision (see subchapter 1.3).

These appliances shall be tested at the manufacturer in accordance with a programme agreed with PRS. Tests for ropes shall be carried out in accordance with requirements given in chapter 21 of the *Rules for the Classification and Construction of Sea-Going Ships, Part IX – Materials and Welding*.

A lift and its individual components shall be stamped in accordance with the requirements of 11.2.4 and 11.2.5.

6.21.2 Before being put into operation (after installation onboard ship), the lift shall be subject to close examination, performed by the PRS Surveyor within the scope of 10.3.13. In the case of positive results of the examinations, lift tests shall be carried out, to the scope specified in 10.3.14.

7 VEHICLE LIFTS

7.1 Application

7.1.1 Requirements of this chapter apply to vehicle lifts whose lifting and lowering speed does not exceed 0.1 m/s.

7.1.2 Requirements of this chapter do not apply to removable stairs, goods and passenger lifts, boatswain hoists and mobile cat-walks.

7.1.3 The requirements o this chapter may be applied to vehicle lifts of working speed over 1.0 m/s or to lifts for vehicles of design not covered by this *Part* of the *Rules* upon separate agreement with PRS.

7.2 Scope of Supervision

7.2.1 PRS supervision covers: platforms, guide rails, guide shoes, buffers, locking cutting and separating devices, mechanical and hydraulic power transmission systems, load bearing strands (ropes and chain cables with guiding and fixing devices, linkage system), hydraulic structure components, racks, mandrels, electric machinery (drives, control and alarm signal systems, protecting devices, lighting).

7.3 Design Requirements

7.3.1 Requirements contained in subchapter 1.5 and in chapters 5 and 9 of this *Part* of the *Rules* apply also to vehicle lifts.

7.3.2 Construction and arrangement of vehicle cranes shall ensure safe access thereto for inspections and maintenance.

7.3.3 Platforms intended for closing cargo openings on open decks and unprotected superstructures shall ensure watertightness, including the requirements given in chapter 7 of the Rules for the Classification and Construction of Sea-Going Ships, Part III – Hull Equipment.

7.3.4 It shall be ensured that the platform surface, during its hoisting and lowering and during cargo handling, including ship inclinations specified in table 7.4.2.1, is permanently parallel to served cargo decks. This requirement shall be fulfilled with the use of guide rails.

7.3.5 If one of load-bearing strands has been destroyed, the remaining ones shall (either in design as well as in functional aspect) be able to ensure collaboration of platform and the guiding components. In such case, the hoist driving units shall stop automatically. Then, controlled lowering of the platform shall be possible, with the use of a respective arrangement, until it reaches locked or supported position, and can be unloaded.

7.3.6 Rope or chain slings of the platform shall have at least four load-bearing stripes. Each rope or chain sling shall be provided with rope or chain sag switch, which automatically switches off the drive in case of a droop or breaking of the load-bearing band.

7.3.7 Ropes for vehicle lifts may be without organic core and shall be of such rated wire strength as for the crane running rigging.

7.3.8 Use of pre-tensioned ropes is recommended for vehicle lifts. The rope tension load, acting for at least 30 minutes shall amount to 0.7 minimum rope breaking load.

7.3.9 When assembled onboard, the ropes may have ends poured in rope brackets. Such connection shall be load tested in accordance with 10.3.16.

7.3.10 Design of a vehicle lift and its control devices shall ensure maintenance of platform on one level in relation to deck during handling operations. If the platform is suspended on elastic strands (e.g. ropes) and the equalizing devices do not restore the level automatically, appropriate device locking the platform on deck level shall be provided for the time of handling operations. Locking condition shall be visually indicated on the control panel.

For platforms which are not provided with devices locking them in decks during cargo handling operations, the maximum difference in height between platform level and deck level shall not exceed 20 mm. In order to avoid control failures, automatic control systems are recommended.

7.3.11 Appropriate device locking the platform for the time of voyage, and appropriate platform drive lock shall be provided. This condition shall be visually indicated on the control panel. Heel and trim experienced during the ship movement shall not cause unlocking the platform.

7.3.12 Lift drive shall ensure braking smoothness and movement slow down at acceding the stop and holding the platform on the required level.

7.3.13 Driving units installed in closed spaces onboard a ship shall be constructed taking into account temperature range defined for the space.

7.3.14 Brakes may be omitted in hydraulic drives which at pressure decay automatically prevent platform lowering.

7.3.15 Control panels shall be arranged and equipped so that lift operator can, directly or aided by signalers, monitor all the platform travel. In no case, however, the control panel may be located less than 1500 mm from the platform deck opening.

7.3.16 Switching items of the control panel shall automatically return to zero position. Heel and trim experienced during the ship movement shall not cause self-activating the drive. Safety switches shall be distributed in accordance with 1.5.5.4.

7.3.17 Where several control panels are installed, possibility of use of one panel only and appropriate means of (telephone) communication shall be ensured.

7.3.18 On the control panel, at least the following visual and sound signals shall be received indicating:
- any protecting device action;
- platform movement (blinker);
- non-closed guards;
- failure of electric or hydraulic driving unit.

7.3.19 All control panels shall be provided with appropriate means to prevent use of the lift by unauthorized persons.

7.3.20 Control items and signal indicators shall have permanent notices made in national and English languages.

7.3.21 Vehicle lifts shall be provided with limit switches for the highest and the lowest position of platform and overload protecting devices (SWL limit stops). The hydraulic drives shall have overload protection in accordance with the Rules for the Classification and Construction of Sea-Going Ships, Part VII – Machinery, Boliers and Pressure Vessels, subchapter 7.2.

7.3.22 At failure of the main lifting machinery, protecting devices shall automatically stop the platform.

7.3.23 Platform deck openings shall be appropriately protected against falling people or vehicles into them. Mobile guard fences shall be provided with devices automatically locking or unlocking them respectively to platform movements. The guard fences and protecting rails shall be painted with warning colors and lighted.

7.3.24 Where people engaged in cargo handling and those who stay not only in operator's cabin but also directly on the platform are moved thereon, a removable guard fence shall be provided on at least one of longitudinals sides of the platform and a permanent notice shall be exhibited to specify the place where people should stay on the platform.

7.3.25 Space under platforms moved with use of a linkage system, a mandrel, etc. shall be protected against access of unauthorized persons. Counterweights shall be enclosed with trunks. Dangerous sections of the platform travel shall be marked with a warning paint or provided with signaling lamps.

7.4 Calculations

7.4.1 General Instructions

7.4.1.1 Unless specified otherwise in the below requirements, at the strength and stability calculations of vehicle lift structures, requirements of chapter 2, applicable for lifting appliances, in particular for cranes, shall be considered.

7.4.1.2 Calculations are performed with the assumption that the speed of platform lifting and lowering does not exceed 0.1 m/s and that the ship is in a port during handling operations and the platform is locked in this time.

7.4.1.3 Permissible load of the platform shall as a minimum comply with the permissible load of surrounding deck, where the platform is locked in voyage position.

7.4.1.4 The calculations shall be performed for the most unfavourable load distribution.

7.4.2 Design Loads

7.4.2.1 Design loads for vehicle lifts are specified in table 7.4.2.1.

Table 7.4.2.1

Item	Cargo handling phase	Load case	Condition	Design load	Remarks
1	Cargo handling operations (loading and unloading)	1.1	Platform locked on deck	Dead load; SWL (unfavorable distribution); static load due to ship inclination (5° heel, 2° trim); dynamic loads due to vehicles movement	The load-bearing slings without load, locks do not transfer bending and torque moments
		1.2	Platform supported by load-bearing components	Loads as in 1.1	–
2	Lifting and lowering	2.1	Equivalent stress	Dead load and SWL unformly distributed throughout the platform; static load due to ship inclination (5° heel, 2° trim); dynamic load due to starting and braking	When agreed with PRS, dynamic loads due to starting and braking need not be considered
		2.2	Maximum load at unfavourable distribution relevant to operation procedure	Dead load and SWL; static load due to ship inclination (5° heel, 2° trim); dynamic load due to starting and braking	
		2.3	Destruction of the load-bearing item	Dead load and SWL; static load due to ship inclination (5° heel, 2° trim); dynamic load due to destruction of the load-bearing item	Other load-bearing items shall, considering their design, be capable of taking additional loads and suitable for further operation
3	Platform in voyage condition	3	Locked platform	Dead load and SWL; forces due to locking; inertia forces due to ship movement in waves	See remark to 1.1

7.4.2.2 Except the loads given in table 7.4.2.1, the platform shall be calculated for a load due to carried vehicles, taking into account axial and surface pressure of wheeled vehicles tires.

7.4.3 Permissible Stresses, Strength Reserves and Stability Criteria

7.4.3.1 At the action of loads specified in chapter 7.4.2, equivalent stresses created in the load-bearing structure and in standing rigging of vehicle lifts shall not exceed the stresses given in table 7.4.3.1.

Table 7.4.3.1

Load case acc. to table 7.4.2.1	Permissible equivalent stress not higher than:	
	for connections and gear	for load-bearing structure
1.1	0.7 R_e	0.75 R_e
1.2	0.7 R_e	0.75 R_e
2.1	0.7 R_e	0.75 R_e
2.2	0.8 R_e	0.85 R_e
2.3	0.9 R_e	0.95 R_e
3	0.7 R_e	0.75 R_e

R_e – used material yield stress [MPa]

7.4.3.2 Strength reserve of the load-bearing strands (ropes, chain cables and other interchangeable gear items) exposed to breaking strain shall amount to at least 5. For the load case 2.3 in accordance with table 7.4.2.1, the required breaking strength reserve may be taken by 50% lower than the values required in normal conditions.

7.4.3.3 At calculating stability of compression components, compliance with requirements of 2.8.2 shall be ensured.

7.4.3.4 Platform rigidity in normal load conditions (load cases 1.1, 1.2, 2.1, 2.2, 3 in table 7.4.2.1), shall ensure deflection not exceeding $l/250$ (l – length between supports or length of hanging part of platform). In voyage condition and watertightness being maintained, platform deflections shall not exceed the values given in 7.10.4 of the *Rules for the Classification and Construction of Sea-Going Ships*, *Part III – Hull Equipment*.

7.5 Materials, Heat Treatment and Welding

7.5.1 Requirements which shall be fulfilled by materials used in manufacture of load-bearing structure components and driving components and units of vehicle lifts, as well as requirements for heat treatment of forgings and castings, welding procedures of steel load-bearing structures, components and machinery, methods of quality control and heat treatment of welds, shall be in accordance with appropriate provisions contained in chapter 3 of this Part of the Rules, unless otherwise specified in this chapter.

7.5.2 Use of steel castings for clamps intended for fastening rope ends and for locking devices subject to compression load, is permitted.

7.5.3 Locking items subject to loads due to tensile force and/or tensile force at bending, shall be made as forgings or from rolled steel.

7.5.4 Upon agreement with PRS, the interchangeable gear components of vehicle lifts may be manufactured of higher strength materials.

8 RAMP OPERATING ARRANGEMENTS

8.1 General Provisions

8.1.1 These requirements apply to arrangements intended for lowering and hoisting ramps installed onboard ships if the cargo handling is executed in a port or in protected waters.

8.1.2 The ramp load-bearing structure shall comply with the requirements contained in subchapter 9.7 of the Rules for the Classification and Construction of Sea-Going Ships, Part III – Hull Equipment.

8.1.3 If the ramp is intended for operation conditions other than these specified in 8.1.1, loads due to operation in such conditions shall be taken into account at determining loads to the ramp operating arrangement.

