INTLREG
INTERNATIONAL REGISTER OF SHIPPING

RULES AND REGULATIONS FOR CLASSIFICATION OF STEEL VESSELS 2021

Part 9
Cargo Gear Arrangements and Surveys

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CHANGES HISTORY

Refer Changes history in Part 1

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CHAPTER 1 GENERAL

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SECTION 1 GENERAL

Contents

1.1 General

1.1.1. The Society shall provide partial or complete certification to a specific lifting appliance or special equipment only upon receiving a special request from Builder or the Owner. In particular, general approvals shall be provided where standardized equipment's are concerned.

These requests are required to clearly specify whether special regulations are to be applied. However, if such instructions are not given, Society's own rules as stated here are to be applied.

1.1.2. The certification requests of a lifting appliance or of a category of lifting appliances fitted aboard an offshore unit or a ship which is not classed with the Society, are to be specially examined.

1.1.3. For ships classed or not classed with the Society, Society's Surveyors shall conduct periodical surveys required either by international regulations or by specific national regulations. When the authority to do so lies with the Society, it issues the certificates and stamp the Cargo Gear Register of the offshore unit or ship, provided that the general maintenance condition of the lifting appliances are satisfactory, various existing test certificates are submitted to the Surveyor and the documents attached to the Register are in order.

1.1.4. Upon Builder's or Owner's request, in some instances, the Society shall perform verification calculations using their own processes like their structure analysis software for forces and stresses analysis.

1.1.5. Similarly, upon special request, the Society's Surveyors shall also witness particular tests, ascertain damages or repairs, or deliver attestations.

1.1.6. Normally, the aforementioned interventions result in issuance of technical notes, certificates or attestations, or as the case may be.

1.2 Function for lifting appliance

Each lifting appliance has its separate intended functions. Examples of intended functions are:
Cargo handling in within deck area, loading and discharging of offshore supply vessels, launch and recovery of diving systems, launch and recovery of ROV, loading and discharging from sea or sea bed, personnel handling, handling of ramps and movable cargo decks.

1.3 Existing Lifting Appliances

1.3.1. Existing Lifting Appliances without Register

For existing lifting appliances that do not have a Register issued by a recognized classification society, or a recognized cargo gear organization, submission of information as required in the respective chapters of this Part, with verification of material, is required.
Existing lifting appliances shall be certified subject to satisfactory plan review, conditional survey, operational tests including luffing, slewing, test of safety devices, and proof testing of the lifting appliances as units as required in the respective chapters of this Guide. The conditional survey shall include inspection for excessive wear, damage, corrosion, and fractures. Nondestructive testing or verification of materials may be required at the discretion of the Surveyor. All crane hooks shall be examined using magnetic particle or other suitable crack detecting inspection methods to the satisfaction of the attending Surveyor. All mechanical, electrical and piping systems and components shall be examined as deemed necessary by the attending Surveyor.

1.3.2. Existing Lifting Appliances with Register

For lifting appliances having a Register issued by a recognized classification society or a recognized cargo gear organization, evidence of previous design approval and survey under construction is to be submitted.
Suitable evidence of the design approval shall be drawings of the arrangement and details which bear the approval stamp of the losing authority or which are specifically covered by an approval letter from the authority issuing the previous register or the previous register itself.
An INTLREG Register of Lifting Appliance shall be issued after review of above data and a proof test and examination in accordance with the requirements of the respective chapters of this Part

SECTION 2 APPLICATION

Contents

2.1. General

2.1.1. Application

2.1.1.1. This applies to lifting appliances fitted on ships, floating objects, mobile or fixed offshore platforms, and used:

a. At harbor for loading or unloading cargoes, spare parts, equipment's, or consumables.
b. In offshore conditions for various lifting operations excluding appliances mentioned in item a).
c. Lifting in offshore conditions for launching and recovery of subsea equipment

Note 1: Lifting appliances used in harbor or under similar conditions for lifting operations except for ships loading or unloading falls under type (a) above.

2.1.1.2. This does not address handling apparatus such as movable or lifting platform, derricks, cargo ramps, cargo and passenger lifts, lift trucks and lifeboat davits. However, upon Owner or Builders request and when deemed possible and reasonable, this shall be used wholly or partly by the Society for appliances not listed in 2.1.1.1 of this section.

2.1.1.3. The scantlings of component parts of cargo gear, especially of loose gear, are given either by formulae or in table. However, the components which conform to national or international standards or with specifications considered as equivalent may be accepted.

2.1.1.4. INTLREG may modify and add new ones or accept other Rules considered as equivalent, if deemed advisable or essential. In particular, Rule requirements of Lifting Appliances that apply to derricks and union purchase, are still valid and applicable.

2.1.2. Scope of INTLREG intervention

2.1.2.1. The following services relating to the appliances as per [2.1.1.1] of this section covers the scope of INTLREG intervention:

a. Issuance of Class Notations (refer part 9 chapter 1 section [4.1] of this rule.
An offshore unit or ship may be classed to the Society, one or several mark notations and class notations as per rules, stating that the lifting appliances are under full survey and conform to the requirements in section [4.4] or [4.5] of this part.

b. Issuance of certification (refer Part 9 chapter 1 section [2.2] of this rule.):
- INTLREG certification of lifting appliances on the basis of the international regulations given in [2.1.3.3] and [2.1.3.4] of this section (refer Part 9 chapter 1 section 2.2.2 of this rule.)
- Certification of lifting appliances as per special national regulations on behalf of National Authorities (refer [2.2.3] of this section).

c. Issuance of Cargo Gear Register. refer chapter 1 section [4.7] of this part

d. Interventions at the Owner's or Builder's request. refer chapter 1 section [1.1] of this part

- certification of lifting accessories, refer [5.2]
- verification of lifting pad eyes, refer [5.3].

2.1.3. Rules to be applied

2.1.3.1. Some requirements given herein are derived from Rules for classification of Steel Ships and Offshore Units.

In case of discrepancy, the one that is applied is of the edition in force of the relevant rules and regulations, taking into account updated amendments, if any.

2.1.3.2. The Rules for Steel Ships and Offshore Units deal with the scantlings of the fixed parts of the lifting appliances (refer Note 1 below) and their connections with the ship or offshore unit structure. However, the scantlings of movable parts of these appliances are outside the normal scope of classification.

Note 1: The fixed parts of lifting appliances, considered as integral part of hull, are the structures definitively connected by welding to ship hull or offshore unit structure (for instance masts, crane pedestals, derrick heel seating, etc. excluding the cranes themselves, ropes, derrick booms, rigging accessories, and, generally, any dismountable parts).However, the shrouds of the masts that are fixed in the ship structure are considered as fixed parts.

2.1.3.3. Provisions of the Rules given below generally are in line with those of:
a. Protection against Accidents (Dockers) Convention (revised), 1932:
b. Occupational Safety and Health (Dock Work) Convention no:152, 1979: and
c. The relevant Recommendation No:160 adopted by the International Labor Organization (l.LO)

It is regarding the security of workers employed in loading and unloading ships when applied to appliances used for loading/unloading ships at harbor.

2.1.3.4. These provisions are generally in accordance with Resolution A-414 (Xl) of the International Maritime Organization (l.M.O.) as amended: Code for the Construction and Equipment of Mobile Offshore Drilling Units, 1979 (MODU code). They also consider the code of practice of the International Labor Office (I.L.O.): Safety and Health in the Construction of fixed Offshore Installations in the Petroleum Industry (edition 1981) when applied to apparatus used in offshore conditions.

2.1.3.5. These provisions consist of rules which reflect either from the application of the international regulations mentioned in [2.1.3.3] and [2.1.3.4] of this section, from their accepted interpretation or from special requisites of the Society.

2.1.3.6. The attention of Owners' and Builders' is drawn to the fact that it is their responsibility to ensure that the legal provisions and the national rules of the Flag country of the ship or the working unit and those of the competent authorities of operation site are fulfilled.

2.2. Certification

2.2.1. Scope

2.2.1.1. The certification procedures of the lifting appliances are detailed in [2.2.2] or [2.2.9] of this section, as the case may be.

Certification results for issuance of the Cargo Gear Register and of test certificates are given in chapter 1 section [2.2.2.2] or [2.2.2.3] of this part, or as the case may be.

Certification does not necessarily grant additional class notations and as such it is not mentioned in the Register of Ships of the Society.

2.2.2. INTLREG certification

2.2.2.1. The forms of certificates recommended by the International Labor Office corresponds to the certificates issued by the Society on behalf of the administrations for entering the appliances in the Cargo Gear Register.

2.2.2.2. Comprehensive certification of a lifting appliance of a offshore unit or a ship includes:

a. Approval of the drawings and examination of the documents listed in Part 9 chapter 1 section [4.6] of this rule.
b. The test and survey certificates issued before the items of loose gear such as hooks, blocks, shackles, chain cables, swivels, rings, rigging, lifting beams, etc. were first used.
c. The test and survey certificates issued before the steel wire ropes and fiber ropes were first used.
d. The test and survey certificates issued before the winches were first used onboard.
e. Survey of the fittings onboard as specified in Part 9 chapter 4 section 2.8 of this rule.
f. Survey and certification of the general tests before first use onboard as specified in Part 9 chapter 4 section [2.8] of this rule.
g. Delivery of INTLREG Cargo Gear Register refer chapter 1 section 4.7 of this part.

2.2.2.3. The test certificates issued in line with [2.2.2.2] of this section are also used during periodical re-tests and tests re-executed post repair, conversions or changes in elements.

2.2.3. Certification in compliance with special National Rules

2.2.3.1. It is reasserted that certification of lifting appliances in compliance with specific National regulations can only be delivered by the Society when it is duly authorized by competent National Authorities for the same.

2.2.3.2. The forms prescribed by the specific National regulations are to be used for the test certificates and the Cargo Gear Register. If specific National regulations have not prescribed some special forms of wording, the forms of the Society may be used and the following is to be then specified:

- Precise references of the regulations to be applied
- The Surveyor of the Society is a competent person and is recognized by the concerned Authorities
- The test procedures different from the procedures provided on the form and used for the certificate that are required by the specific National regulations.

2.2.3.3. The Cargo Gear Register is delivered, provided the interventions specified in chapter 1 section [4.7.1] of this part. have been executed to the satisfaction of the Society, considering the special requirements of the National regulations, even if some of the aforementioned interventions are not required to be applied. However, if specific National regulations include other provisions than those given in chapter 1 section [4.7.1] of this part, these are to be also complied with.

2.2.3.4. When provisions of the National regulations cannot be complied with or when its interpretation is inconspicuous, it is Owner or the Builder’s responsibility to take

the requisite steps in coordination with the competent authorities to obtain the requested derogations or explanations, and also duly inform the Society.

2.2.3.5. The Owners and Builders are aware that the choice of the construction marks may be, in some cases, implicitly prescribed by the National regulations applied, especially when the latter require material's inspection.

2.2.3.6. When the test load or the test conditions prescribed by the National regulations for the lifting appliances or their accessories are stern than the provisions given herein, they shall be taken into account by the designer to determine the scantlings.

2.2.3.7. When lifting appliances in service are concerned, and with the same reserves as those mentioned above, the minimum interventions required are to be equivalent to those specified in chapter 1 section [4.7.1] of this part.

2.3. Documents to be submitted

2.3.1. General

2.3.1.1. The construction drawings and documents listed in [2.3.2] and [2.3.3] of this section are to be submitted for approval. The material specifications are to be depicted on construction drawings.