8.1.4 The ramp hoisting and lowering arrangements shall be selected taking into account the highest loads occurring during ramp operation or the loads due to ramp suspension instead of its supporting on the berth.

8.2 Loads

8.2.1 At determining the maximum load for the ramp operating arrangement, loads due to the below conditions shall be considered:

.1 forces due to ramp dead load;
.2 forces due to the highest combined mass of vehicles which may simultaneously be present on the ramp;
.3 dynamical forces due to operations of hoisting, lowering or suspending the ramp;
.4 forces due to permanent heels and trims of the ship;
.5 dynamical forces due to vehicles movement.

8.3 Design Requirements

8.3.1 The requirements contained in subchapter 1.5 and in chapter 9 of this Part of the Rules apply also to the ramp operating arrangements.

8.3.2 If a chain cable is a part of the ramp operating arrangement, its safety factor shall not be less than 4.

8.3.3 If a steel wire rope is a part of the ramp operating arrangement, its safety factor is determined by the below formula:

$$K = \frac{10^4}{8.85G + 1910} \tag{8.3.3}$$

K – safety factor
G – ramp mass (if the ramp is operated without cargo) or ramp mass with cargo, [t].

The safety factor shall not be lower than 4 nor higher than 5.

8.3.4 Where winches are component parts of the ramp operating arrangement, they shall comply with applicable requirements contained in subchapter 1.5 and in 2.9.5 of this *Part* of the *Rules*.

8.4 Permissible Stresses

8.4.1 Taking the loads determined according to 8.2.1, the stresses in the load-bearing structure of the arrangement shall not exceed the stresses specified in 2.7.1 of this *Part* of the *Rules*.

9 GEAR AND ROPES

9.1 General Provisions

This chapter defines the requirements for ropes, interchangeable gear and permanently attached gear.

Manufacture and acceptance of ropes and interchangeable and permanently attached gear shall comply with the requirements given in this chapter, as well as in chapter 10 of this *Part* of the *Rules*.

9.2 Permanently Attached Gear

9.2.1 The permanently attached gear shall be so connected to the load-bearing structure that its sufficient strength and adequate transmission of forces to the steel structure members, shall be ensured.

9.2.2 Angle of circular section mast contact with boom bearing body and span rope bracket shall amount to 40° counting from the body symmetry axis. In the bottom part of the boom bearing, the angle of contact may be reduced, however, it shall be at least 30°. With other sectional shapes of mast, the angle of contact shall be equivalent.

Where lower angles of contact have been taken, the mast shall be strengthened in place of body fastening by increasing the wall thickness or application of stiffeners inside the mast.

9.2.3 Boom brackets for fastening runner blocks and span ropes, and brackets for guys and preventers shall fully penetrate the boom head and be welded on both sides along the whole boom perimeter.

Boom guy brackets for light booms need not penetrate fully the boom head, provided they are welded to the boom and to the boom bracket used for the attachment of runner blocks and a span rope.

9.2.4 Boom heel double lug fitting may be made by forging or welding, or it may be cast from cast steel.

The lug fitting bolts shall have nuts with cotter pins. A thread shall be cut on the bolt on not more than 1/3 width of bolt setting in the lug fitting wall.

9.2.5 Boom bearing pins shall be secured against being ejected from lower boss or thrust bearing.

Bearings shall be well-welded and lubricated as well as well-protected against impurities and water.

9.2.6 Grip rings used for securing lead blocks shall be wholly manufactured as forgings and the boom resistance nose may be connected by welding.

9.2.7 Lower bearing pin shall have drainage openings.

9.2.8 Bodies and span brackets may be forged, cast or welded. Span cleat brackets shall be made of forgings only.

The span bracket pin shall be secured against being ejected from the body or being rotated inside or, in case of clamp brackets, within the clamp. The contact surfaces shall be smooth. Brass washers are recommended to be used under the bracket bearing surfaces.

Direction of the resultant force acting on span bracket at the lowest permissible boom angle shall intersect the bracket pin axis at least as high as the mid-length between the bracket bosses.

9.2.9 Brackets for the attachment of standing rigging, guys and preventers, span chain cables, opendable blocks, etc. to ship hull or steel structure of lifting appliances, shall be of a strength adequate to forces their transfer and their shape shall ensure proper adjoining of parts fixed to them.

Brackets location shall be such that their plane of the highest rigidity coincides with the direction of standing rigging ropes, and in the case of ropes of variable direction, with the rope average direction.

Thickness of the plate the bracket is welded to, shall be not less than 1/3 of bracket thickness, in no case, however, it shall be less than 5 mm. As a rule, the plate stiffening members shall be situated parallel to bracket direction.

9.3 Interchangeable gear

9.3.1 The safe working load (SWL) of the interchangeable gear, excluding blocks, is the highest permissible load which may be imposed on the gear by suspension of cargo of a defined mass or exerting a force equivalent to the gravity force acting onto suspended cargo, the gear is designed for.

SWL for a pulley block is the maximum permissible load on the block eye.

For single blocks with or without a becket, SWL is the maximum permissible force acting in the rope. For the single block without a becket, SWL is the permissible force acting in a rope which amounts to the half of its maximum load on the block eye.

For the single block with a becket, SWL is the permissible force acting in a rope which amounts to 1/3 of the maximum load on the block eye.

9.3.2 Threaded joints of the interchangeable gear shall comply with national standards.

9.3.3 Blocks

9.3.3.1 Blocks shall be manufactured so as to prevent rope jamming between enclosure and the sheave.

Block sheave axes shall be securely protected against rotation and axial displacement.

In the case of slide bearings, block sheaves shall be provided with bushes made of antifriction materials (e.g. of bronze).

Blocks eyes or fork fittings shall be wholly forged. Swivel nuts shall be securely protected against unscrewing.

Blocks with open hooks shall not be used in lifting appliances.

A thread fastening of fork fittings, due protection being ensured, shall be each time considered individually by PRS.

Internal diameter of steel wire rope sheaves as measured for the groove, shall depend on the rope structure, crane group and sheave type.

Sheave diameter for natural or synthetic fibre ropes shall not be lower than 5 times rope diameter.

Groove profile shall ensure adequate rope fit without jamming.

The lowest permissible diameters of a sheave for floating cranes shall be determined from the ratio D/d (where D – sheave diameter, d – rope diameter) specified in table 9.3.3.1 and taking into account the rope structure.

Table 9.3.3.1

Minimum ratio D/d depending on the rope structure	
Steel wire ropes of type:	D/d
6x7	42
19x7 or 18x7 (non-rotating rope)	34
6x36 WS	23
35x7 (non-rotating rope)	20
8x46 WS	18
Cable rope (in average)	60

Note: D – sheave diameter, d – rope diameter

The diameter of the drum shall not be less than 0.9 times sheave diameter.

The diameter of the equalizing (guiding) sheave shall be within the range 0.7-0.8 x D – of the sheave.

9.3.4 Minimum diameters of rope sheaves shall comply with the below provisions:
- the minimum diameter of the sheave shall be not less than the defined in Table 9.3.3.1 multiple of the diameter of the given type steel wire rope operating with the sheave (D/d),
- the minimum diameter of the sheave shall be not less than 360th multiple of the diameter of a single wire in the external plait of the rope operating with the sheave.

9.3.5 Floating cranes are divided into the following groups, respective to intensity of their use and their relative loads.

I group – construction cranes and the cranes of SWL over 100 t.
II group – cranes for handling general cargo, operating with hooks
III group – grab cranes.

The minimum diameters of sheaves, which shall be increased by the coefficient depending on the crane group, are given in Table 9.3.5.

Table 9.3.5

Crane group	Ratio *D/d*
I	D/d_I = min. D/d
II	D/d_{II} = min. D/d x 1.25
III	D/d_{III} = min. D/d x 1.5

Note: D – sheave diameter, d – rope diameter

9.3.5.1 Sheaves shall be made of a steel forging, and those of significant diameters – by welding.

Use of cast iron thimbles shall be considered by PRS on a case basis.

Wooden sheaves may be used only for synthetic ropes.

Sheave diameter and groove profile shall be chosen respectively to the diameter of the rope of the lowest applied rated strength of wires.

9.3.5.2 At design calculation of the dimensions of cargo block items with movable axes, each sheave shall be considered as loaded with the radial force, equal to resultant force in ropes. For blocks with fixed axes, the force component due to permissible rope deflection of 6°, parallel to sheave axis and applied 0.5 of sheave diameter from the sheave axis, shall also be considered.

9.3.6 Cargo Shackles

9.3.6.1 Cargo shackles and their fastening items shall have no protruding parts nor sharp edges.

Arrangement of a cargo shackle shall prevent its skew operation.

9.3.6.2 Cargo shackles shall be wholly made of steel forgings or of separate articulated items.

Use of plate cargo shackles shall be considered by PRS on a case basis.

Shackles shall be plain and have bolts fastened in bows on a thread or by means of a nut. Bolts or nuts shall be securely protected from disconnecting.

Round shackles may be used as cargo shackles (instead of hooks) and for plant or synthetic fibre ropes.

Shackles for fastening items in a sling (hooks, triangular plates, weights and chain cables) shall have bolts with a countersunk head and without nuts.

9.3.7 Cargo Hooks

9.3.7.1 Cargo hooks and their fastening items shall have no protruding parts nor sharp edges.

For shipboard and boom derricks, the cargo hook design shall be such that hook touching protruding parts and unintentional detachment of slings is not possible during lifting.

9.3.7.2 Cargo hooks shall be manufactured by forging or steel extrusion moulding. Application of plate hooks shall be in each case considered individually by PRS.

For cranes and boom derricks of SWL at least 10 t, ramshorn hooks may be used which shall comply with the requirements for a single hook.

Onboard floating cranes and special purpose ships provided with lifting appliances, upon agreement with PRS, ramshorn hooks may need be provided with means protecting against accidental detachment of slings nor have a shape preventing hooking up the ship structure items.

Ramshorn hooks load shall be symmetrically distibuted..

Swivels of cargo hooks and blocks shall be manufactured of forgings. The swivel nut shall be secured against self-loosening.

9.3.7.3 Calculation of stresses in curvilinear part of a hook shall be performed, as a rule, in accordance with curved beam theory. Upon agreement with PRS, calculation of stresses in curvilinear part of a hook may be performed by approximation without considering the curvature. For this case, permissible stress as compared to calculated stresses for an internal fibre of the curvilinear part of the hook, shall not exceed 60%.

9.3.8 Spreaders, Traverses and Frames

9.3.8.1 Spreaders, traverses and lifting frames shall be made of carbon structural and alloy steels, respectively to the purpose of particular components.

Use of aluminium alloys for some parts of loose gear requires special PRS agreement in each particular case.

When calculating strength and carrying out load tests, spreaders, traverses and lifting frames shall be considered as interchangeable gear or as items of steel load-bearing structure.

9.3.8.2 Design of container spreaders, considering the loads due to the wind pressure and ship inclination, shall enable, by the use of special loading devices (such as a rotating device), setting the spreader in any position needed for hooking and positioning the container.

9.3.8.3 Spreader design shall ensure simultaneous closing its rotating gripping devices.

9.3.8.4 Possibility of appropriate positioning mobile spreader telescopic beam for the relevant working position shall be ensured. Spreaders shall have a device equalizing their gravity centre. Devices reducing swaying motions and preventing inadvertent rotation of the spreader, shall be provided.

9.3.8.5 At power control, proper entry of rotating eye head into container corner fitting sockets shall be indicated by a contact sensor.

Maintaining the rotating eye heads in "held" or "released" position shall be executed by means of limit switches. Crane control position shall be provided with visual signals to inform on the position of rotating eye heads.