2.3.1.2. Relevant additional calculations and drawings may be requested by the Society to complement the requirements hereafter mentioned.

2.3.2. Lifting appliances

2.3.2.1. The drawings and documents given below are to be submitted:

a. General arrangement of the ship's lifting appliances depicting working areas for each of them.

b. For every lifting appliance, rigging drawings clearly showing the reeving arrangement of the ropes and the number of parts in purchase tackles.

These drawings should include all the items of loose gear duly marked and numbered also specifying type of the blocks used (blocks with roller-bearings or plain bearings).

c. Force diagrams for each lifting appliance, in service conditions.

When the forces are calculated, the relevant calculations are submitted for information and the maximum forces determined in the various elements are required to be schematically indicated for each lifting appliance on a sketch referred to as a force diagram.

The aforementioned force diagrams and the sketches are to clearly depict the maximum forces applied to all the loose gear items.

d. Drawings of structural parts of lifting appliances: structure carrying the luffing tackle and the hinged pin of the jib, jib structure, structure of crane post etc.

The steel grade of the foundation bolts with the crane post and the scantlings are to be specified. For information purposes, the relevant calculations of the Manufacturer are to be attached to these drawings. When calculations

have been computed, both computer data and sufficient explanations to check the calculation process are to be supplied.

Upon request, a general approval of a standardized production shall be granted to the Manufacturer by the Society.

e. List of fiber ropes and steel wire ropes giving nominal diameter, construction type, minimum effective breaking load and the reference standards.

The metal cross-sectional area of the wire ropes used for stays and shrouds is also to be specified.

f. List of all loose gear items, marked as per the drawings requested in item b) specifying the SWL and the test load of each item.

The construction drawings of loose gear items as indicated in [3.1.4.3] of this section and of the other stationary or movable accessories for which no distinct test is asked are not required if their scantlings conform to some national or international standards, or with approved specifications. In such a case, the standards used are to be specified and the corresponding elements are to be designated according to these standards with mention of steel grade as per Part 9 chapter 2 section [1.1.6] of this rule.

g. Swing circle assembly drawings and details, including, as applicable:
   a) Hold down bolt size with calculations, arrangement of bolts, material, grade and pre-tensioning, together with the method used for pre-tensioning

   b) Slewing ring drawings, along with static strength calculations and details, which are to include material specifications of raceways and rollers or balls, hardness and heat treatment details of raceways and rollers, number and diameter of rollers or balls, raceway static capacity, specified planarity (flatness) tolerances and surface finish of bearing and supporting flanges, bearing wear tolerances.

   c) Procedure for wear down measurement of slewing ring (“rocking test”).

h. Crane capacity rating charts (load charts) and corresponding wire rope reeving diagrams

i. Details of all prime movers such as diesel engines, motors and generators

A general approval of the standards of the Manufacturers may be granted by the Society upon a special request. In every case, the drawings showing specially designed elements are to be submitted for approval.

2.3.2.2. Specifications of winches

Construction drawings of winches are not needed when standardized production is concerned, provided references of their use in service are to the satisfaction of the Society.

For information, a technical documentation is to be submitted when prototype is concerned. The documents covers description of technical specifications, a general arrangement drawing, detailed operating manual, constructional drawings

of the main items and all the calculations of the Manufacturer. The speculated test programme is to be sent for approval as well.

2.3.2.3. Hydraulic and/or electric schemes

The scantling drawings of load transporting hydraulic cylinders (for instance the luffing cylinders of a hydraulic crane) are to be submitted for approval (refer Part 9 chapter 2 section [2.2.3] of this rule).

2.3.2.4. A detailed account of safety devices (limit switches, alarms, overload cut-out devices, etc.) is to be submitted for approval (refer Part 9 chapter 2 section [2.2.3] of this rule).

2.3.3. Supporting structure of the lifting appliance

2.3.3.1. The drawings to be submitted are given below:

a. Drawings of the structural parts of the offshore unit or ships supporting the lifting appliance and carrying forces to the hull structure.
b. Drawings of the structural parts of the offshore unit or ship located in way of the fixing points of the stays, shrouds and other fastening fittings.
c. Drawings of the winch foundations and lifting appliances.

2.4. Customers who may request certification and verification

Certification may be requested by:

- manufacturer of a complete lifting appliance
- manufacturer of components or loose gear
- owner/user of a lifting appliance
- owner of a ship, mobile offshore unit or offshore installation, etc.
- shipyard or offshore installation fabrication site, etc

SECTION 3 DEFINITION

Contents

3.1. Definitions

3.1.1. The term “lifting appliance” used herein is designated to all the elements used for suspending, lowering or raising loads or moving them from one to other position while suspended or supported, for example a crane and its whole mechanism, etc.

3.1.2. The “Safe Working Load” (SWL) of a lifting appliance refers to the maximum mass which may be vertically lifted by this appliance at the hanging point of the load (hook or lifting ring) and which may be moved in operation. Thereby, when a special lifting aid that is not permanently attached to the apparatus is used (for instance, lifting beam), the maximum mass which may be hung to it is equal to the SWL of the appliance less its own mass and of the slings used. Depending on usage also, a lifting appliance may have several values of SWL.

The safe working force (SWF) of a lifting appliance is the static force corresponding to its SWL. Note that a lifting appliance is not to be used to obliquely pull any object (for instance, shift a cargo) if this appliance is not specially designed to do so.

3.1.3. Loose gear includes all items not permanently attached to the structure of the lifting appliances and which are to be tested separately as per the provisions of Part 9 chapter 4 section [2.7] of this rule. As such these items may be interchanged between various lifting appliances. Items of loose gear are as given below:

- Lifting beams
- Hooks
- Slings
- Blocks
- Shackles
- Rigging screws
- Swivels
- Chains rings
- Hand operated tackles with pitched chains, hooks, shackles, rings and swivels permanently attached
- other movable items with similar use of the items listed above.

3.1.4. The Safe Working Load (SWL) of a lifting appliance is the maximum mass, in tons, which may be lifted vertically by this appliance at the hanging point of the load (hook or lifting ring) and which may be moved in operation.
Note 1: This mass includes the mass of any lifting accessories not permanently attached to the apparatus (lifting beam and slings for
instance). In such case, the own mass of the lifting accessories are to be deducted from the SWL in order to obtain the maximum mass
which may be hung.

The safe working load (SWL) of an item of loose gear refers to the maximum mass which it may bear vertically (see Part 9 chapter 2 section 3 of this rule for the single sheave blocks).

The safe working force of an item of loose gear (SWF) refers to the static force corresponding to its SWL.

3.1.5 The test load of a lifting appliance refers to the mass to be applied vertically upon testing onboard the offshore unit or ship.

The test force of a lifting appliance is the static force corresponding to its test load.

3.1.6 The test load of an item of loose gear is the mass to be applied vertically upon its separately.

The test force of an item of loose gear is either the static force corresponding to its test load or the force to be applied when test requires application of a force.

3.1.7 The breaking load of an element is the minimum mass which causes its breaking when applied vertically.

The breaking force of an element is either the static force corresponding to its breaking load or the minimum force which causes its breaking.

3.2. Measuring units

3.2.1. The units used in herein are those of the International System SI.

3.2.2. SWL and test loads of lifting appliances and loose gear are expressed in tones (t). Breaking loads are also expressed in t (1 t = 1 000 kg).

3.2.3. SWF and test forces of lifting appliances and loose gear are expressed in kilo-Newton's (kN). Breaking forces are also expressed in kN.

3.2.4. The value of the acceleration due to gravity g is equal to 9,807 m/s^2. However, in order to simplify, the following value may be considered:

$$g = 10 \text{ m/s}^2$$

Taking into account the latter value of g, the relation between the loads (mass) P, in t, and the corresponding static forces F, in kN, is as follows:

$$F = 10\,P$$

Tensile strengths and yield stresses as well as the stresses are in N/mm^2.

3.2.5. Lengths and dimensions are expressed either in millimeters (mm) or metres (m).

3.2.6. Angles are expressed in degrees (°), 1° = π/180 radians.

SECTION 4 SYMBOLS & MARKING

Contents

4.1. Classification

4.1.1. General
Offshore units or ships fitted with lifting appliances meeting the requirements of [2.2.3] of this chapter may be assigned the additional class notations as specified in 2.2.2 of this chapter.

Classification results shall be issued with the Cargo Gear Register.

4.1.2. As per the provisions of Part 1, of this rule, and considering the provisions in 2.2.3 of this chapter, the construction marks  and * are associated with the class notations as per 2.2.2 of this chapter.

4.2. Class notations

4.2.1. The class notations are as specified:

1	**CG(H)**	For lifting appliances used at Harbor conditions
2	**CG(H1)**	For lifting appliances used at Harbor conditions and complying with specified National regulations
3	**CG(O)**	For lifting appliances used at Offshore conditions
4	**CG(O1)**	For lifting appliances used at Offshore conditions and complying with specified National regulations

CG(H) or CG(H1) for appliances for lifting at harbor, as per [2.1.1.1], item a of this chapter)

CG(O) of CG(O1) for appliances for lifting in offshore conditions, as per [2.1.1.1], item b of this chapter

4.2.2. One of the additional notations listed in [4.2.1] of this section shall be granted only if the offshore unit or ship is or will be registered in the Register of ships of the Society and, as a rule, if all the appliances for lifting conform to the criteria to grant the corresponding notations.

The criteria for granting the above mentioned class notations are defined in Chapter1 section [4.4] or [4.5] of this part.

4.2.3 The granting of one or several class notations CG(H) or CG(O) leads to the issuance of INTLREG certificates following international regulations and guidelines mentioned in [2.1.3.3] and [2.1.3.4] of this chapter. It results in the issuance of the INTLREG Inspection Cargo Gear Register refer chapter 1 section [4.7] of this part.

In most cases, the INTLREG Inspection Cargo Gear Register and the corresponding certificates are internationally accepted. However, upon Owner's special request, additional certification in conformation to special national regulations shall be given if the national Authorities duly authorize the Society to do so. The opinion of the Society matters in this aspect but this additional certification does not grant a special notation. As a rule, if there is a discrepancy between the requirements of the national regulations and those of this Rule, the more severe one is applicable and yet if there is a doubt, the opinion of the Society shall be taken.

4.3. Construction marks

4.3.1. The construction mark  assigned when lifting appliances have been surveyed by the Society during their construction as per the procedure given in chapter 1 section [4.4.1] of this part.

4.3.2. The construction mark * is assigned to lifting appliances where the procedure for the assignment of classification is other than those given in [4.3.1] and [4.3.2] of this section, however deemed acceptable and in conformation to chapter 1 section [4.4.3] of this part.

4.4. Criteria for granting CG(H), CG(O) class notations

4.4.1. When Society surveys a lifting appliance during construction, it is submitted to the following requirements to grant the supporting ship or offshore unit one or several of the class notations CG(H), CG(O)

- Approval of drawings and examination of documents as required in Part 9 chapter 1 section [4.6] of this rule.
- Inspection at works of materials as given in Part 9 chapter 4 section 1 and 2 of this rule.
- Construction survey and inspection at works of equipment as specified in Part 9 chapter 4 section 1 and 2 of this rule.
- Survey of tests at works prior to fitting onboard, in particular certification of the loose gear as specified in Part 9 chapter 4 section [2.7] of this rule.
- Survey of fitting onboard as given in Part 9 chapter 4 section 2.8 of this rule.
- survey and certification of the general tests before the appliance is put into service, as per Part 9 chapter 4 section [2.9] of this rule.
- Issuance of the INTLREG Cargo Gear Register (refer chapter 1 section [4.7] of this part)

As per Part 9 chapter 3 section [4.2] of this rule, lifting appliances are to be submitted for examinations and periodical tests to maintain the class notations.

4.4.2. When a lifting appliance has been surveyed by an IACS Society during its construction and is requested to be admitted to class, it will be subjected to the requirements given below to grant the supporting offshore unit or ship one or several of the class notations CG(H), CG(O)

- Examination of the drawings and documents required in [4] and submitted for information (refer Note 1 below)
- Examination of materials inspection certificates, construction survey attestations, test certificates at works for equipment's and loose gear, and, if any, of the existing Cargo Gear Register
- Survey of the lifting appliance concerned (refer Note 2 below)
- Issuance of the INTLREG Cargo Gear Register (refer chapter 1 section [4.7] of this part).

As per Part 9 chapter 3 section [4.2] of this rule., thorough examinations and periodical tests are required for maintenance of the class notations.

Note 1: These drawings are to be marked with the stamps of the organization by which they were approved upon construction.

Note 2: The extent of this survey depends on the existing conditions of certification, on the general maintenance conditions and on the age of the lifting appliances. If the existing certification for these tests (tests before first use and/or quinquennial renewal of tests) is valid, general tests are not required.

4.4.3. When the procedure adopted does not conform to that given in [4.4.1] or [4.4.2] of this section but the Society deems that it is acceptable for the assignment of class, the construction mark

* is assigned and the interventions to be given to grant one or more class notations CG(H), CG(O) are as given below:

- Approval of the drawings and examination of the documents required in section [4.6] of this chapter (refer Note 1 below)
- Examination of the certificates issued after testing at works of loose gear, and, likely, of the existing Cargo Gear Register
- Survey of the lifting appliance concerned (refer Note 2 below)
- Issuance of the INTLREG Cargo Gear Register (refer chapter 1 section [4.7] of this part).
- As per Part 9 chapter 3 section [4.2] of this rule. Examinations and periodical tests are done to maintain the additional classification class notations.

Note 1: If it is agreed upon by the Society, the approval of drawings may not be required if enough proof supporting that these drawings have been earlier approved by a recognized organization. In such a case, the aforementioned drawings and documents are to be submitted for information.

When some drawings and documents are unavailable, the Society is to appreciate whether it is possible to grant the requested class notations, considering the fact that a Cargo Gear Register has possibly been delivered by a recognized organization or a National Authority. Particular controls or measurements are executed aboard, and witnessing by a Surveyor of the Society, may be required.

The documents mentioned in chapter 1 section [2.3.2] of this part, to be annexed to the Cargo Gear Register, are to be submitted.

Note 2: The extent of this survey is to be defined as per the state of the existing certification, the general state of maintenance and the age of the lifting appliances. As a rule, a re-testing isn't required if the existing certification relating to these tests (tests before first use and/or quinquenal renewal of tests) is valid. Checking of thicknesses of structural elements is to be executed on the lifting appliances whose age is greater than, or equal to, 12 years.

4.4.4. The test certificates, classification certificate, the Cargo Gear Register and documents attached to it are to be kept onboard the offshore unit or ship and shall be available to the Society's Surveyor upon request.

4.4.5. When the lifting appliances are built under the survey of the Society as per the provisions laid out in 4.4.1 of this section, except for the ones regarding inspection of materials and equipment's at works, one or more of the additional marks CG(H), CG(O) may be granted to the offshore unit or ship.

The Builder has to prove that the materials and equipment's used conform to provisions of Rules. The Surveyor may check it at random.

4.5. Criteria for granting CG(H1) or CG(O1) class notations

4.5.1. Provisions of [4.4] of this section are, as a rule, to be conformed to with to obtain one or several class notations CG(H1) or CG(O1However when national regulations include provisions which do not agree with those of this Rule, and normally the provisions of the national regulations are to be applied.

4.5.2. For application, attention is drawn to provisions from section [2.2.3.4] to [2.2.3.6] of this chapter.

4.5.3. The periodical surveys are to be executed by the Society as per the requirements of the national regulations.

4.6. Cargo Gear Register

4.6.1. General

INTLREG Inspection Cargo Gear Register is a document which mainly allows:

- To list all the lifting appliances of the offshore unit or ship which have been certified.
- As required in Part 9 chapter 3 section [4.2] of this rule. And the occasional inspections or tests, records of the periodical examinations and tests are maintained.
- Make note of the possible remarks of the Surveyor.
- To check the certification validity for the concerned lifting appliances.

4.6.2. The documents or details mentioned below are to be attached to the Inspection Register:

- General sketch showing lay-out and reference marks of the lifting appliances of the offshore unit or ship.
- Document indicating the main characteristics of each lifting appliance (SWL, maximum and minimum working radius or load capacity chart, working area, etc.) and its working conditions (maximum wind in service, list and trim angles, sea condition, etc.), duly stamped by the Society.
- Force diagram for each lifting appliance in every working condition (union purchase, different methods for hoisting, etc.) displaying the maximum forces applied to the items of loose gear and main structures.
- For each lifting appliance, sketch giving useful particulars for correct reeving of ropes and position of every item of loose gear.
- For each lifting appliance, list of steel wire and fiber ropes giving their characteristics (specially their minimum breaking load) and list of every item of loose gear with their SWL and test load.
- For complex or special type lifting appliance, a working and maintenance manual prepared by the Builder.

In addition to the aforementioned attachments to the Cargo Gear Register, the manual relating to the lifting appliance is to include the information given below:

- Design criteria;
- Design standards;
- List of elements heavily loaded in service;
- Material specifications;
- Cable specifications;
- Construction standards;
- Sheaves design standards;
- Inspection report during fabrication;
- Design standards of piping’s and electrical circuits;
- Description and maintenance instruction of brake system;
- Diagrams of the latter description of safety devices;
- Instruction for operating, mounting, dismounting and transportation;
- Instruction for maintenance.

This latter manual is to be kept near the appliance it is related to.

4.7. Criteria for issuance of INTLREG Cargo Gear Register

4.7.1. The appliance may be put down on INTLREG Cargo Gear Register when the examination and survey as given below are done to Society’s satisfaction:

- Approval of the drawings and examination of the documents listed in section [2.3] of this chapter

- Examination of the test certificates at works of the items of loose gear such as blocks, hooks, shackles, swivels, chain cables, rings, rigging, lifting beams, etc.
- Examination of the test certificates at works of the fiber ropes and steel wire ropes.
- Survey of the fitting onboard as specified in Part 9 chapter 4 section [2.8] of this rule.
- Survey and certification of the general tests before first use as specified in Part 9 chapter 4 section [2.9] of this rule.

When lifting appliances already in service are concerned, the examination and survey carried out by the Society are given below:

- Examination of the drawings and documents required in section [4.6] of this chapter which are to be submitted for information (refer Note 1 below)
- Examination of the certificates delivered after testing at works of loose gear, and possibly of the existing Cargo Gear Register.
- Survey of the concerned lifting appliances (refer Note 2 below).

Note 1: If the ship does not have Cargo Gear Register given by a recognized organization or a National Authority, the all above mentioned drawings and documents are to be approved by the Society.

Upon agreement with the Society, approval of drawings may not be required if these have been previously approved by a recognized organization. In such a case, the above mentioned drawings and documents are to be submitted for information. Particular measurements or controls conducted aboard, and witnessed by a Surveyor of the Society, may be required.

The documents specified in section [4.6.2] of this chapter, annexed to the Cargo Gear Register, are to be submitted.

Note 2: The extent of this survey is to be defined according to the state of the existing certification, the general state of maintenance and the age of the lifting appliances. As a rule, re-testing isn't required if the existing certification relating to these tests (testing prior to first use and/or qinquenal renewal of tests) is valid. Checking thicknesses of structural elements is to be done on the lifting appliances of age greater than or equal to 12 years.

4.7.2. The INTLREG Cargo Gear Register can also be issued on the basis of intervention as given in section [2.2.2.2] or [4.4] of this chapter.

CHAPTER 2 LIFTING GEAR

CONTENTS

SECTION 1 CRANE

Contents

1.1. General

1.1.1. The provisions of this Section are applicable mainly to lifting appliances used in port conditions. However, as the case may be, they also apply to lifting appliances used in offshore conditions.

1.1.2. On the basis of minimum design temperature of -10°C, the requirements of this Section are evaluated. Other cases are to be subjected to special consideration from the Society.

1.1.3. The materials used to manufacture the fixed parts of the lifting appliances, their connections with the ship structure (masts, crane columns, seating's, etc.), and those used locally to strengthen this structure, are required to meet with the requirements of Part 2 Materials and Welding of this rule.

However, the materials meeting some requirements of recognized international or national standards and whose characteristics are equivalent to those required by Part 2 Materials and Welding of this rule may be accepted on case to case basis by the Society.

1.1.4. If steel with very high mechanical characteristics (of minimum specified yield stress greater than 355 N/mm^2) is used, it is to be examined on a case by case basis by the Society.

In such a case, a comprehensive technical specification which gives its manufacturing process, utilization conditions (ability for welding and forming), chemical and mechanical characteristics and the feasible heat-treatments is to be presented before the Society.

1.1.5. The materials used to manufacture primary elements of high capacity lifting appliances like heavy derrick booms, jibs and main load carrying structures of gantry-cranes and cranes, lifting beams, are to meet the requirements of Part 2 Materials and Welding of this rule.

However the materials used to manufacture elements other than those as given in Part 9 Chapter 2 section1.[1.3] of this rule may be accordingly chosen to meet some international or national standards or approved specifications. Thereby selected materials are to be submitted to the Society for their approval.

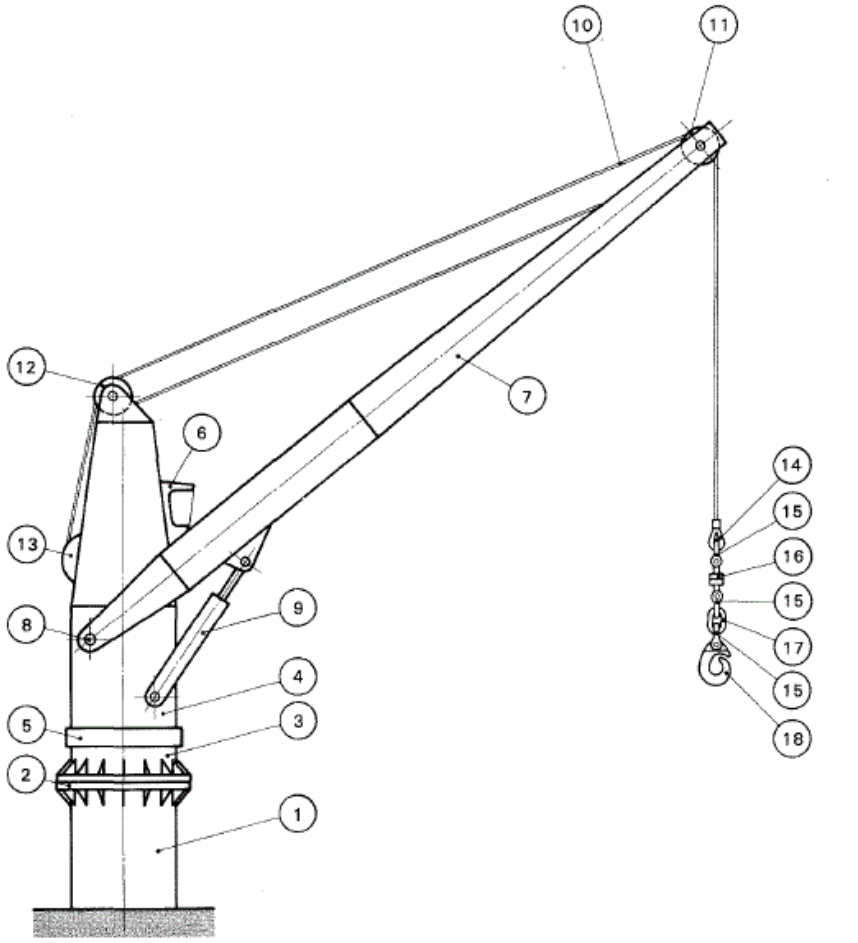
1.1.6. For the manufacturing of some specific elements, reference is to be made to the requirements of some special specifications dealing with them. For steel wire ropes and fiber ropes, the requirements of Part 9 Chapter 2 section [3.5] of this rule are applicable respectively.