9.3.9 Other gear

9.3.9.1 Thickness of triangular and polygonal plates used for connecting ropes and chain cables shall be relevant for the opening of fastened shackles and provide a minimum axial clearance ensuring their free movement. Welding pads from both sides of the plate in places of connection is allowed.

9.3.9.2 Turnbuckles with eyes and forks, forged as a whole with the screw part, shall be applied. Turnbuckles with hooks are not allowed. Turnbuckle design shall provide appropriate protection against their unscrewing after tightening.

Fastening forks using a thread, appropriate protection being ensured, shall be each time considered separately by PRS.

9.3.9.3 Thimbles shall be made of steel by open-die or closed-die forging. Use of forged thimbles shall be in each case individually considered by PRS.

9.3.9.4 Chain cables used in lifting appliances shall comply with general requirements of chapter 20 of the Rules for the Classification and Construction of Sea-Going Ships, Part IX – Materials and Welding and of relevant national standards.

9.3.9.5 Runner chain cables shall have short oval links, while span and preventer chain cables used in union purchase operations shall have long links.

9.4 Steel Wire Ropes

9.4.1 Wire ropes used in lifting appliances, within the scope not covered by special requirements of this *Part* of the *Rules*, shall comply with the requirements of chapter 21 of the *Rules for the Classification and Construction of Sea-Going Ships, Part IX – Materials and Welding*.

Application of six-lay steel wire ropes made of wires of nominal tensile strength from 1370 to 1960 MPa is recommended.

9.4.2 For the running rigging, ropes with a single organic core and at least 114 wires, are recommended. Use of ropes with higher number of cores shall be agreed with PRS separately. Wire diameter in external lay layer shall not be lower than 0.6 mm.

9.4.3 Upon agreement with PRS, wire ropes with steel core may be applied. In such case, ratio of sheave and drum diameter to rope diameter shall be taken according to table 9.3.3.1.

9.4.4 For standing rigging, wire ropes with one or several organic cores of wire nominal tensile strength between 1370 MPA and 1570 MPA, and wire diameter in external layer of the rope lay not less than 1 mm and wires number at least 42, are recommended.

9.4.5 The wires of running and standing rigging ropes shall be zinc plated for a thickness conforming to the relevant requirements of national standards.

9.4.6 Use of ropes spliced connections is not allowed in lifting appliances.

9.5 Natural and Synthetic Fibre Ropes

9.5.1 Natural fibre ropes (manila, sisal, hemp, coconut) and synthetic fibre ropes may be used only for light boom guy tackles, schoonerguys and internal guys for union purchase operation, as well as in manually operated lifting appliances.

Application of synthetic ropes requires special PRS consideration in each case.

In each case, rated diameter of natural and synthetic fibre ropes shall be not less than 20 mm. A force needed for manual heaving in a rope shall not be more than 300 N.

Use of ropes spliced connections is not allowed in lifting appliances.

9.6 Loose Gear

9.6.1 Loose gear shall comply with the requirements of subchapters 1.5 and 2.1 in applicable scope.

9.6.2 Design of container spreaders, considering the loads due to wind pressure (see 2.2.3) and ship inclination (see 2.2.2), shall enable, by variable arrangement of the lifting appliance ropes or by the use of spreader special devices (such as a rotating device), setting the spreader in any position needed for attaching and positioning the container.

9.6.3 Spreader design shall ensure simultaneous closing its rotating gripping devices.

9.6.4 Possibility of appropriate securing spreader telescopic beam in relevant working position shall be ensured.

9.6.5 A device used for equalizing gravity centres shall in the most unfavourable case act in longitudinal direction.

9.6.6 Container spreaders which are so suspended that possibility of container self-rotating or swaying is not excluded, shall be equipped with devices preventing such movements.

9.6.7 At power control, proper entry of rotating eye heads into container corner fitting sockets shall be indicated by a contact sensor.

Maintaining the rotating eye heads in “held” and “released” position shall be executed by means of limit switches.

The crane control position shall be provided with visual signals to inform on attaching or releasing the rotating eye heads.

10 TESTING, EXAMINATIONS AND SURVEYS

10.1 General Provisions

10.1.1 The purpose of testing, examinations and survey activities is to determine if a lifting appliance complies with the requirements of this Part of the Rules and if its condition ensures its safe use.

10.1.2 The manufacturer or Shipowner is obliged to submit lifting appliances to tests, examinations and surveys required by this *Part* of the *Rules*, as well as to perform any necessary preparations and perform the tests.

10.1.3 PRS Surveyor shall refuse to attend tests or examinations if the lifting appliance is not prepared for them and where faults and failures negatively affect the tests and examinations safety.

10.1.4 During examinations for periodical surveys of lifting appliances performed by PRS, ship management shall notify PRS of any found faults of, and changes made to, the appliance, repairs and replacements of gear and ropes executed from the previous survey.

10.1.5 In the case of failure of the lifting appliance during its service period, the ship management or Owner is obliged to submit the ship to PRS after damage survey within due time.

10.1.6 PRS performs surveys and participates in examinations and tests of lifting appliances not before completion of construction, conversion or repair of steel structure, machinery and gear and after submission certifying performance of final acceptance by the manufacturer.

10.1.7 If during survey, examination proves that the lifting appliance, its steel structure, machinery and gear do not comply with the requirements of this Part of the Rules or their condition does not ensure their safe use, this appliance or its part is not issued with the PRS documents, and in the case of appliances in service the previously issued documents become invalid until deficiencies are removed and the appliance is brought to the condition complying with the Rule requirements.

10.1.8 PRS documents issued for the lifting appliance become invalid in case of missing any test and examination certificates required by the Rules, or missing entries on carrying out periodical surveys in due time, or in the event of the appliance nonconforming with the issued documents, as well as after damage.

10.1.9 At the initial survey of the lifting appliance constructed without PRS supervision, the Owner shall submit drawings and calculations to the scope given in subchapter 1.4 and documents issued by supervision bodies or manufacturers concerning acceptance and examination of lifting appliances.

Examination of the lifting appliances submitted for initial survey shall be performed to the scope as provided in subchapter 10.3.

Where the Owner is granted certificates by competent supervision bodies (see 11.1.8) on interchangeable gear and ropes examinations, they need not be repeated, provided that applied proof loads are in compliance with the requirements of subchapter 10.2.

10.1.10 Test weights shall fit this purpose and their mass shall be certified. The mass of test weights is determined by weighing with accuracy confirmed by relevant documents. Where the mass of test weights may not be determined by weighing, it shall be determined by calculation. The mass of a test weight shall be not lower than that given in tables in subchapters 10.2 and 10.3 and may not exceed these values by more than 2.5 %.

10.2 Tests of Interchangeable Gear and Ropes

10.2.1 Any new parts of the interchangeable gear of the lifting appliances shall be subjected to proof load tests attended by a competent surveyor, using the load specified in table 10.2.1,.

Table 10.2.1

Item	Gear	SWL, [t]	Proof load P_{pr}, [t]
1	Hooks, chain cables, swivels, turnbuckles, etc.	SWL ≤ 25 SWL > 25	2 × SWL (1.22 × SWL) + 20
2	Single blocks without becket	SWL ≤ 12.5 SWL > 12.5	4 × SWL (2.44 × SWL) + 20
3	Single blocks with becket	SWL ≤ 8 SWL > 8	6 × SWL (3.66 × SWL) + 20
4	Pulley blocks	SWL ≤ 25 25 <SWL ≤ 160 SWL > 160	2 × SWL (0.933 × SWL) + 27 1.1 × SWL
5	Traverses, frames, beams and similar inter-changeable gear, container spreaders	SWL ≤ 10 10 <SWL ≤ 160 SWL > 160	2 × SWL (1.04 × SWL) + 9.6 1.1 × SWL

Tests shall be performed using appliances provided with indicators of exerted load or by suspension of a weight of a specified mass. Testing appliances shall ensure indication accuracy of ± 2%, which shall be certified.

The proof load shall act statically for a period of at least 5 minutes.

Where practicable, all gear parts shall be submitted to tests and examinations covered with anticorrosion layer (not painted).

If the SWL of the interchangeable gear is considerably high or the gear dimensions preclude the use of test appliances, the test may be executed by gear suspension under appropriate structure or a lifting appliance and application of a proof load thereto.

10.2.2 Several gear pieces may be tested simultaneously, if they may be connected so that the gear is operating as if in actual service conditions. Each piece is subjected to proof load equal to its SWL.

10.2.3 After testing, all gear parts shall be close-examined by the PRS Surveyor, in order to confirm that the gear does not prove faults or permanent distortions. For the examinations, blocks shall be disassembled for checking axes and sheaves.

Positive results of carried out close examinations and tests are certified on the Form No. 410 (3) issued by the PRS Surveyor. The gear subjected to examinations shall be stamped in accordance with 11.2.1.

10.2.4 Container spreaders subjected to proof load tests shall be additionally submitted to operational tests in corresponding service conditions.

Traverses of considerable SWL intended for heavy cargo to be used with a specified lifting appliance are regarded as proof load tested if they have been tested together with the appliance.

10.2.5 After repair, interchangeable gear shall be proof load tested again and re-examined by a competent person, in accordance with the requirements of 10.2.1.

10.2.6 Tensile tests of chain cables, steel wire ropes, natural and synthetic fibre ropes, shall be performed in accordance with the requirements of Chapters 21 and 22 of the *Rules for the Classification and Construction of Sea-Going Ships*, *Part IX - Materials and Welding*.

Testing shall be confirmed with manufacturer's certificate for natural and synthetic fibre ropes; for chain cables and steel wire ropes, additionally with certificates on Forms 410 (No.3) and 408 (No.4), issued by the PRS Surveyor.

10.2.7 The ramshorn hooks shall be proof load tested in accordance with Fig. 10.2.7. The test may be made in one operation, in accordance with Fig. 10.2.7(a), or by two operations, see Fig. 10.2.7(b).

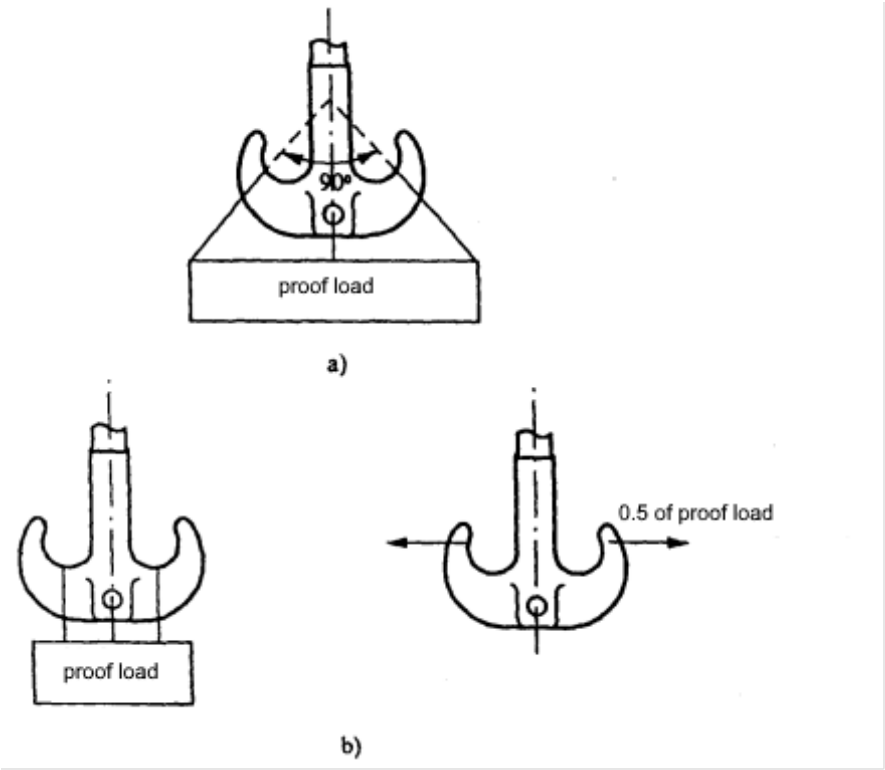


Fig. 10.2.7

10.2.8 Blocks with forks shall be tested by suspension of a proof load, as shown in Fig. 10.2.8. The method of loading the single block without a becket is presented in Fig. 10.2.8(a); for the single block with a becket Fig. 10.2.8(b) applies, while for a pulley block – Fig. 10.2.8(c); *n* in the drawing for the pulley block means the number of ropes.

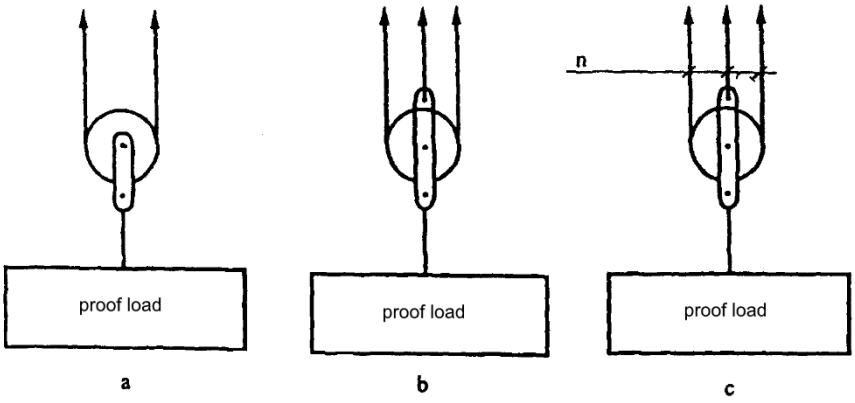


Fig. 10.2.8

10.2.9 Prototypes of standardized parts of the interchangeable gear and of such parts of this gear which are manufactured by the given manufacturer, shall be tested under boundary load equal to double proof load specified in table 10.2.1. PRS may demand carrying out such test also for permanently attached gear prototypes.

For interchangeable gear of considerable SWL (100 t and more), PRS may depart from the boundary load test, if sufficient gear strength is proved by calculations and proof load tests results.

PRS may demand carrying out periodical boundary load test also in respect to interchangeable gear taken from current manufacture. The number of parts from the batch to be subject to such test is agreed with PRS. Cone ends and sockets of steel wire ropes shall be tested together with the rope.

The gear part is considered as withstanding the test if it has not been destructed at anticipated boundary load, The PRS Surveyor may demand the test to be continued until the part destruction.

The gear parts subjected to boundary load test shall not be repaired or put into use.

The boundary load tests shall be performed by the manufacturer obligatorily in the presence of PRS Surveyor. The test shall be documented by a report issued by the manufacturer and confirmed by the PRS Surveyor.

10.2.10 The dead load of the interchangeable gear items which are not from series manufacture, shall be determined by weighing the whole appliance or its components.

10.3 Testing and Examinations of Complete Lifting Appliances

10.3.1 The lifting appliances completed as a whole in the manufacturer's works shall be subjected to tests and examinations at the manufacturer, in accordance with PRS approved test programme, in the presence of the PRS Surveyor.

Proof loads shall comply with the requirements of table 10.3.4.

Carrying out the tests and examinations shall be confirmed by PRS certificate or manufacturer's certificate signed by the PRS Surveyor.

After tests, the lifting appliances shall be stamped in accordance with 11.2.2.

Thermal insulation and painting of the load-bearing components of the lifting appliances shall be executed after testing and examination.

10.3.2 Prior to tests and examinations of the lifting appliance, but after its installation onboard, the PRS Surveyor shall be furnished with: PRS or manufacturer's certificates for lifting appliances, certificates of interchangeable gear and ropes examination issued by PRS Surveyor, manufacturer's documents confirming lifting appliance compliance with the PRS approved technical documentation, protocols of control of performed works and of quality control of welded joints, material and product certificates and certificates of performed heat treatment.

For the appliances which were subject to structural changes during repair or modernization, the scope of submitted documents shall correspond to the scope of performed changes.

For the periodical surveys of lifting appliances in service, which were not subject to conversion, alteration or repair, the scope of submitted documents shall conform to the list given in subchapter 11.1.

10.3.3 The shipboard lifting appliance to be subject to examinations, shall be fully prepared for these activities.

Prior to tests, a detailed examination of the appliance shall be performed by the responsible employee of the manufacturer, who executed the appliance installation onboard, or by the person responsible for test performance. The appliance may be submitted to tests if during examinations no faults negatively affecting testing safety have been ascertained.

10.3.4 After installation of lifting appliances onboard, but prior to their putting into service, they shall be submitted to proof load test under load exceeding SWL by the value given in table 10.3.4.

Table 10.3.4

SWL [t]	Proof load
below 20	1.25 x SWL
20 – 50	*SWL* + 5 t
above 50	1.1 x *SWL*

As a rule, tests shall be performed with the use of test weights and by performing full range of movements. No exceptions are permitted from this principle during testing for initial survey. For repair or replacement, or where repeated proof load tests are required during periodical survey, the use of a spring or hydraulic dynamometer may be allowed, provided the permissible working load does not exceed 15 tonnes, the device is reliably attached, winches are in good operational condition, or appropriate appliances are provided for inducing proof test load and appropriate safety conditions are ensured.

Where a dynamometer is used, it must be calibrated with accuracy of ±2%, and its indicator shall remain steady for 5 minutes.

Calibration of the dynamometer shall be performed by a competent person at least every 12 months. It is not allowed to use the dynamometer whose validity has ceased.

For hydraulically driven hoisting mechanisms, if lifting the test weight of mass defined in table 10.3.4 is impossible due to limited hydraulic pressure, lifting the weight of possible highest mass, but generally not less than working load increased by 10%, shall be deemed sufficient.

If the winch being part of the tested appliance is not able to lift the test weight, then it may be lifted with the use of other winch, however, braking and holding the test weight shall be executed with the use of the winch subjected to test.

If removable stays or shrouds are provided for the operation of heavy boom derricks, they shall be installed at place during testing.

The boom derricks with replaceable booms shall be subjected to tests with booms fixed in each of relevant bearings.

The boom derricks with booms operating over two hatches shall be tested for each hatch position.

The boom derricks with booms provided with two head brackets shall be tested in each of the brackets.

For boom derricks, the test weight shall be lifted at an angle of boom inclination to horizontal of 15° for light booms and 25° for heavy booms. If for service conditions greater angle of boom inclination is set (see 4.2.1), the boom shall be tested for such an angle.

Powered boom derricks shall be subject to proof load also at maximum permissible inclination angles.

The boom inclination angle shall be given in the certificate (Form 406 (No. 2)), and when the inclination angle is limited but higher than 15° for light booms, it shall also be marked on the boom (see 11.2.12).

In the case of powered boom derricks and the variable radius cranes, the test weight shall be lifted at maximum radius and transferred to the minimum radius. In the case of SWL, varying depending on the luffing radius, the test weight shall be lifted at the maximum radius for each value of SWL and transferred to the minimum radius.

The crane radius shall be given in the certificate on Form 406 (No. 2), and where the radius is variable, it shall be marked also on the crane (see 11.2.12).

After being lifted, the test weight shall be transferred to an extreme position through the boom or crane rotation or crane (hoist or cargo winch) travel.

10.3.5 Proof Load of Floating Cranes of Drilling Units and Floating Docks

10.3.5.1 Static Test

The static test of cranes shall be performed with proof load value in accordance with table 10.3.5, at calm weather.

Table 10.3.5

SWL [t]	Proof static load to be applied
below 20	1.4 *SWL*
20 to 50	$\left(1.5 - \frac{SWL}{200}\right) SWL$

The test shall be carried out maintaining sufficient freeboard, only with moving hoisting mechanism and at the crane location most unfavourable as reagrds stability and at the minimum and maximum jib deflection angle. Test result is considered satisfactory if after lifting the weight to the height not exceeding 200 mm it is not lowered for 10 minutes and no cracks, ruptures and permanent deformations of items are ascertained.

10.3.5.2 Dynamic Test

The dynamic test shall be performed with proof load specified in table 10.3.4. For the test, all kinds of movements in their whole range shall be executed with non-full speed of machinery and measurements of pontoon inclinations shall be carried out.

10.3.5.3 Proof SWL Load Test

After the above load test, the crane shall be loaded with the test weight equal to SWL and all kinds of movements in their whole range shall be executed with full speed of machinery.

After testing, thorough examinations of the crane shall be performed in order to confirm that no damages, cracks or permanent deformations occurred.

10.3.6 Action of brakes of boom derrick and jib crane winches shall be checked by rapid lowering of test weight by about 3 m and sharp braking thereof. The test shall be performed for at least two boom or jib positions. During the test, it shall be proved that the test weight is held at shut off drive of the winch and manual release of the brake shall be checked.

For heavy boom derricks, the change of radius of the appliance under test load shall be effected to check brakes of span and guy winches provided with own drive.

10.3.7 After carrying out proof-load tests, the crane shall be subject to tests with load equal to SWL and perform all kinds of movements within their whole range at full speed of machinery. Checking the operation of brakes of particular items of machinery shall also be performed by sharp braking. During the tests, operation of limit switches and indications of radius indicator shall be checked.

Where the crane design provides for simultaneous execution of several movements (lifting, derricking, slewing and travel), the tests shall be carried out taking into account combination of such movements.

If the cranes are provided with overload switches, their operation shall be checked at lifting a boundary load.

Tests of powered boom derricks are performed similar.

10.3.8 After tests carried out in accordance with 10.3.4 an 10.3.7, the whole load-bearing structure, all machinery items and gear of the lifting appliance shall be submitted to PRS for close examination for faults or permanent deformations.

If during examinations any faults adversely affecting operation safety have been ascertained, the damaged parts or assemblies shall be replaced or repaired, and afterwards the tests shall be repeated.

Carrying out the above mentioned tests and examinations shall be certified on Form 406 (No. 2).

10.3.9 The boom derricks intended for union purchase operation shall be subjected to proof load tests in accordance with the requirements of 10.3.4. Each crane shall be tested separately. Additionally, particular pairs of boom derricks shall be tested with coupled runners under proof load equal to 1.25 of SWL for union purchase operation.

During the test, the test weight shall be moved from one boom head to the other boom head, the angle between runners being close to the boundary angle.

If for union purchase operation booms shall be arranged in various positions, the test shall be performed at such booms arrangement where preventers are loaded to the maximum.

Selection of boom arrangements during load tests for union purchase operation, specified in test programme, shall be determined at design stage, in result of analysis of performed calculations.

During the test, means for control of the angle between runners as well as arrangement of booms and preventers shall be checked.

After tests, union purchase booms gear and equipment shall be submitted to PRS for thorough examinations for faults or permanent deformations.

Positive results of the above mentioned tests and examinations shall be certified on Form 425 (No. 2 (u)).

10.3.10 Where carrying out tests of a hoist installed in machinery room, in screw shaft tunnel or in other similar enclosed rooms is difficult due to design or technological conditions, then upon PRS consent, the proof load tests of the hoist may be performed on a special stand beyond these spaces. On one-rail travel track onboard ship, the proof load tests shall be executed with the use of a dynamometer, by applying the proof load along the track in different points, to the satisfaction of PRS Surveyor. After being installed on a travel track, the hoist shall be subject to checking its operation without load.