1.1.7. None of the component parts of a lifting appliance and its accessories are to be manufactured in wrought iron.

1.1.8. The Society reserves the right to especially examine the use of non-ferrous or synthetic materials.

A typical deck crane and parts detailed below

DECK CRANE



Deck crane – Parts Table

1	Crane pedestal (or crane column, or crane post)	7	Jib (or crane boom)	13	Cargo winch
2	Bolted connection	8	Jib heel pin or boom heel pin	14	Rope terminal (thimble)
3	Fixed lower structure	9	Luffing (or topping) cylinder	15	shackle
4	Superstructure (or crane body, or revolving	10	Cargo runner (or hoisting rope, or lifting rope)	16	Swivel
5	Slewing ring	11	Jib head built-in cargo sheaves	17	Link
6	Driving cab	12	Crane top built-in cargo sheaves	18	Cargo hook (C-hook, or Liverpool hook)

1.2. Steel plates and sections

1.2.1. Steel plates and sections used to assemble components which fall within the scope of interventions of the unit are categorized under hull steel grades as defined in Part 2. Their minimum yield stresses are given below:

- 235 N/mm^2 for ordinary hull steel grades A, B, D or E
- 315 N/mm^2 for high tensile steel grades AH32, DH32 or EH32
- 355 N/mm^2 for high tensile steel grades AH36, DH36 or EH36.
- The aforementioned values are valid for up to 100 mm thicknesses.

1.2.2. The hull steel grades to be used for manufacturing structural elements as specified in Part 9 Chapter 2 section [1.2.1] of this rule(tubes made out of welded rolled up plates or plate welded structures) are defined in Table 2.1.1 as per the below mentioned plate thicknesses.

Table 2.1.1: Hull steel grades for plates

Plate thickness t, in mm	Hull steel grade
t ≤ 20	A or AH
20 < t ≤ 25	B or AH
25 < t ≤ 40	D or DH
40 < t	E or EH

1.2.3. As a Rule, the requirements of Chapter 2 section [1.2.2] of this part are applicable to sections (flat bars, angle bars, etc.) which form the load carrying structures and to those used to stiffen plates when they contribute to the general structural strength.

1.2.4. Steel grades of welded pipes and seamless pipes are to be selected on the basis of the same principles as given for opened sections and plates.

1.2.5. The use of grades as per Part 2 is to be considered for areas that are subject to high stresses in through thickness direction.

1.2.6. On the construction drawings submitted for approval, the specifications of the materials used are to be mentioned. If that is not the case, steel used would be considered as normal strength hull steel grade A, as defined in Part 2.

1.2.7. As a Rule, when plates of thickness t are cold formed, the folding radius r is not to be lower than the value given below:

For ordinary hull steel, r = 2.5 t

For high tensile steel, r = 3.0 t

1.2.8. In some special cases like highly stressed plates in the thickness direction, the Society may require that plates of higher-grade quality are to be used that comply with Part 2 to minimize the risk of laminar tearing.

1.3. Welding's

1.3.1. For welded construction, selection of materials takes into account:

- the extent of its importance in the whole structure of the considered element
- the design temperature of the element
- the thickness of the element
- the stress relieving treatment performed after welding.

1.3.2. Hull steel grades to be used for structural part supporting the appliance and welded to the ship structure are to be selected as per Part 2.

1.3.3. It is to be considered that structure is usually not stress relieved.

1.4. Steel forgings

1.4.1. The provisions of Ch1, Sec 6 and Ch 2, Sec 6, apply to steel forgings after the particulars of Chapter 2 Section [1.4.2] and [1.4.3] below are considered.

1.4.2. The minimum guaranteed values for yield stress and tensile strength are to be specified on the drawings that are submitted for approval. Other characteristics are required to meet the requirements of Part 2, Ch 1, Sec 6 and Part 2, Ch 2, Sec 6.

1.4.3. The chemical composition and the carbon content of the forged parts in particular is intended to form a welded assembly and that is defined in Part 2, Ch 1, Sec 6 and Par 2,Ch 2, Sec 6.

1.5. Steel castings

1.5.1. The provisions of Part 2, Ch 1, sec 7 and Ch 2, Sec 8. Materials and Welding apply to steel castings, after the particulars of Chapter 2 Section [1.5.2] to [1.5.4] of this part are considered.

1.5.2. The minimum guaranteed values for yield stress and tensile strength are to be specified on the drawings that are submitted for approval. Other characteristics are required to meet the requirements of Part 2, Ch 1, Sec 5 and Ch 2, Sec 8.

1.5.3. The chemical composition and the carbon content of the steel castings in particular is intended to form a welded assembly as defined in Part 2, Ch 1, Sec 5 and Ch 2, Sec 8.

1.5.4. Highly stressed steel castings are to be subjected for suitable non-destructive examination.

1.6. Iron castings

1.6.1. The provisions of Part 2, Ch 2, Sec 9 apply to iron castings, after the particulars of Part 9 Chapter 2 Section [1.6.2] to [1.6.4] are complied.

1.6.2. The use of grey iron, spheroidal graphite cast iron either combined ferrite/pearlite structure or pearlite structure or malleable iron is allowed, as a Rule, for manufacturing block sheaves or low stressed elements of lesser importance.

1.6.3. Making use of spheroidal graphite cast iron (SG iron) instead of cast steel may be accepted by the Society, in following cases:

- Requirements of Part 2 for SG irons are met.
- Tensile properties are clearly mentioned on the drawing submitted for approval.
- The concerned part is not intended to constitute the welded assembly.

1.6.4. Welding is forbidden on iron castings, even while casting defects are repaired.

1.7. Bolting

1.7.1. While design and manufacturing of lifting appliances, standardized bolts are used for load carrying connections, the nuts and screws are to be of the steel quality grades as given Table 2.1.2 and as specified in ISO 898-June 09. For the screws, the same table also specifies the

nominal tensile strength σ and the yield stress σ_Y which are taken into account during the strength calculations.
Bolts are to be furnished with a traceable test certificate issued by the bolt manufacturer.
Round bottom and rolled thread profiles are to be used for bolts in critical bolt connections.
Additional tests, such as hardness tests and magnetic particle inspection 48 hours after final quench and tempering, as deemed necessary by the attending Surveyor, may be required to ensure the quality of the bolt material.
Bolts are to be permanently marked with fastener manufacturer's identification mark and industry grade, such as SAE, ASTM or ISO.

a) Hold-down Bolts

Hold-down bolts are to comply with ISO 898-1, or equivalent, and in general are not to be made of material with ultimate tensile strength exceeding 1040 N/mm2 (106 kgf/mm2, 150800 psi) (10.9 Grade).

Table 2.1.2: Steel quality grade marks for screws and nuts

Quality grade marks for screws	6.8	8.8	10.9	12.9
Nominal tensile strength of screws, in N/mm^2	600	800	1000	1200
Yield stress of the screws, in N/mm^2	480	640	900	1080
Quality grade marks for nuts	6	8	10	12
Note1: Other steel quality grades defined by national standards may be accepted, as an alternate.				

1.7.2. It is assumed that the nut is of normal height (0, 8 times the nominal diameter of the screw), on a bolt (i.e. screw + nut), the quality grade mark of nut is required to correspond to the first figure of the designation symbol of the quality grade mark of the screw.

1.7.3. On every nut and screw that is used, the designation symbol of the steel quality grade mark is to be clearly indicated.

1.7.4. For assemblies with pre-stressed high strength bolts, the quality grade marks of the screws and the nuts are to be 8.8, 10.9 or 12.9 and 8, 10 or 12 respectively. Also, the quality of the washers used is to be as per the quality grade marks of the screws and nuts.

Rolling is to be used for obtaining screw threading, and inclusive of any other process.

For compliance of the bolts and screws with recognized national or international standards, an attestation may be required.

2 Constructional arrangements

1.7.5. Minimum thickness

As given in Table 2.1.3, thickness of crane pedestals is to be not less than that given and be in accordance with the SWL P of the crane.

1.7.6. The thickness of the component plates in the structural parts of the load carrying cranes is not to be less than 6 mm.

When tubular structures are concerned, tube thickness is not to be less than 4 mm (except for crane pedestals, the minimum thickness of which is given in Table 2.1.3.

1.8. Constructional arrangements

1.8.1. Minimum thickness
The minimum thickness of crane pedestals is to be given in Table 2.1.3, and corresponding with the SWL P of the crane.

1.8.2. The thickness of the plate component in the structural parts of the load carrying cranes is not to be less than 6 mm.

When tubular structures are concerned, tube thickness is not to be less than 4 mm (except for crane pedestals, the minimum thickness of which is given in Table 2.1.3.

Table 2.1.3: Minimum thickness of crane pedestals

SWL of crane P, in t	**Minimum thickness t_{min},in mm**
P ≤ 1 1 < P < 5 P ≥ 5	6.0 3/8 (P+15) 7.5

1.9. Diameter/thickness ratio for crane pedestals of circular cross-section

1.9.1. For crane pedestals of circular cross-section, b/t ratio between the external diameter b, and the thickness t, (in mm), of each considered cross-section is not to go beyond either 150 nor the values given in Table 2.1.4 according to the SWL P of the crane and the design yield stress σ, in N/mm^2, of the crane pedestal as defined in Part 9 Chapter 3 section [4.1.3] of this rule.

Table 2.1.4: Crane pedestals of circular cross-section: b/t ratio

SWL of the crane P, in t	**b/t ratio**
P ≤ 5	$\frac{23500}{\sigma}$
5 < P < 160	$\frac{47000P}{\sigma(P+5)}$
P ≥ 160	$\frac{45600}{\sigma}$

1.9.2. For structural elements of circular cross-section (exclusive of crane pedestals), b/t ratio is not to exceed 2/3 of the value as required in [1.9.1] above.