10.3.11 The ramp operating arrangements, after being installed onboard, but prior to being put into service, shall be subjected to operation tests and to proof load test under a load exceeding permissible load by the value given in table 10.3.4. Permissible load of the ramp operating arrangement is determined according to 8.1.4 and amounts to:
- ramp dead load – for the ramp operated without vehicles;
- ramp dead load and the highest combined mass of vehicles, which may be simultaneously placed on the ramp, which is suspended, but not supported on the quay.

10.3.12 Prior to the crane survey and testing, after it is installed onboard ship, the PRS Surveyor shall be provided with:
.1 certificates of tests of particular appliances and ropes;
.2 control protocols of works conducted onboard ship and of quality examinations of welded joints;
.3 attestation certificates for materials and products used for works carried out onboard and certificates of performed heat treatment;
.4 measurements of parallel and rectilinear arrangement of trunk walls and rectilinear arrangement of guide rails in the trunk and their span.

10.3.13 During the close-up survey of the crane, condition and operation of all crane parts shall be checked, in particular:
.1 control arrangements and electric drive;
.2 safety locks and safety switches of trunk doors;
.3 safety stops;
.4 flexible buffers;
.5 signal and lighting systems;
.6 limit switches;
.7 strands, their attachment and slings;
.8 the structure load-bearing components.

10.3.14 After being installed onboard, the crane shall be subjected to the below tests:
.1 static load test under proof load equal to 1.5 of SWL, [t]; after 10 minutes, the car cabin (platform) shall not deflect from the permissible level by more than 20 mm;
.2 dynamic load test, for checking crane operation for 2 working cycles (2 travels upwards and 2 travels downwards, the car being stopped at each level) under proof load equal to 1.1 of SWL.
.3 for cranes with frictional winch, friction contact test, for checking if the ropes are not subject to permanent slide in the friction disc grooves after braking the cabin travelling with a rated speed downwards, under proof load equal to 1.5 of SWL, [t]; the test shall be performed only after the crane installation onboard and after ropes replacement.

10.3.15 After tests referred to in 10.3.14, the crane shall be submitted to a survey for determining whether any faults or permanent deformations occurred. If it is considered necessary, machinery parts as indicated by the Surveyor shall be disassembled for the survey.

Any faulty parts shall be repaired or replaced. In such case, tests shall be repeated.

10.3.16 Vehicle lifts are subject to static load test under load equal to 1.5 of SWL for the lifts with friction winch, and to 1.25 of SWL for lifts with other hoisting mechanisms. The lifts with friction winch shall be submitted also to friction contact test in accordance with the requirements of 10.3.14.3. If the above test results are positive, the vehicle lifts are subjected to short-duration dynamic load test under load equal to 1.1 of SWL, taking into account the requirements of 10.3.4.

10.3.17 New types of vehicle lifts are subject to tests respectively to expected service conditions, either with anticipated permissible load or with agreed proof load. During the tests, measurements of platform deformation shall be performed, considering the requirements of 7.4.3.4, and a dummy lifting strand break test shall be carried out.

10.3.18 In the case of positive results of the tests carried out in accordance with the requirements of 10.3.4 and 10.3.16, vehicle lifts are subjected to an operation test under load equal to SWL, respectively to service conditions. The test scope shall include several carriage operations, respective to expected service conditions, including: loading the platform with low-chassis trailers, tractors or other vehicles. During the tests, operation of the safety devices, the devices securing the openings in decks and devices locking the platform with the deck, shall be checked.

10.4 Periodical Surveys, Examinations and Tests

10.4.1 All boom derricks, together with their gear attached permanently to booms, masts and decks (including span chain cables), shall be submitted at least every 12 months to a close-up annual survey and at least every 5 years to a close-up 5-year survey. These surveys are performed by the PRS Surveyor.

The survey results shall be entered in Parts I and II of the *Register of Ship's Lifting Appliances and Items of Loose Gear* on Form 103 (No. 1).

10.4.2 All cranes, powered boom derricks, overhead cranes, hoists and winches shall be at least every 12 months subjected to a close-up survey, by PRS Surveyor.

Survey results shall be entered in Part I of the *Register* on Form 103 (No. 1).

10.4.3 All floating cranes, floating dock cranes and drilling unit cranes shall be at least every 12 months submitted to an annual survey and at least every 5 years to a 5-year survey, carried out by the PRS Surveyor.

During the annual survey, the crane is subjected to proof load tests under load equal to SWL, while at the 5-year survey it is subject to load tests under proof load as specified in table 10.3.4.

The survey results shall be entered in Part V of the *Lifting Appliance Book* in Form 104. After carrying out load tests, a *Certificate of Lifting Appliance Survey* shall be issued on Form 411.

10.4.4 Ramps together with their ramp operating arrangement shall be at least every 12 months subjected to a close-up annual survey and at least every 5 years to a 5-year survey, to be performed by the PRS Surveyor. During the 5-year survey, the ramp shall be subjected to load tests under proof load determined in accordance with 10.3.11. After load tests, *Certificate of Test and Thorough Examination of Lifting Appliances* on Form 406 (No. 2) shall be issued.

Survey results shall be entered in Part I of the *Register* – Form 103 (No. 1).

10.4.5 Lifts shall be subjected at least every 12 months to a close-up survey within the scope defined in 10.3.13, whereas every 5 years the close-up survey shall be supplemented with load tests according to 10.3.14. After the load tests, carried out in accordance with 10.3.14, a survey shall be carried out in accordance with the requirements of 10.3.15.

10.4.6 If in result of survey, any deficiencies are found adversely affecting the lift operation safety or causing wear higher than permissible value, the worn or damaged parts shall be repaired or replaced, and deficiencies removed. After repair or replacement of a part, operation check shall be repeated, and in the case repair or replacement concerns the load-bearing structure parts, tests specified in 10.3.14 shall also be performed.

10.4.7 Admission for PRS supervision of a lift installed onboard a ship in service is effected after initial survey carried out by PRS Surveyor, which includes a close-up survey within the scope defined in 10.3.13 and tests referred to in 10.3.14 with the survey specified in 10.3.15.

Prior to initial survey, PRS Surveyor shall be furnished with technical documentation for consideration and approval (see 1.4.3) and the available lift documents.

10.4.8 Irrespective of periodical surveys performed in accordance with 10.4.5, the lift shall be subjected to an occasional survey after its damage or repair, or conversion made between periodical surveys.

The scope of the occasional survey shall be agreed with PRS Surveyor. After conversion, repair or replacement of the load-bearing parts, the lift shall be subject to tests mentioned in 10.3.14 with the inspection referred to in 10.3.15.

10.4.9 The Owner of the ship or the manufacturer is responsible for submission of the lift for surveys and tests in cases and time periods provided by this *Part* of the *Rules*, as well as for performance of any necessary preparatory work and tests.

10.4.10 The ship management is responsible for compliance of lifts condition with PRS issued documents and these Rules, their maintenance in condition ensuring their safe service and observance of operating manual in time periods between lift surveys carried out by PRS Surveyor.

10.4.11 The lift trunk doors being out of service having disassembled or damaged safety lock (see 6.15.3) shall be closed so as to preclude their opening by unauthorized persons.

10.4.12 Vehicle lifts shall be at least every 12 months subjected to close-up annual survey and at least every 5 years to close-up 5-year survey, carried out by PRS Surveyor. During the 5-year survey, the vehicle lift shall be submitted to load tests in accordance with the requirements of 10.3.16 and 10.3.17. Carrying out surveys and tests for vehicle lifts shall be confirmed by the issue of the certificate on Form 406 (No. 2). The survey results shall be entered in Part I of Register – Form 103 (No. 2).

10.4.13 All parts of interchangeable gear and loose gear shall be subject at least every 12 months to a close-up survey, by PRS Surveyor.

The results of the close-up examinations shall be recorded in Part II of the *Register* on Form 103 (No. 1).

10.4.14 During periodical surveys, availability of tests and examination certificates of lifting appliances, interchangeable gear and ropes, loose gear, as well as all relevant stamps, shall be checked. Technical condition of steel structures, together with their nods and machinery items connections and of lifting appliance gear shall be determined.

If during periodical surveys, performed examinations reveal defaults adversely affecting appliance service safety or its wear exceeding permissible values, the damaged or worn parts shall be repaired or replaced, and defaults removed.

Closed spaces of steel structure inaccessible for examinations, shall be tightness tested by air pumping in to the overpressure of 0.03 MPa and covering their walls with foam forming solution. Upon agreement with PRS, other testing method may be applied.

At least every 5 years, measurements of actual thickness of steel structure walls shall be executed.

If a need arises, after repair or replacement of structure parts, an occasional survey and tests, in accordance with the requirements of subchapter 10.5, shall be performed.

10.4.15 Tests of lifting appliances installed onboard ship executed to the scope specified in 10.3.3 to 10.3.9, shall be performed at least every 5 years.

Occasional tests carried out in accordance with the requirements of subchapter 10.5 are regarded as periodical tests.

Carrying out tests and associated surveys shall be confirmed by a certificate issued on Form 406 (No. 2) and by a record in Part I of the *Register* – Form 103 (No. 1).

10.5 Occasional Surveys and Tests

10.5.1 In the case of conversion, repair or replacement of lifting appliances, their machinery items, steel structure or gear, close-up examinations and appliances tests shall be performed, in accordance with subchapter 10.3.

The examinations and tests shall be carried out in particular in the below cases:

.1 at the replacement of the whole lifting appliance or its displacement;
.2 at making changes in the equipment, general overhaul or after damage repair of the appliance;
.3 at the general overhaul, change or replacement of steel structure, machinery items and permanently attached gear of lifting appliances;
.4 at the change of span rope attachment level and the change of shrouds and stays attachment points;
.5 after dismounting cranes from their foundations and their re-installation on the same foundation.

Where the replacement covers parts of interchangeable gear and loose gear, and ropes, the whole appliance need not be tested, however, tests certificates on Form 410 (No. 3) for the gear and on Form 408 (No. 4) for ropes shall be submitted.

After replacement of container spreader, operation test of the lifting appliance with suspended spreader and attached container shall be carried out, within the whole scope of service range.

Carrying out the occasional survey and tests is confirmed by a certificate issued on Form 406 (No. 2) and a record in Parts I and II of the *Register* on Form 103 (No. 1).

10.5.2 After damage to the lifting appliance in service, it shall be submitted to an occasional survey for determining technical reasons of damage.

For the considered case, necessary scope of survey is set by PRS Surveyor. The survey shall be performed notwithstanding the validity date of the appliance documents.

10.6 Permissible Wear

10.6.1 The below given normative values of wear shall be treated as given for information and they may be changed respective to actual operational conditions of the part and kind of wear. For more precise determination of wear effect on strength and operation of the appliance, calculating methods may be applied.

The below given normative values of wear shall be referred to the place of the highest wear.

10.6.2 Parts of gear proving wear of 10% and more their thickness or diameter, as well as parts where cracks or permanent deformations have been revealed, may not be accepted for further use.

10.6.3 The steel wire rope shall be withdrawn from use if:

.1 in any point of the rope, on a section equal to 10 times its diameter, the number of broken wires amounts to 5% or more their total number;

.2 a tendency to protruding wires or entire strands from the rope exists;
.3 a strand has broken;
.4 there are indications of excessive wear in the form of flat surfaces of external wires;
.5 corrosion, especially internal, is ascertained
.6 concentration of broken wires has been found in one strand or in a rope section shorter than 10 times its diameter or on loops of a rope with metal sockets;
.7 two or more broken wires appear in a section directly adjacent to metal union piece.