1.9.3. When the maximum combined stress σ_C, defined by the strength criteria as per Chapter 3 section [4.1.3] of this part, is lower than the allowable stress $\eta\sigma$ given in Chapter 3 section [4.1.3] of this part, b/t ratio from Table 2.1.4 may be increased in ratio:

$$\frac{\eta\sigma}{\sigma_c}$$

1.10. Width/thickness ratio of plane walls

1.10.1. Ratio b/t of the width b of an unstiffened plane bulkhead (or spacing between the stiffeners of this bulkhead) and its thickness t, (in mm), is to be not greater than equal to:

$$\frac{b}{t} \leq \frac{720}{\sqrt{\sigma}}$$

1.10.2. When the maximum combined stress s defined by the strength criteria as per Chapter 3 section [4.1.3] of this part is lower than the allowable stress $\eta\sigma$(see Chapter 3 section [4.1.3] of this part), the b/t ratio may be taken equal to the following maximum value:

$$\frac{b}{t} \leq \frac{900}{\sqrt{R_e}}\sqrt{\frac{\eta\sigma}{\sigma_c}} \quad \text{When } \sigma_c \leq 0.63\eta\sigma$$

$$\frac{b}{t} \leq \frac{1610}{\sqrt{\sigma}}\sqrt{1 - 0.8\frac{\sigma_c}{\eta\sigma}} \quad \text{When } \sigma_c > 0.63\eta\sigma$$

Ratio b/t is not to go beyond 100.

1.10.3. If the requirements given from [1.10.1] to [1.10.2] do not entirely meet the strength of plates and associated stiffeners, local buckling is to be justified by calculations, to the satisfaction of the Society .refer Part 9 Chapter 3 section [4.1.5].

1.11. Means of access

1.11.1. Means of access are to be provided in all lifting appliances and equipment.

1.11.2. Vertical and sloped ladders (angle of slope with the vertical < 15°) may be provided with single rungs 25 mm minimum in diameter (circular section rungs) or 22 x 22 mm^2 minimum in section (square section rungs). Guard hoops are to be provided in the ladders over 3 m in height.

1.11.3. Ladders whose angle of slope with the vertical exceeds 15° are to be fitted either with pairs of rungs or steps, the clear gap of twin rungs being 5 cm maximum. Suitable hand rails are to be provided in such ladders.

1.11.4. Vertical Ladder are to at least extend 1 m above landing platform.

1.11.5. Landings and catwalks are to be fitted with guardrails 1 m in height minimum and manrope or rail at mid-height.

1.11.6. Access ladders and catwalks are to be firmly secured at frequent close intervals to avoid rattling.

1.12. Constructional arrangements

1.12.1. As per general engineering practice local strengthening of the crane structures is done by using additional stiffeners, transverse web plates, connecting brackets or by locally increase in thickness in way of the concentrated applied forces and at places subjected to concentrated stresses due to discontinuity in shape.

1.12.2. Strength continuity of the structural parts subjected to tensile stresses is to be ascertained by continuous plates or by butt welding. For the strength continuity of structures use of fillet welds on transverse plate is to be avoided. For such transverse plates, use of special quality plate is recommended.

In line with the aforementioned, the crane pedestal structures are to be continuous through the uppermost attachment deck, unless otherwise accepted by the Society.

1.12.3. Where there is possibility of rain or sea water stagnation, drain holes or other draining arrangements are to be provided in the structural parts.

All the structural parts are to be so designed that inspections are feasible and all parts are accessible for painting except when feasibility is hampered due to its small dimensions. In such case, closed and watertight constructions are to be provided.

1.13. Local scantlings of attachment decks

1.13.1. As a Rule, the local thickness (in mm) of the decks on which the pedestal is attached is to be not less than:

$$1.2\ s\ \frac{235}{\sqrt{\sigma_0}}$$

Where

s : Local spacing, in m, of the deck stiffeners

σ_y: Minimum yield stress, in N/mm^2, of the deck plate steel.

1.13.2. Additionally, for crane pedestals of circular cross-section, the local thickness (in mm) of the lower and upper attachment decks is not to be less than the values greater than the two values given below:

$$t_2 = 0.8t\frac{b}{H}\frac{\sigma_{Y(C)}}{\sigma_{Y(d)}}$$

$$t_3 = 0.5t$$

where:

t, b Thickness (mm) and external diameter (m) of the pedestal at the uppermost deck level, respectively

$\sigma_{Y(C)}, \sigma_{Y(d)}$, : Minimum values of the yield stress (N/mm) of, the pedestal plate and the deck plate, respectively

H' : Clear height (m) between the two attachment decks.

Assuming that the crane is attached to the middle of a deck area, the value of t_2 is given. In case, the crane is attached to the free edge of deck or is connected to by large brackets, the value of t as obtained here above is to be multiplied by two. If the crane is fixed to a strip of deck of length l_d, in m, both sides of which are free and at a distance S, in m, from the farthermost end of this strip of deck, the value t_2 is to be multiplied by $2S/l_d$ ratio.

1.13.3. In certain cases, it may be required that the scantlings of the attachment decks by direct calculations be checked, taking into account the provisions of Part 9 chapter 3 Section [4.3.2.]

1.13.4. When the thickness of the attachment decks is not adequate to meet the requirements given in Part 9 chapter 2 Section [1.13.1] to [1.13.3] of this rule, a thick plate is to be inserted in the deck plating. The dimensions of this inserted plate are not to be lower than twice the dimensions of the cross-section of the crane pedestal.Generally use of double plates is not allowed.

1.13.5. Additionally, the provisions as per Part 9 chapter 2 Section [1.13.1] to [1.13.4] and with respect to the longitudinal strength of the ship and to the local stress concentrations, the Society may require local increase of deck plate thickness and/or fitting of a diaphragm plate inside the crane pedestal when the pedestal is passing through the deck.

SECTION 2 DERRICK / ENGINE ROOM OVERHEAD CRANES, MONORAIL HOIST

Contents

2.1. Winches

2.1.1. Application

2.1.1.1. This section deals with the winches used to operate lifting appliances apart from other winches (for e.g. mooring winches) which are not part of the lifting appliances and so is not considered herein this section.
The documents to be submitted to the Society are listed in Part 9 Chapter 1 section [2.3.2.2].
Note 1: Rest of the winches (mooring, towing or tugging winches) are considered as a separate equipment. However, when application is considered reasonable, this Section may be applied for these equipment's.

2.1.1.2. For designing each winch, following shall be taken into consideration:

- The maximum rope tension that can occur when operated in the worst service conditions
- The stalling force corresponding to the maximum torque of the motor.
- The maximum holding force that a winch has to withstand in static service conditions.
- The total number of turns of ropes and the corresponding maximum number of rope layers on drums (it is to be taken into account that when rope is at the uppermost layer, an assumed constant rope tension, the applied torque is at a maximum).

The calculations of scantlings are to be done in conformation to, either national or international standards, or recognized codes or specifications.

Winches which do not entirely meet the requirements of this section shall be specially considered.

2.1.1.3. The nominal force at the rope drum of a winch (or Safe Working Force, SWF, of the winch) is the maximum rope tension (in kN) at which the winch can haul at the upper winding layer, in normal service conditions, when the drum rotates at nominal recovery speed i.e. its maximum service speed.

To determine this force at the drum, the efficiency of the sheaves and purchase tackles on which the rope is wound is to be taken into account.

The rated winch capacity is normally defined as the maximum mass that a winch can lift vertically on a single part of rope and at the upper winding layer when the drum rotates at its nominal recovery speed and when the rope is reeved through two single sheave blocks. In such a case, the rated capacity of the winch, in t, is equal to 0.09 times its SWF.

2.1.1.4. Every winch must be designed to operate with a recovery overload as given in Table 2.2.1, considering maximum number of rope layers on the drum, but irrespective of speed conditions.

Table 2.2.1: Overload for winch operation

SWF of winch, in kN	Over load, I n kN
SWF<200	25 %
200kN≤SWF≤500	50 kN
SWF>500	10 %
Note1: Attention is drawn to the fact that if more severe test conditions than those provided in Ch 4 Sec 2 are required by the purchaser or special National Regulations, it is necessary to ascertain that the abovementioned overload is sufficient to lift the test load provided for the lifting appliance.	

2.1.2. Drums

2.1.2.1. Capacity of the drums are to be adequate to allow at the most three layers of rope to be wound on it; unless satisfactorily winding method may be proved with a greater number of layers.

2.1.2.2. For safety purposes, three (3) complete turns of rope must remain on the drum in every case, except in stowed condition, where two (2) safety turns of rope may be considered as adequate.

2.1.2.3. The builder must determine the diameter of the winch drums depending on the use provided for the lifting appliance (intensive or occasional use, frequent or rare use at full capacity, fast or slow recovery speed, etc.) and on the nature of the wire or fiber rope provided (number of strands, steel or fiber core) to ascertain a useful life for the rope.

The values given from [2.1.4.1] (e). and [2.1.5.5] of this rule for steel wire ropes are for guidance but they must be considered as a minimum for those lifting appliances which are regularly used for loading and unloading cargoes and are frequently operated below 75% of their maximum capacity (for e.g. multi-purpose cranes).

For very rare and/or not intensive use at maximum capacity (for e.g. derrick or crane for spare parts or supply) the indicated ratio between the drum and the rope diameter can be reduced by 2 units.

On the other hand, for appliances used intensively at loads near to or equal to their maximum capacity (for e.g., cranes for containers or grab cranes to unload dry cargoes in bulk), it is recommended that drums with larger drum diameters are used.

For synthetic fiber ropes, the values indicated for the steel wire ropes shall be divided by 2 considering the conditions given in above two paragraphs.

2.1.2.4. It is required that the drums are flanged at both ends so that the rope shall easily wound or unwound without over-riding the end flanges. For the same, flange height should be such that it projects at least by 2.5 times the rope diameter beyond the outermost rope layer when the rope is fully reeled on the drum in service, test and stowed condition of the lifting appliance. This requirement may not be met provided the drum is fitted with a special device that serves the same purpose and prevents overriding of the end flanges by the rope.

2.1.2.5. Irrespective of the position of the derrick boom or crane jib, arrangements are to be such that a reasonably even reeling of the rope is obtained. Following are recommended for the purpose:

- The fleet angle of the rope is as small as possible (see Note) and does not exceed 4° in any working position (Fig 2.2.1) gives the fleet angle when the guide block is in a fixed position).
- The drum diameter is as large as possible (refer [2.1.2.3], [2.1.4.1] (e) and [2.1.5.5] above).
- The drum is grooved according to the diameter of the rope.
- If required, a spooling device is provided.

Note 1: When a single rope layer is provided, the drum axis may be shifted by a σ angles (approx. 1°) equal to the slope of the spiral formed by the rope (refer Fig 2.2.1) to reduce the maximum fleet angle which would be increased by σ without this shifting as and when several reeling layers are provided (refer Fig 2.2.2).

2.1.2.6. The end of the rope is to be attached to the winch drum in an effective manner so that it withstands without damage twice the maximum rope tension in service conditions.

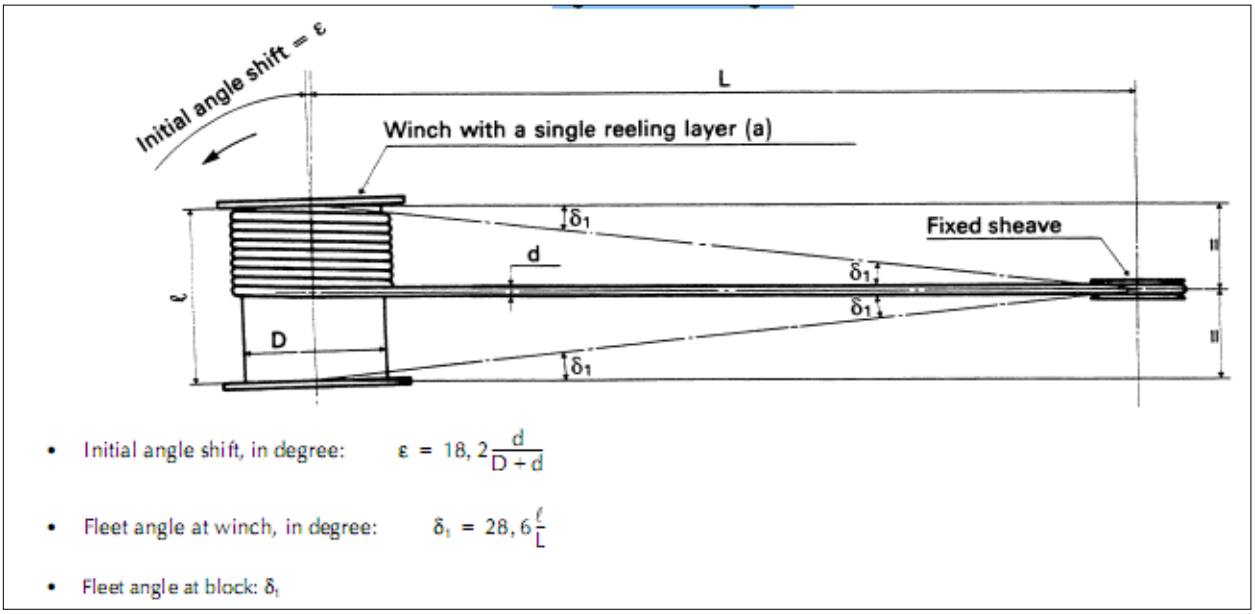


Figure2.2.1: Fleetangles

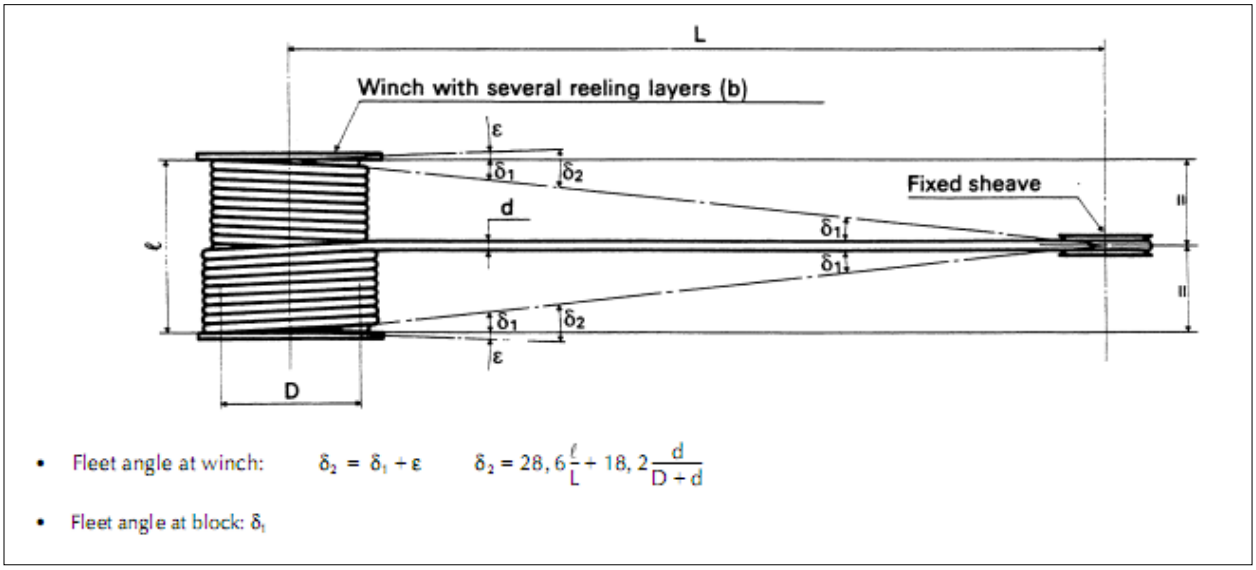


Figure 2.2.2: Reeling

2.1.3. Seating's

2.1.3.1. To avoid internal corrosion the seats of the winches of closed box construction are made watertight.

In open constructions, the design is to be such that access for painting and maintenance is easily available.

Fitted bolts are to be used, when the seats are bolted to the ship, otherwise efficient stop plates are provided to protect the bolts against shear forces.

As per Chapter 1 section [2.3.3] of this part, the drawings of the winch foundations and local ship structure that falls in their way are to be submitted for approval of the society.

2.1.3.2. Normally, cargo winches are self-powered.

2.1.3.3. Electric and hydraulic equipment, motors, electric control and safety devices are to meet the requirements of Chapter 2 Section 1of this part.

2.1.4. Winches

2.1.4.1.Under load, hand winches and winches are not to be operated.

a) Normally, the use of hand winches is restricted to the positioning without any loading.
b) Lightly powered type topping winches are those which operate only when the lifting appliance boom is not loaded (not operated under load).
c) Drums of hand winches of indirect driven winches and of lightly powered winches as specified in (a) and (b) as above (or similar winches intended for other purposes) are to be fitted with ratchet wheels or equivalent arrangements such as irreversible worms and locking pawls. Such locking devices are to be so designed that they can withstand a holding force at least equal to 1.5 times the maximum pull applied to when the derrick boom is loaded in the most severe service conditions.

Pawls must fall, automatically and instantly, into the locked position when not held in open position by hand.

The locking devices of the lightly powered winches and indirect driven winches must be connected to the winch control so that the derrick boom may not be lowered before to drum is unlocking.

Although language corresponding to the ship flag and English language is recommended, an instruction plate written in appropriate language, whatsoever it may be, is to be attached near to the controls of these winches to duly inform the users, that the herein mentioned devices must not be operated when the derrick is loaded.

d) The lightly powered winches must be fitted with a brake that gets applied automatically and progressively to the driving motor when the winch control is in "OFF" position and power failure has occurred.

This brake must be able to keep the drum in such a position that it withstands a force equal to 1.5 times the maximum rope tension corresponding to topping with no load at the derrick.

On the indirect driven winches such a brake is not required, provided this brake is fitted to the driving powered winch.

e) Normally, the drum diameter is not to be less than 12 times the diameter of the steel wire rope. However, for winches driven by a separate powered winch, the drum diameter or of the drum part where the auxiliary driving rope is wound, is not to be less than 16 times the diameter of the wire rope used.

2.1.5. Powered winches and winches operated under load

2.1.5.1. All self-powered winches which run under load must be provided with an efficient brake that is capable of withstanding a force at least equal to the one depicted on Table 2.2.2 when the test conditions of the lifting appliance meet the requirements of Chapter 4 of this part.

Table 2.2.2: Minimum braking force

SWF of winch, in kN	Minimum braking force
SWF<200	1.5 SWF
200kNSWF≤500	1.2 SWF + 60 kN
SWF>500	1.32 SWF

2.1.5.2. The brakes required in [2.1.5.1] must automatically apply when the drive is in "OFF" position or neutral position if there is a change-speed gear box. It shall progressively come into action to avoid very sudden dynamic shocks.

In case of a power failure in the supply to the motor or control device, this brake is also to be applied automatically. Also, the cargo winches must be provided with an emergency device allowing lowering of the suspended load. This device must allow lowering of a load likely to exert a pull equal to the SWF of the winch increased by the overload on the drum, and as per Table 2.2.1.

2.1.5.3. It is also required that a hand-operated emergency stop is provided to cut off power supply and bring the brake rapidly into action.

2.1.5.4. On the indirect driven winches which may be operated under load, the braking device as per [2.1.5.1] is not required, provided there is such a device on the driving powered winch.

Yet, these must be provided with a drum locking device capable of bearing a force of at least equal to 1.5 times the SWF of the winch on drums.

2.1.5.5. The diameter of the drums is not to be lower than the values given below:

- 18 times the diameter of the wire rope used for the cargo winches of the derrick booms, the winches of travelling cranes and cranes.
- 16 times the diameter of the wire rope used for the span and slewing winches of derrick booms.

Note1: In general, the reduction by 2 units as per [2.1.2.3] 3rd paragraph of the ratio between the drum and the rope diameter applies to the winches of derrick booms.

2.1.6. Tests

2.1.6.1.General provisions

a) All the winches which either directly or indirectly are power operated must be tested by the manufacturer before they are fitted to the lifting appliances and must also be tested aboard the ship.

On the contrary, the indirectly driven winches shall be tested with this external drive.

b) The tests to be carried out at the manufacturing plant are defined:

In [2.1.6.2] when prototypes are concerned

In [2.1.7] when standardized winches are concerned, whose type has already been submitted either to prototype tests as per [2.1.6.2] or to tests considered as equivalent.

c) Other testing methods which are not described in this Section may also be accepted, provided they are recognized as equivalent by the Society.

d) Tests done aboard the ship are detailed in Part 9 Chapter 4 of this rule.

2.1.6.2. Prototype tests

a) Dynamic tests include three types of tests:

- running tests with no load;
- running tests under nominal force at rope drum;
- overload tests refer below (b), (c) and (d).

Static tests are conducted on with braking and locking devices if they are fitted (see below (e) and (f).

b) The running test with no load is done at maximum speed and in continuous operation for 5 min for each gear change and in each direction of rotation.

During this, operation of control devices and oil tightness is checked.

c) The running test under nominal force at rope drum (SWF) applied to the first reeled layer is done at nominal speed for 30 min while hoisting. However, while lowering a load corresponding to the SWF (the rated capacity is accessed as per [2.1.1.3] of this section as it is a Rule) through a height of 10 m. The two consecutive cycles should not be separated by a pause of more than 20 seconds.

Additionally, if the winch is fitted with fixed ratio change speed gear, operation of the winch is to be checked for 5 min for each speed ratio with the maximum working load corresponding to each ratio. After each speed changeover, automatic application of the brake is to be checked when the control lever is in the neutral position.

If a continuous speed variation is fitted with the winch, a test of speed variation is to be conducted over the entire range of the possible speeds.

After these tests are done, many dynamic tests of the operation of the brake (at least two when the winch is recovering and two when the winch is rendering) are to be conducted at the maximum service speed.

A simulation of cut off in the power supply to the motor and the control device is to be done and its coming back into operation satisfactorily is to be checked in both cases. The emergency stop is also to be tested when the test load is lowered at its maximum speed.

Following elements are checked or measured during the tests:

- oil-tightness
- operation
- bearing temperature
- power input
- actual speeds for recovering and rendering
- efficient working of the braking device without sudden shocks.

d) The overload test is done during two hoisting/lowering cycles, without speed condition, with a load equal to the SWF increased by the overload as depicted in Table2.2.1. During each lowering phase, the brake will be applied to the load which will be ceased at least once during each phase.

For the cargo winches, an emergency stop test is to be done and the test load will be lowered in using the emergency device discussed in [2.1.5.2].

e) For the static test of the braking system, for 5 minutes a force equal to the minimum braking force as indicated on Table 2.2.2 is to be applied to the first reeled layer. During the test, drum shall not rotate.

f) For the static test of the locking device, to the first reeled layer, a force equal to 1.5 times the maximum holding force of the winch is to be applied for 2 minutes.

The repetition of the test is to be done under similar conditions with another engaged tooth.

2.1.7. Tests of standardized winches

2.1.7.1. Each winch must be tested under the conditions laid out in [2.1.7.2] in the presence of a Surveyor of the Society when:

- prototype tests are not required as the supplier has proved that a winch of the type concerned has been tested as a prototype as per [2.1.6.2] or
- it has been submitted to tests considered as equivalent by the Society

2.1.7.2. Each winch must undergo a running test with no load at nominal speed and for 15 min in each direction of rotation under continuous operation.