See also *PRS Publication No 10/I „Wytyczne oceny stanu lin stalowych dla urządzeń dźwignicowych"* (the Polish version only).

10.6.4 Natural or synthetic fibre ropes having broken strands, decayed, excessively worn or deformed shall be withdrawn from service.

10.6.5 Steel masts, booms, winch foundations and steel structures of lifting appliances and loose gear, with walls of thickness reduced by at least 20% in relation to original values, shall not be accepted for use.

10.6.6 Permissible wear of rotating components shall not exceed 5% of diameter in any point of related shape. If the shift of axis is of a nature similar to that shown in Fig. 10.6.6, the axis shall be replaced irrespective of the wear amount.

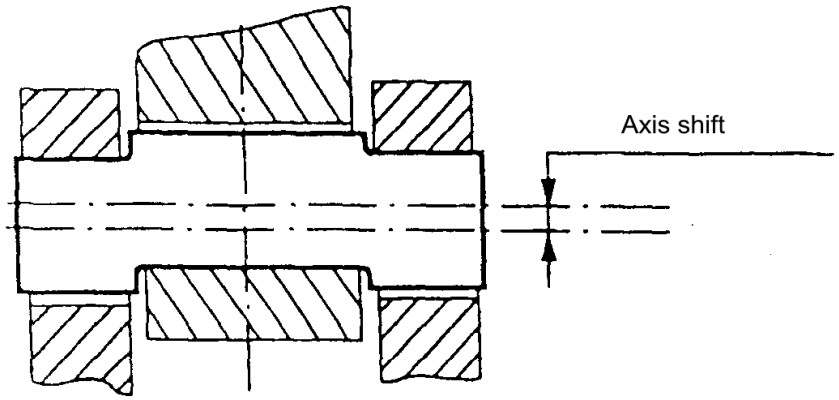


Fig. 10.6.6

10.6.7 Permissible wear in articulated joints of a boom derrick (pin – bearing, pin boom forks, etc.) shall be determined based on principles for slide bearings.

11 DOCUMENTS AND STAMPING

11.1 Documents

11.1.1 Ships provided with lifting appliances subject to PRS survey, shall have (respectively to installed appliances) the below documents:
.1 *Register of Ship's Lifting Appliances and Loose Gear*, on Form 103 (No. 1);
.2 *Certificate of Test and Thorough Examination of Lifting Appliances,* on Form 406 (No 2);
.3 *Certificate of Test and Thorough Examination of Derricks Used in Union Purchase* – Form 425 (No 2 (u));
.4 *Certificate of Test and Thorough Examination of Interchangeable Components and Loose Gear* on Form 410 (No 3);
.5 *Certificate of Test and Thorough Examination of Wire Rope*, on Form 408 (No 4);

.6 Manufacturer's certificate for natural and synthetic fibre ropes (see 10.2.6);
.7 Instructions for union purchase boom operation.

11.1.2 Floating cranes, floating dock cranes and drilling unit cranes, provided with lifting appliances covered by PRS survey shall have the below documents:
.1 *Lifting Appliance Book*, on Form 104;
.2 *Certificate of Lifting Appliance Survey*, on Form 411;
.3 *Certificate of Test and Thorough Examination of Interchangeable Components and Loose Gear* on Form 410 (No 3);
.4 *Certificate of Test and Thorough Examination of Wire Rope*, on Form 408 (No 4);

11.1.3 Ramps and vehicle lifts shall be entered in the Register of Ship's Lifting Appliances and Loose Gear, Form 103 (No. 1). After carrying out initial survey and periodical 5-year surveys, Certificate of Test and Thorough Examination of Lifting Appliances is issued on Form 406 (No. 2). The interchangeable gear and ropes used in the above mentioned appliances shall be issued with certificates on Forms 401 (No. 3) and 408 (No. 4).

11.1.4 A lift covered with PRS survey shall have the below valid documents and certificates:
.1 *Lift Book*, on Form 102;
.2 *Certificate of Test and Thorough Examination of Lifts and their Accessory Gear, Before Being Taken into Use and After 5 yearly Examination*, on Form 416;
.3 *Certificate of Test and Thorough Examination of Wire Rope*, on Form 408 (No 4);
.4 *Survey Report on Lift*, Form 349, issued after an annual survey and after an occasional survey in accordance with 10.4.8, where survey has not been completed with tests.

11.1.5 The lift shall be subject to permanent maintenance by an approved maintenance technician. He/she shall conduct inspections of the lift in accordance with maintenance manual.

The maintenance technician shall make records from carried out inspections in Part II of the *Lift Book*, Form 102.

11.1.6 The records in books and certificates shall be made in an official language of the vessel's flag state, and in the case of the vessel carrying out foreign voyages, also in the English language.

11.1.7 Precise description of the examined interchangeable gear and loose gear made on Form 410 (No. 3) shall include:
– conventional marks, in accordance with relevant standard;
– safe working load, for non-standardized components;
– category distinguishing symbol, in accordance with table 11.2.1;
– and the following characteristic dimensions:
.1 for shackles – pin diameter, and for non-standardized shackles, also bail diameter and aperture;
.2 for block and other swivels and for turnbuckles – thread diameter;
.3 for blocks – sheave diameter and axis diameter;
.4 for chain cables – bar diameter and kind of link (short or long).

11.1.8 Possession of valid documents issued by other competent supervision bodies, whose requirements are considered by PRS as equivalent to the requirements of the present *Rules*, is sufficient basis for accepting lifting appliance as fit for safe service. However, in the case of any doubts as to the technical condition of the appliance or to its compliance with documents, the appliance, irrespective of granted documents, shall be subjected to survey and examinations in accordance with the requirements of these *Rules*.

11.1.9 In the Register, Form 103 (No. 1), lower permissible ambient service temperature of the lifting appliance shall be given (see 1.5.1.3. and 2.2.4).

11.2 Stamping

11.2.1 After the proof load test carried out with positive result in accordance with 10.2.1, each piece of the interchangeable gear and loose gear shall be stamped.

The stamp shall include the below data:

.1 value of safe working load, preceded by letters SWL, [t];
.2 year and month of the test;
.3 distinguishing number;
.4 PRS stamp;
.5 dead load, preceded by letters T_w [t] (for traverses, beams and lifting frames and container spreaders);
.6 steel grade distinguishing symbol, in accordance with table 11.2.1;
.7 distinguishing number, as given in test certificate (for container spreaders, traverses, frames, etc.).

Table 11.2.1

Distinguishing symbol	Steel grade	Tensile strength, [MPa]
L	normal strength	300
M	higher strength	400
P	alloy	500
S	alloy	630
T	alloy	800

Stamps shall be extruded in specified spots of the gear and devices, as below:

- hooks – on one of side surfaces, near the eye; for ramshorn hooks – on expanded part between hook horns;
- swivels – on one of expanded surfaces of swivel joint boss;
- blocks – on the casing or carrying belt (where there is no enclosure), between the eye and sheave axis;
- forks of double blocks – middle of side surface;
- block swivels – on the side surface of casing near the pin;
- rope ends – on the cone part;
- chain cables – on the end link of each cable length;
- turnbuckles – on the tightening nut, while the distinguishing number also on eyes and forks;
- container spreaders, beams, lifting frames, etc. – on an visible place of the frame or beam.

The value of permissible load of container spreaders, traverses and lifting beams shall be placed in well-visible place, and the digit size shall enable their easy reading.

Examples of stamping the interchangeable gear are given in figures 11.2.1.1 ÷11.2.1.5.

While stamping the item of small size, where it is difficult to place all the marks, test year and month may be omitted.