Following elements are checked or measured during testing:

- oil tightness
- satisfactory operation
- bearing temperature
- power input
- actual speeds for recovering and rendering

Satisfactory operation of the brake is to be demonstrated when it is normally driven and when the power supply to the motor and the control device is cut off.

If the winch is fitted with fixed ratio change-speed gear, winch operation is to be checked for 5 min for each speed ratio. On every speed change-over, automatic application of the brake is to be checked when the control lever is in the neutral position.

If a continuous speed variation is fitted with the winch, a test of speed variation is to be conducted over the entire range of the possible speeds.

2.2. Electrical Installations and Hydraulic Systems

2.2.1. Application

2.2.1.1. The minimum requirements for the classification or certification of lifting appliances are given herein this part of the Section. The Owners or Builders are required to pay attention to these and also towards the fact that national regulations may include additional provisions, in particular, for worker's safety. It is the responsibility of the concerned parties to ensure that all applicable requirements are met satisfactorily.

2.2.2. General

2.2.2.1. Power operated lifting appliances are to be so designed that any harm caused to motor, pump, monitoring system, electrical or hydraulic fluid supply will not result in dropping of the load, or let the appliance go out of control thereby endangering the life of operator or of the personnel onboard.

Automatic devices are to be fitted to lifting appliances to maintain them in place so that in case of power failure or rupture of hydraulic fluid pipe, means to lower the load at controlled speed remain there.

2.2.2.2. The emergency power networks of the appliances handling manned submarine craft are to be there to supplement the normal ones.

Drawings illustrating these provisions are to be submitted.

2.2.3. Documentation to be submitted

2.2.3.1. It is required to submit the documents listed in Table 2.2.3 and Table 2.2.4.

The listed documents serve as guidance for the whole amount of information that is submitted, rather than an actual list of titles.

The Society reserves the sole right to request the submission of some additional documents in case of non-conventional design or if it is deemed necessary for the evaluation of the equipment, system or components.

Plans are to be all inclusive and shall contain all the data vital for their interpretation, verification and approval.

Unless otherwise agreed with the Society, all the documents sent for approval if submitted by the Shipyard is to be sent in triplicate and if submitted by the equipment supplier, in four copies.

Documents requested for only information purposes are to be sent in duplicate.

Yet, when deemed necessary, in any case, the Society reserves the right to require additional copies.

2.2.4. Electrical installations, hydraulic and pneumatic systems

2.2.4.1. Electrical installations

a) Electrical installations of the lifting appliances are to meet the requirements given in Part 6 of the Rules for Steel Ships, and as applicable to them and especially considering:
   i) general environmental conditions, (Part 6, Ch1 sec 2[2.3.2]
   ii) distribution systems Part 6, Chaper 2 sec 4 [4.2]
   iii) rotating electrical machines. (Part 6, Chapter 4)
   iv) transformers. Part 6, Ch 2 sec 4[4.1.1]
   v) semiconductors. Converters. Part 6, Ch-2 sec 4 [4.1.2]
   vi) switchboards. Part 6, Ch 2 sec 4[4.1.10]
   vii) electrical cables. (Part 6, Ch 6)
   viii) electrical accessories, (Part 6, Ch 3 sec 2)
   ix) installation (Part 6)
   x) testing. (Part 6)

b) For applying requirements given in Part 6, of the Rules for Steel Ships, the electrical equipment and systems are not to be considered as assuming an ‘essential service’ except those fitted on lifting appliances categorized under class notation CG(H) or CG(O) .

c) For lifting appliances not categorized under class notation, the electrical equipment and systems will be accepted if the individual works’ certificates issued by the manufacturers are submitted and if during the tests, satisfactory performances of the lifting appliances is observed.

d) Equipment, electric motors, and cables are to be duly protected against:
   i) overcurrent ingress of liquids, depending on their location
   ii) ingress of solid foreign bodies, depending on their intended use
   iii) moisture and corrosion in sea water
   iv) atmosphere

v) accidental shocks, depending their on location.

e) The index of protection of electrical equipment, in relation to their location and against ingress of liquids and solid bodies is generally like it is specified in Part 6, Ch 2, Sec 4, Table 2.4.16.

Table 2.2.3: Electrical documents to be submitted

N°	I/A (see note 1)	Documents to be submitted
1	A	Single line diagram of the power distribution system
2	A	Schematic diagrams of the motors tarter cabinet(s) and control/safety system
3	A	General arrangement diagram of the lifting appliance showing all essential electrical equipment(electric motor, control panels, limit switch, etc.…)with regards to hazardous area when applicable
4	A	Detailed specification of the safety system
5	A	Justification of the safety character of electrical equipment located in hazardous areas(when applicable)
6	A (refer note 2)	General arrangement of the operator cabin and workstation
7	A (refer note 2)	The list of them on it or parameters for alarming/monitoring and safety systems
8	I	Risk analysis of radio control system (when applicable)

Note:
1. A: Documents to be submitted for approval
   I: Documents to be submitted for information
2. For crane whose SWL exceeds 50 tons

Table 2.2.4: Drawings, information and data to be submitted for hydraulic system and pressure vessels (hydraulic cylinders, accumulators)

N°	A/I(1)	Item
1	A	Diagram of hydraulic system
2	I	General arrangement plan, including nozzles and fittings
3	A	Sectional assembly
4	A	Safety valves (if any)and their arrangement
5	A	Material specifications
6	A	Welding details, including at least: • typical weld joint design, • welding procedure specifications, • post-weld heat treatments.
7	I	Design data, including at least design pressure and design temperatures(as applicable)
8	I	Type of fluid or fluids contained

(1) A: Four copies of such documents are to be submitted for approval
(2) I: Duplicate copies of such documents are to be submitted for information

f) As per Rules, electrical equipment's are not to be installed in areas considered as hazardous due to formation or accumulation of explosive gas or vapors or flammable particles. When during operations, this requirement cannot be met; electrical installations are to meet the requirements specified in Pt 6, Ch3, Sec 6 of the Rules for Steel Ships.

g) Cables are to be secured against mechanical damage and these protective supports are to be installed to prevent strain, chafing and allow free displacement during operation of the lifting appliance.

h) Unless otherwise accepted by Society, all exposed conductive parts that do not carry current are to be earthed.

i) The electrical installations are to be made and tested onboard the ship to satisfaction of the Society's Surveyor.

The tests are to be done to meet the requirements of Part 6 of the Rules for Steel Ships.

Moreover, satisfactory operation of the motors, their circuits and protective devices are to be proved with the various source of power utilized. Also, operation of the safety equipment running with electric power is also to be checked.

j) Black-out test of main power source is to be made under real or simulated conditions to check that it will not result in an immediate danger for the lifting gear operators or crew . refer [2.2.2.1]

2.2.5. Hydraulic systems

2.2.5.1. Hydraulic installations of the lifting appliances are to conform to the applicable requirements taking into account in [2.2.5.3]to [2.2.5.7].

2.2.5.2. Excluding lifting appliances categorized under class notation CG(H) or CG(O), pumps and hydraulic motors need not be inspected by the Society at the manufacturer's works provided that they are produced in series and as per a recognized standard. Additionally, the acceptance of these equipment's are subject to submission of manufacturer's test certificates and satisfactory performance during the testing of the lifting appliances.

2.2.5.3. The design pressure of a piping system is the pressure considered by the manufacturer to determine the scantling of the system components. It is not to be taken less than the maximum working pressure expected in this system or the highest setting pressure of any safety valve or relief device, whichever is greater.

2.2.5.4. Hydraulic equipment are to be duly protected against:
a) overpressure
b) oil pollution (abrasive particles)
c) corrosion
d) accidental shocks

2.2.5.5. The general principles specified in [2.2.2] are to be taken into consideration while hydraulic fluid systems are designed.

2.2.5.6. Pressure pipes are to meet the applicable requirements.
Flexible pipes are to be of approved type as per requirements.

2.2.5.7. Hydraulic systems is to be hydraulic tested after assembly onboard under the conditions defined in Part 5A, Chapter 8.

2.2.6. Hydraulic cylinders

2.2.6.1. The minimum thickness t, in mm, of the steel cylindrical shell of luffing or slowing hydraulic cylinders is given by the formula:

$$t = \frac{pD_{icy}}{(2\sigma - p)e}$$

p : Design pressure, in MPa
D_{icy} : Inside diameter of the cylinder, in mm
e : Efficiency of welded joint as given in Part 2 Chapter 3of Rules for Steel Ships
σ : Permissible stress, in N/mm^2.
Where not otherwise specified, the permissible stresses σ, may be taken as the minimum of the values obtained by the formulae given below:

$$\sigma = \frac{\sigma_{m,20}}{A}$$

$$\sigma = \frac{\sigma_S}{B}$$

Coefficient of utilization A and B are given in Table 2.2.5
$\sigma_{m,20}$: Minimum tensile strength at ambient temperature(20°C),in N/mm^2
σ_S : Minimum between σ_{eH} and $\sigma_{p0.2}$at the design temperature T, in N/mm^2.

Table 2.2.5: Coefficients of utilization

	Steel	Cast steel	Nodular cast iron
A	2.7	3.4	4.5
B	1.8	2.3	3.5

The thickness obtained is "net" thickness, as it excludes any corrosion allowance. The thickness obtained by the above formulae is to be increased by 0.75mm.

The Society reserves the right to increase the corrosion allowance value in the case of vessels exposed to particular accelerating corrosion conditions. The Society may also consider the reduction of this factor where particular measures are taken to effectively reduce the corrosion rate of the ship.

Irrespective of the value calculated by the formulae, the thickness t (in mm) is not to be less than the value obtained by formula given below:

$$t = 3 + \frac{D_{icy}}{1500}$$

No corrosion allowance is to be added to the above value.

Note 1: the formula of t is applicable if the ratio external diameter/inside diameter is equal to or less than 1.5, if not the cylinder is subject to special consideration.

2.2.6.2. The head of the cylinder and the thickness of the bottom is to meet the applicable requirements.

In this calculation, the reinforcement of the cover due to the fixation of the cylinder (often welded on the cover) with the crane is not taken into consideration.

2.2.6.3. Scantlings of piston rods are to be checked for buckling as per the strength criterion given below:

$$\omega\sigma_c \leq 0.55\sigma$$

where:

ω : Buckling coefficient defined in Part 9 chapter sec 5 of this rule with effective length of buckling equal to twice the maximum reach of cylinder rod

σ_C : Compression stress, in N/mm^2,corresponding to design pressure p as defined in [2.3.1]

σ_y : Yield stress, in N/mm^2, considered in calculations of cylinder rod resistance(see Part 9 chapter sec 5 of this rule).

2.2.6.4. For ascertaining internal soundness, cast steel or spheroidal graphite ferrite cast iron shells of hydraulic cylinders are to be ultrasonic-tested.

2.2.6.5. Using direct calculations, fastening of cylinder bottoms and of cylinders are to be checked. Combined stress are not to exceed 0.55 σ_Y . For welded bottoms, all welds are to be checked with help of non-destructive methods.