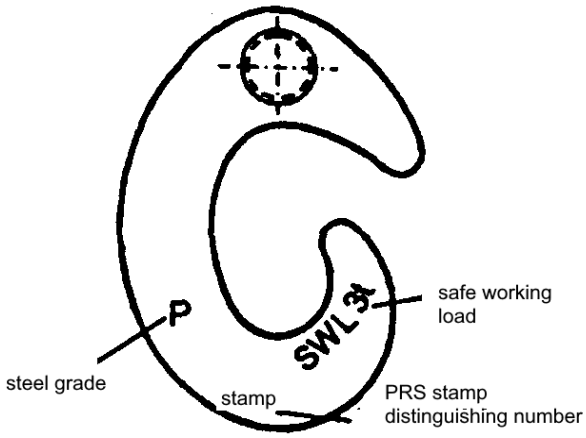


Fig. 11.2.1.1 Stamping a hook

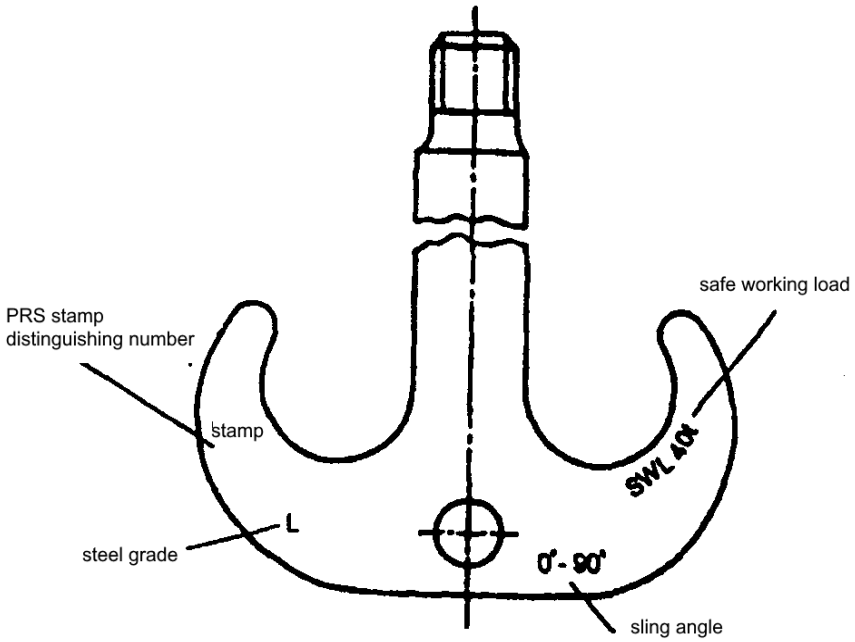


Fig. 11.2.1.2 Stamping a ramshorn hook

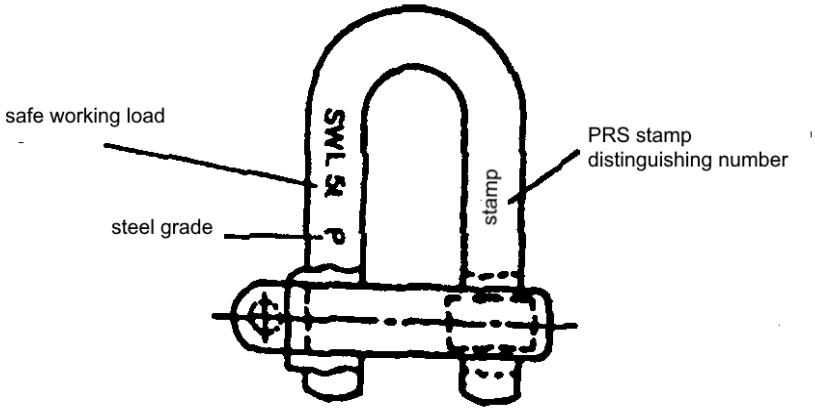


Fig. 11.2.1.3 Stamping of a shackle

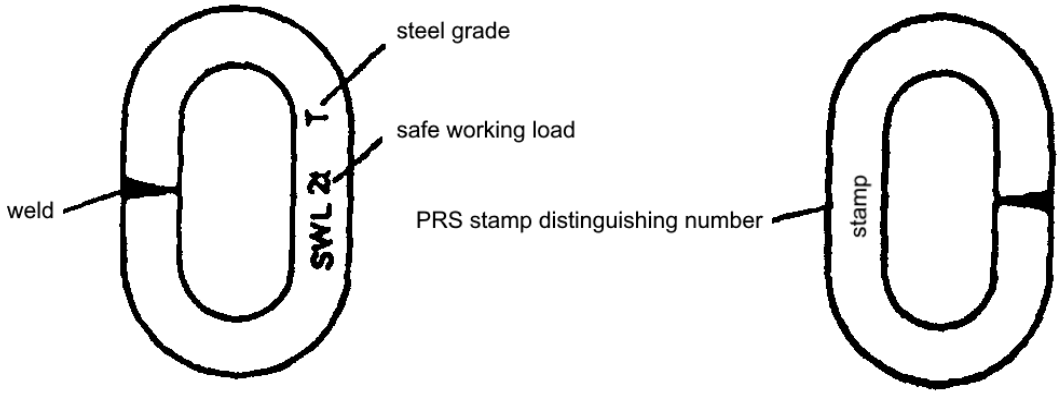


Fig. 11.2.1.4 Stamping of a chain cable

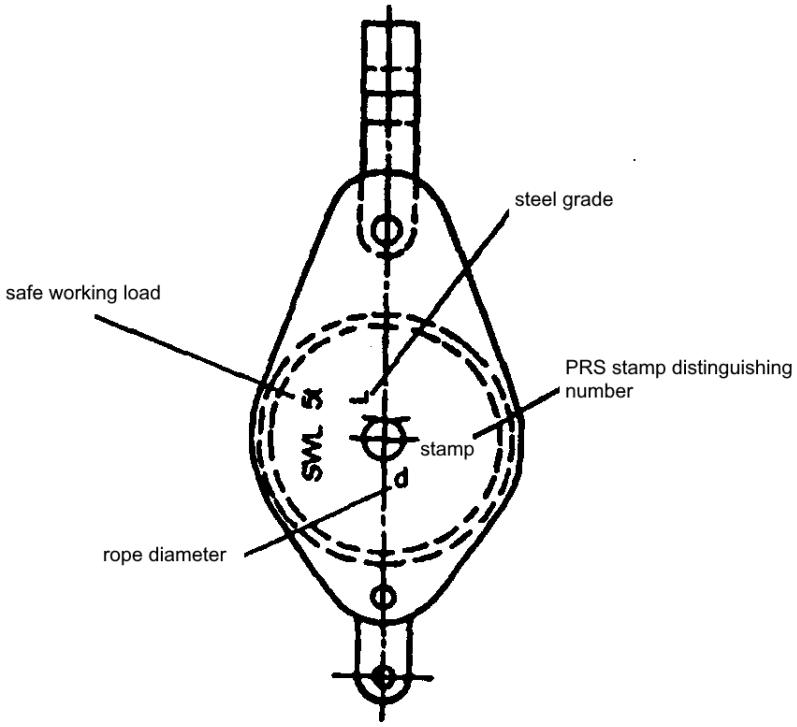


Fig. 11.2.1.5 Stamping of a block

11.2.2 Cranes, overhead cranes, hoists, winches and drums, whose examinations and tests carried out in accordance with 10.3.1 were completed with positive results, shall be stamped.

The stamp shall include the below data:

.1 SWL [t], (pull, span rope tension) [kN];
.2 examination year and month;
.3 distinguishing number;
.4 PRS stamp (for examinations attended by PRS Surveyor) or manufacturer's mark (for examinations attended by other competent person).

11.2.3 Each lifting appliance subjected to proof load test, in accordance with the requirements of 10.3.4, in case of positive result of examinations carried out after the test, shall be stamped.

The stamp shall include the below data:

.1 SWL and the lowest permissible boom inclination angle (if permissible inclination angle exceeds 15° for light booms, and 25° for heavy booms), and for cranes of variable radius – the SWL and the lowest and the highest permissible radius; if the SWL varies depending on the radius, the lowest and the highest radius shall be given for each set SWL value;

.2 examination year and month;

.3 distinguishing number of lifting appliance;

.4 PRS stamp.

The stamp shall be placed on the boom heel fork fitting, and in the case of jib cranes on the bottom part of jib at its attachment. In every case, the stamp shall be placed in well visible and accessible place.

11.2.4 After completion of factory tests, winches, spreaders, speed governors, buffers and other component parts of a lift, shall be stamped.

The stamp shall include the below data:

.1 permissible operating conditions (SWL, speed, etc.);

.2 examination year and month;

.3 identification number;

.4 PRS stamp.

The stamps shall be placed as shown on the drawings or near to the factory plate.

11.2.5 After onboard tests referred to in 10.3.14 and surveys specified in 10.3.15, the lift shall be stamped. The stamp shall include:

.1 manufacturer's name;

.2 SWL in kgs, and in the case of passenger lifts and goods passenger lifts, additionally permissible number of carried persons;

.3 examination and test year and month;

.4 lift identification number;

.5 PRS stamp.

The stamps shall be placed on a plate located on lift trunk doors of the lowest trunk stop or in the lift car.

11.2.6 On the lift trunk doors on their external side or close to them, plates shall be placed with the below data:

.1 lift type;

.2 SWL;

.3 permissible number of persons;

.4 possible restrictions of use.

11.2.7 In the lift car, a plate shall be placed with the following data:

.1 lift type;

.2 SWL;

.3 permissible number of persons.

11.2.8 On all lift trunk doors of the goods lift trunk, additionally a clear and durable warning plate shall be placed forbidding the carriage of persons in the lift and informing whether the lift car may be entered during cargo loading.

11.2.9 Stamps to be placed on lifting appliances shall be sufficiently legible and durable. The stamping place shall be marked with distinguishing paint.

In the case the material which shall bear the stamp is vary hard or where stamping may have effect on further safe operation of the stamped item, the stamp may be placed on a plate, disc or other acceptable material permanently attached to the item.

11.2.10 If the dimensions of the stamp, being in accordance with 11.2.3.1, are unreasonably high, information on intermediate values of the crane SWL may be shortened, upon agreeing it with PRS Surveyor.

In such case, for the cranes of variable SWL as related to radius, a plate with the SWL in relation to the crane radius, shall be placed in the crane cabin.

11.2.11 Markings, easily readable for operating persons, specifying permissible load on traverses, beams, container spreaders, and such appliances shall be placed in well-visible places.

Where the markings are placed directly on the interchangeable gear items, the height of characters shall not exceed, for the gear with permissible load:
- up to and including 2 t – 3 mm,
- from 2 t to 8 t inclusive – 4.5 mm,
- above 8 t – 6.0 mm.

When marking gear items of round sections – chain cables, etc., the height of a character, depending on the diameter, shall not exceed, at the diameter of:
- up to 12.5 mm inclusive – 3.0 mm,
- from 12.5 mm to 26.0 mm inclusive – 4.5 mm,
- above 26.0 mm – 6.0 mm.

Where necessary or at request of a competent person, the height of marks put on plates and discs permanently attached to the gear, may be more than above mentioned.

11.2.12 An inscription to define the SWL (in tons) shall be placed on each lifting appliance, and in the case of boom derricks of a minimum inclination angle of 15° for light boom derricks and 25° for heavy boom derricks – also the minimum permissible inclination angle.

For the cranes of variable radius and for power-driven boom derricks, the lowest and the highest radius, while for cranes with variable SWL as related to radius – the lowest and the highest radius for each set SWL value, shall be given.

The inscription with SWL shall be placed in the vicinity of boom heel on both sides, and in case of cranes – in well-visible place.

Examples of inscriptions are given in table 11.2.12. They shall be made with use of distinguishable paint, by Arabic letters at least 80 mm in height, while for the boom inclination angle with 50 mm high digits.

On steel booms and structures, marks shall be durably outlined, e.g. by punching.

Except the inscription, on each lifting appliance, the shipboard order number of the appliance shall be placed.

The lifting appliances onboard chips shall be numbered in the below order:

.1 all light boom derricks and heavy boom derricks located beyond the ship symmetry axis – counting from the bow, from starboard to port side;

.2 all heavy boom derricks arranged in the ship symmetry axis, counting from the bow;

.3 deck jib cranes, irrespectively of numbering of boom derricks, counting from the bow, from starboard to portside.

Table 11.2.12
Examples of inscriptions on lifting appliances

Example	Meaning
Boom derricks	
SWL 1.5 t	SWL of 1.5 t at the boom inclination angle to horizontal not less than 15°
SWL 5 t 30°	SWL of 5 t at the boom inclination angle to horizontal not less than 30°
SWL 3/5 t	At the boom inclination angle to horizontal not less than 15° – SWL of 3 t with single runner operation and SWL of 5 t with double runner (tackle) operation
SWL 3/5 t 30°	At the boom inclination angle to horizontal not less than 30° – SWL of 3 t with single runner operation and SWL of 5 t with double runner (tackle) operation
SWL 3/5 t / 10 t	At the boom inclination angle to horizontal not less than 15° – SWL of 3 t with single runner operation and SWL of 5 t with double runner (tackle) operation At the boom inclination angle to horizontal not less than 25° and at application of special gear in accordance with the appliance design documentation – SWL of 10 t
SWL 20 t	SWL of 20 t at the boom inclination angle to horizontal not less than 25°
SWL (U) 2 t	SWL of 2 t at union purchase operation of booms, in accordance with union purchase manual
Jib cranes and power-driven boom derricks	
SWL 3 t	SWL of 3 t (only for non-jib cranes, hoists and cranes with steady radius)
SWL 1.5 t 4 – 12 m	SWL of 1,5 t at radius 4 m to 12 m
SWL 3 t 4 – 12 m	SWL of 3 t at radius 4 m to 12 m
SWL 5 t 4 – 12 m	SWL of 5 t at radius 4 m to 20 m
SWL 32/8 t – 22/24 m	SWL of 32 t at operation of main hoisting mechanism; 8 t with auxiliary hoisting mechanism. The highest radius of main hook 22 m, auxiliary hook 24 m.
SWL $\frac{100}{32}$ t – $\frac{16}{24}$ m	SWL of 100 t at radius 16 m, and 32 t at radius 24 m.

12 SUPERVISION OF LIFTING APPLIANCES IN SERVICE

12.1 General Provisions

Within periods between surveys of lifting appliances performed by PRS Surveyor, the ship management is responsible for the appliance condition conformity with PRS issued documents and this *Part* of the *Rules*, observance of set SWL limitations and radius of cranes, cargo booms inclination angle, control of boom and preventer setting, runner ropes angle at union purchase operation and maintaining the lifting appliance in condition ensuring its safe operation.

12.2 Regular Surveys of Loose Gear

Each item of the loose gear, before use, shall be submitted, on a regular basis, to visual examinations by a responsible person designated by the Shipmaster or the Shipowner, having adequate knowledge and experience for such surveys. Records of such regular surveys shall be made in Part III of the *Register*, *Form 103* (No.1), however, only when defaults of the examined item have been ascertained during the examinations.

12.3 Current Inspections of Lifting Appliances, Interchangeable Gear Steel Wire and Natural Fibre Ropes Performed by Ship Management

Each time, before commencing cargo handling works, the lifting appliance shall be inspected by a person designated by the ship management. Records from inspections shall be made in Part IV of the *Register* on Form 103 (No. 1).

Where deficiencies affecting service safety of a lifting appliance have been disclosed, the responsible person shall made an appropriate entry in Part IV of the *Register* and take appropriate measures for deficiencies removal. The appliance may be operated only after deficiencies removal.

Where necessary, an occasional survey and tests shall be performed, in accordance with the requirements of sub-chapter 10.5.

All interchangeable gear and ropes shall be inspected by a person designated by ship management, at least every 3 months. After disclosing broken wires in a rope, the inspection shall be carried out at least once a month. When wear indications have been ascertained, as defined in subchapter 10.6, the rope shall be withdrawn from use.

Records of performed inspections shall be made in Part IV of the *Register* on Form 103 (No. 1).

Attachment 1

STABILITY OF MOVABLE CRANES INSTALLED ONBOARD VESSELS

1 GENERAL PROVISIONS

1.1 Attachment 1 is applied at calculating stability and carrying out stability tests of movable cranes, installed onboard vessels, operating on both protected and non-protected waters. Stability calculations may also be carried out according to approved national standards.

1.2 In the meaning of this attachment, the movable cranes are :
- cranes moving on rails;
- cranes freely changing the place of operation (car cranes).

1.3 A capsizing edge is an axis around which the considered crane rotates during capsizing as an immobile body.

The capsizing edge is determined by two supporting or pivotal points, which as a rule are taken as fixed. The capsizing edge may deflect from horizontal. During determining the capsizing edge for car cranes, properties of car tyres, as well as suspension systems and position of spring part gravity centre, shall be taken into account.

2 CALCULATIONS

2.1 The movable cranes are considered stable, if it has been proven by calculations that:

$$\frac{\sum M_{fix.}}{\sum M_{caps.}} \geq 1$$

$\Sigma M_{fix.}$ – a sum of fixing moments, calculated in relation to the capsizing edge;
$\Sigma M_{caps.}$ – a sum of load tipping moments, calculated in relation to the capsizing edge;

It shall be considered that cranes are used in accordance with manufacturer's operation manual and comply with the acceptance conditions of supervision bodies.

2.2 The capsizing and fixing moments shall be determined including loads given in table A I-I for required and actual load cases.

Table A I-I
Loads of movable cranes for stability calculations

Load case *i*	Vessel operating on	Service condition of a crane on open deck	Load components					Loads from wind pressure	
			Gravity force from dead load	SWL forces in combination with vertical component of inertia force	Inertia forces due to slewing and derricking and travel direction	Gravity force components due to heel and trim	Inertia forces due to ship movement	Wind pressure [Pa]	Wind force compo-nent
1	protected waters	working	1.05 S_G if supports capsizing	1.25 S_{SWL}	1.0 $S_{m\ obr.}$	1.0 $S_{przech.\ i}$	0	300	1.1 W_i
2		shut off		0	0	1.0 $S_{przech.\ i}$	0	1200	1.1 W_i
3		working with overload		1.05 S_{pr} or 1.05 $S_{SWLspec.}$	1.0 $S_{m\ obr.}$	1.0 $S_{przech.\ i}$	0	0	0
4		tearing up or uncontrolled placing cargo	0.95 S_G if prevents capsizing	–0.3 S_{SWL}	0	1.0 $S_{przech.\ i}$	0	300	1.1 W_i
5		power decay during normal operation		1.6 S_{SWL}	0	1.0 $S_{przech.\ i}$	0	300	1.1 W_i
6	non-protected waters	shut off		0	0	1.0 $S_{przech.\ i}$	1.0 S_{mri}	1500	1.1 W_i

At determination of forces, taking into account dynamical factors for permissible load and dead load used for strength calculations, is not necessary.

Table AI–I, Loads of movable cranes for stability calculations, see previous page.

Explanations for table AI–I.

S_G – gravity force due to dead load of particular parts of crane steel structure, [kN];
S_{SWL} – SWL force (SWL or determined special load lower than SWL), [kN];
S_{pr} – a force due to proof load, [kN];
$S_{SWLspec}$ – a force due to permissible load higher than SWL, [kN];
$S_{m\ obr.}$ – inertia forces due to slewing and derricking and travel direction (also impact loads) for appropriate load case *i*, [kN];
$S_{przech.}$ – gravity force components due to ship heel and trim for appropriate load case *i*, [kN];
S_{mri} – mass forces due to ship movement for appropriate load case *i*, [kN];
W_i – load due to wind pressure for appropriate load case *i*, [kN].

2.3 Stability calculations for movable cranes operating under deck in protected waters may also be performed using table AI–I, however, without load due to wind pressure.

Where cranes remain on deck during vessel's movement, the sixth load case shall be considered without load due to wind pressure.

2.4 If cranes movable on open deck are intended for use onboard vessels operating in non-protected waters and if due to their design their stability is unsafe, the load cases: 1, 3, 4 and 5, according to table AI-I, shall be considered at stability calculations. The wind pressure shall be, however, assumed 400 Pa.

Additionally, cranes and vessel mass forces due to vessel's movement during crane operation, shall be considered.

2.5 Protection against capsizing may be considered at stability calculations only when it is ensured that transmitted forces may be adequately transferred by load-bearing connections with the vessel.

2.6 Hand operating the rail tongs shall not require application of a force more than 300 N.

3 SELECTION OF PROOF LOAD

3.1 As a rule, the stability of movable cranes on rails is proved sufficiently by calculations.

In special cases, however, PRS may demand load test to be performed for confirmation of stability calculations. The tests shall be carried out as specified for movable cranes.

3.2 Stability of particular movable cranes or their prototypes shall be each time confirmed by dynamic test using a minor proof load.

PRS or the supervising body may demand carrying out static tests using considerable proof load.

The proof load has been given in table AI–2

Table AI–2

Crane type	Minor proof load	Considerable proof load
Movable cranes	1.25 *SWL*	1.33 *SWL*
Cranes on rails	1.25 *SWL*	1.4 *SWL*

SWL – crane safe working load, [t].

3.3 Dynamic test with minor proof load shall be performed:

- ashore or onboard a vessel operating in protected waters;
- with the vessel and deck inclination permissible for normal work;
- with wind pressure not exceeding 40 Pa;
- at cargo and crane being in positions unfavouravle for stability and performing required movements.

All movements of the care and cargo shall be performed with due care, non-simultaneously and without interrelations.

3.4 The static test using considerable proof load is carried out without moving weight and crane, with the weight and crane positions unfavourable for crane stability.

The test is commenced with a test with minor proof load (see table AI-2). The minor proof load, suspended under the crane, is lifted and transferred low above the ground into positions unfavouravle for stability. Subsequently, the proof load is increased to the value of considerable proof load with due care, to avoid significant crane swaying.

Attachment 2

PROTECTION AGAINST CREEPING AND SKEW OF MOVABLE CRANES INSTALLED ONBOARD VESSELS

1 GENERAL PROVISIONS

1.1 The provisions of this Attachment may be applied to the required by 5.1.4.6 tests proving sufficient protection against creeping and skew of cranes moving on rails or on beam webs by travel wheels or rollers.

The proof tests may also be carried out according to the approved national standards.

2 CALCULATIONS

2.1 Protection against creep and skew of movable cranes is considered sufficient, when the below condition is fulfilled:

$$\vartheta(\delta W + \Sigma H) \le \mu \Sigma V_t + \beta \Sigma V_b + \eta \mu_z \Sigma P_k \qquad \text{(A2–1)}$$

where:

W – wind force component acting in the plane of wheels contact in the direction of creep (moving direction) [kN];

ΣH – the components of forces due to inclination and movements of a vessel, acting in the plane of wheels contact in the direction of creep and skew (moving direction) [kN];

$\Sigma \mathbf{V_t}$ – a sum of resisting forces, acting vertically onto the surface of rolling and on the braked travel wheels [kN];

ΣV_b – a sum of resisting forces, acting vertically onto the surface of rolling and on the non-braked travel wheels [kN];

ΣP – a sum of forces due to the pressure of rail claws or other protecting devices causing friction forces opposite to the direction of creep or snake moving [kN];

μ, μ_z, β – coefficient from table A2–2,

ϑ – protection coefficient, acc. to table A2–3;

δ, η – impact factor, acc. to table A2–3.

2.2 For determining forces given in 2.1 of this Attachment, the load components, neglecting the forces due to rail claws pressure, shall be determined respectively to operation area of the vessel, and to operational condition and the crane location, due regard being paid to table A2-1. The hoist load coefficients due to SWL and dead load are not considered.

Table A 2-I
Loads of movable cranes at calculation determining of the protection against creeping and skew

Load case *i*	Vessel operating in	Service condition and crane location	Load components					Loads from wind pressure	
			Gravity force due to dead load	SWL forces in combination with vertical component of inertia force	Inertia forces due to slewing and derricking	Gravity force components due to vessel and deck inclinations	Inertia forces due to ship movement	Wind pressure [Pa]	Wind force compo-nent
2	Protected waters	working on open deck	1.0 S_G	1.0 S_{SWL}	1.0 $S_{m\ obr.}$	1.0 $S_{przech.i}$	0	300	1.0 W_i
2		out-of-service on open deck		0	0	1.0 $S_{przech.i}$	0	1200	1.0 W_i
3		working under deck		1.0 S_{SWL}	1.0 $S_{m\ obr.}$	1.0 $S_{przech.i}$	0	0	0
4	Non-protected waters	working on open deck		1.0 S_{SWL}	1.0 $S_{m\ obr.}$	1.0 $S_{przech.i}$	1.0 S_{mn}	400	1.0 W_i
5		out-of-service on open deck		0	0	1.0 $S_{przech.i}$	1.0 S_{mn}	1500	1.0 W_i
6		working under deck		1.0 S_{SWL}	1.0 $S_{m\ obr.}$	1.0 $S_{przech.i}$	1.0 S_{mn}	0	0
7		out-of-service under deck		0	0	1.0 $S_{przech.i}$	1.0 S_{mn}	0	0

Note! The symbols given in table A2-1 have been explained below the table A1-1

2.3 As a sliding friction and movement resistance coefficients in formula (A2–1), the values given in table A2-2 may be applied.

Coefficients of different values may be used after submitting detailed calculations or special design solutions

2.4 As safety factor and impact factors in formula A2-1, the values given in table A2-3 may be given.

Table A 2–2

Coefficients	Explanations		Value
Sliding friction between the rail and rail claws	Contact surfaces rough and hardened	μ_z	0.25
Sliding friction between a wheel and rail	Mean value	μ	0.12
	Oil film unbroken	μ	0.07
Movement resistance	At slide bearings	β	0.02
	At rolling bearings	β	0.007

2.5 When applying the formula A2-1, the below shall be considered:

- $\mu \sum V_t$ only when the brakes may take the force. In other case, the values shall be taken, which can be taken by brakes;
- Load components due to SWL need not be considered, when the results of calculations including the load components may not be accepted;
- $\sum P_k$ may be taken only when the transfer of forces to the structure supporting rails is ensured and when protecting rail tongs may act in any position of crane on the track.

Table A2–3

Load case in accordance with table A2–1	Safety factor ϑ	Impast factor			
		δ	η		
			Travel with or without cargo	Crane jammed, with load on hook	Crane out-of-service, jammed
1	1.1	1	0	1	–
2	1.25	1	–	–	1
3	1.1	0	0	1	–
4	1.1	1	0	1	–
5	1.25	1	–	–	1
6	1.1	0	0	1	–
7	1.25	0	–	–	1

List of amendments effective as of 1 January 2020

Item	*Title/Subject*	*Source*
Table 2.7.2	Rope safety factor for submersible handling systems	LR notice 2018