2.2.6.6. Cylinders are to be hydraulically tested before fitting.

2.2.6.7. The design calculations for hydraulic cylinders shall be based on the maximum obtainable pressure (safety valve setting). Alternatively, if the maximum dynamic force applied on the crane is known, this may be used as basis for the design calculations. In both cases different outreach positions shall be evaluated.
Based on case by case considerations, a safety factor with respect to buckling down to 2.3 may be accepted for slenderness ratios above 110. For slenderness ratios below 90, buckling is not considered and a safety factor of 1.8 with respect to yield stress will be required. For slenderness ratios between 90 and 110, linear interpolation between the two above acceptance criteria shall be applied

2.2.7. Pneumatic equipment

2.2.7.1. The design of the pneumatic equipment is to be established on the same basis as hydraulic equipment.

2.2.7.2. It is also to be demonstrated that safety level is not less than that which would be attained by hydraulic equipment to ensure same functions and performances.

2.3. Control and Safety of Lifting Appliances

2.3.1. Application

2.3.1.1. The requirements of this Section apply to lifting appliances as defined in chapter 1 section 2 of this part.

2.3.1.2. Additional provisions of [2.3.5] and [2.3.6] may also be considered depending on the type of lifting operation contemplated.

2.3.1.3. The attention of the owners, manufacturers or operators is drawn to the fact that National Authorities may demand for additional provisions.

2.3.2. Control and safety devices

2.3.2.1.Control devices

The control and safety systems of lifting appliances covered by a class notation CG(H) or CG(O) are required to meet the requirements specified in Part 5A, of the Rules for Steel Ships applicable to them and specially regarding:

- General environmental conditions
- Installation requirements
- Constructional requirements
- Computer based systems
- Testing and electromagnetic interferences.

2.3.2.2. General principles specified in [2.2.2] are to be taken into account for the design of control and safety devices.

2.3.2.3. Control devices shall automatically transfer to neutral position (dead man's control) to automatically actuate the braking device. However, efficient means to lock the control device in this position are to be provided as well.

2.3.2.4. As much as feasible, control levers or wheels are to be so designed that the motion for their actuation corresponds to the motion of the load or lifting appliance, in particular:

- The operator should pull the lever or turn the wheel clockwise for load lifting, upward topping, braking motions, winch recovering,
- The operator should push the lever or turn the wheel counterclockwise for load lowering, downward topping, winch rendering or brake release motions.
- The operator should push the lever to the right or turn the wheel clockwise and vice-versa for right-hand side slewing motions.

2.3.2.5. The required force to apply the brake is not to exceed: 160 N (hand brakes) and 320 N (foot brakes).

2.3.2.6. In event of power failure or electric motor failure, an alarm signal is to be provided at lifting appliance control station.

2.3.2.7. At the discharge of the pump, a low pressure alarm and a hydraulic tank low level alarm is to be provided at the control station.

Before the quantity of lost oil dips to 100 liters or 70% of the normal volume in the tank, whichever is less , the low level alarm is required be activated.

If the crane operator can always see the level gauge, the pressure gauge and the temperature gauge indicators, in case of hydraulics cranes not fitted with an electrical control system, the low level and the low pressure alarms may be waived. Also, a warning label is to be placed on the tank that reminds the operator that before starting any operation of the crane, the oil level is to be checked.

It is to be kept in mind that the hydraulic tank level gauge is to conform to Part6, Ch8, Sec6 of this rule of the Rules for Steel Ships. Society may allow the use of self-closing valves between the gauges and hydraulic oil tanks and oil-level gauges

with flat glasses. For installations with small hydraulic tanks located outside the machinery spaces, special consideration is to be given.

2.3.2.8. Radio controls may be allowed provided that system facilitates same safety levels as hardwired system (e.g. emergency stop of the lifting appliance in case of communication failure or erroneous control signal). In this case, for information purposes, a risk analysis is to be submitted to the Society.

Special precautions are to be taken to prevent parasitic electromagnetic interference that affect the radio control equipment which could lead to an insecure situation.

2.3.3. Safety equipment

2.3.3.1. In event of an emergency, emergency stop devices are to be provided at each control station of powered lifting appliances or apparatus to stop their motion, by cutting off their power-supply. These devices are to be so designed and positioned that they are not actuated inadvertently.

2.3.3.2. Limit switches are to be present on cranes lifting and luffing motions and also on travelling gantry cranes lifting/translation and carriage translation motions.

When actuated, the limit switch is to cease the motions in course without preventing the reverse motion that triggered it off, and it shall be possible to re-engage it.

Operation indicator is to be present at control station for each limit switch.

For crane with SWL not exceeding 10 tons, indicators may be omitted provided that the crane operator has a clear view of the crane movements. Generally, it shall not be feasible to overrun limit switches, except when lifting appliance is to be in stowed position or examined for maintenance.

2.3.3.3. Limit switches are also to be provided whenever slewing of cranes is to be restricted for some reason.

2.3.3.4. Cranes whose lifting capacity varies in span, or whose SWL exceeds 50 t, are to be given a load indicator unless a load moment indicator is fitted.

Such indicators trigger off a visual alarm whenever the load or moment reaches 94% of the permissible value (with a permissible allowance of ± 4%) and an audible alarm is triggered off when this permissible value is exceeded by 96% (with a permissible allowance of ± 4%).

If load (or load moment) indicator automatically cuts off driving power as and when lifting capacity is exceeded, its setting will never exceed 110% of SWL (or 110% of the permissible moment). Then, it is possible to move the lifting appliance back to a more favorable position.

2.3.3.5. Level indicator (list meter and trim meter) is to be provided at control station when list and trim angles are restricted to pre-set figures requiring either prior ballasting of the ship or re ballasting during movement.

2.3.3.6. In all cases when SWL of the lifting appliance is not constant, the diagram of the permissible loads all over the working area is to be provided at the control station.

2.3.3.7. All machinery dangerous parts (gears, engines, chain and bet gearing) are to be effectively guarded, unless they are in a position or of a construction such that they can be considered as safe, as much as when they are properly guarded.

2.3.3.8. All removable parts that are likely to become loose or getting displaced from their housing due to vibrations, dynamic forces or accidental shocks are to be provided with requisite brakes or locking devices.

A device to prevent lifting out of derrick boom from goosenecks is to be present.

2.3.3.9. Gantry cranes are to be fitted with audible and visual warning signals which shall get activated while it is traveling motion.

2.3.3.10. Fire resistant emergency escape routes are to be provided in crane operator's cabins.

2.3.4. Additional requirements applicable to offshore operations

2.3.4.1. Arrangements are to be made to prevent crane boom elevation higher than the design angle and to prevent movement past the vertical position.

2.3.4.2. If operator cannot directly view the hoist drums, a remote watch system is to be fitted.

2.3.4.3. The operator must be empowered with a system that enables him to communicate with personnel in charge of supervision of the lifting operations.

The operator must also be able to warn personnel around while undertaking operation which may present hazards to them and others around.

2.3.4.4. As there may be a significant fire hazard, fire extinguishers must be fitted in the operator cabin control station and machinery cabin.

2.3.4.5. Means to illuminate the appliance and surrounding obstructions, to facilitate the operator to observe at night and be able to handle environment has to be provided and that shall meet the requirements of provisions related to aircraft movements.

2.3.4.6. It is recommended that an additional simple system indicating boom angle and directly visible to the operator is fitted in the crane.

2.3.5. Additional requirements applicable to personnel hoisting

2.3.5.1. The comprehensive drawing review of the whole crane is required. The load chart and curve loading corresponding to personnel hoisting is also to be supplied in scope of review.

2.3.5.2. Winch for personnel hoisting is to have double brakes.

2.3.5.3. Reference is to be made to the requirements given in [2.3.2] and [2.3.3]. Additionally, requirements in as [2.3.5.4] to [2.3.5.12] mentioned below, are to be met.

2.3.5.4. In all cases, non-rotating cables are to be fitted.

2.3.5.5. A rope with breaking load of at least 4 times the design load evaluated in the most unfavorable condition of personnel elevation is to be fitted between the basket and the hook so as to prevent hitting of the personnel by the crane's hook.

2.3.5.6. The appliance must operate at a speed equal to the ratio of the wave height to its period, when a consistent system of units is used.

2.3.5.7. It must be feasible in case of emergency to override the self-applying brake system and operate the lifting hoist, in full safety.

2.3.5.8. Only one control location of the lifting appliance shall be there.

2.3.5.9. A control foreman must supervise the operation.

2.3.5.10. For emergency control, arrangement of safety devices as specified in Part 9 Chapter 3 section [4.4.6] of this rule is to be provided.

2.3.5.11. Special instructions are to be in the knowledge of personnel.

2.3.5.12. Specifications of baskets are to be as per the provisions given under:

preference is given to soft type baskets

the rated load of the basket is calculated as:

- 165 kg for the first person

- 100 kg for the following ones

- the design of the basket is to be such that personnel be standing on the periphery and can hold the basket
- the allowed number of persons is to be affixed on the basket
- the dimensions of the basket are to be such that it is stable when lowered onto the deck.

2.3.5.13. Overall test with load corresponding to personal hoisting is to be given.

The simulation of power failure is to be done during this test.

2.3.5.14. Only when test results are satisfactory, certificate will be issued.

2.3.6. Additional requirements applicable to lifting of submarine crafts

2.3.6.1. Requirements of [2.3.4] and [2.3.5] above are applicable, especially the ones pertaining to personnel hoisting when the submarine craft is manned, except for particular provisions given herein this Section.

2.3.6.2. In case of the main lifting cable of the diving chambers breaks down or is released, it is assumed that following means of emergency ascent can be used:

- The free ascent of the chamber by ballast releases the umbilical of the chamber or the guide-cables.
- Operating the release system of the main lifting cable must be dependent on two independent self-willed actions.
- The means of emergency is to allow implementing a procedure of recovery and transferring ensuring same safety as the normal for the personnel.

- The emergency power networks must supplement the normal power networks of the appliances handling manned submarine craft.

The drawings illustrating these provisions are to be submitted.

2.3.6.3. It is required to investigate the circumstances and the consequences of the possible failure of one of the raising jacks of sheering off gantries.

2.3.7. Secondary structure and means of access

2.3.7.1. Secondary structures (cabins, access, etc.) are to be designed to:
- resist climatic and live loads to which they are submitted
- bear control and safety devices required for functioning of the appliance
- ascertain safety of personnel.

2.3.7.2. In case of an accident, the structure of the appliance is to keep the operator safe and allow him to access a safe escape route.

The need to meet applicable legal provisions is recalled here.

2.3.7.3. It is also highly emphasized that escape routes are so designed that they are in line with the general scheme of the escape routes of the supporting unit or installation.

2.3.7.4. Operator's cabins are to be of metal and substantial design.

2.3.7.5. Parts of the appliance (running gear, open wire conductors, etc.) which are prone to risk are to be competently guarded.

2.3.8. Structural calculation

2.3.8.1. Dead loads and live loads are the responsibility of the designer.

The operating load is not to be taken less than 400 kg/m

Environmental conditions to be considered are similar to those considered for main structures.

2.3.9. Means of access

2.3.9.1. As per the requirements laid out in 2.3.9 access ways are to be designed.

2.3.9.2. At mid span, handrails are to stand firm up to a load of 75 kg.

2.3.9.3. For lifting appliances intended for use in offshore conditions, handrails are to be fitted with two (2) intermediate handrails and also the height of the foot plate is not to be less than 150mm.

2.3.9.4. A free distance of at least 0.60 m is to be left between lifting appliances and surrounding buildings of the supporting installation, as and when they move or rotate.

In cases when this last provision cannot be fulfilled, access to such open spaces is to be prevented.

2.3.10. Operator's cabin

2.3.10.1 On deck cranes an operator's cabin shall normally be required. This may also apply to other types of cranes. National authorities may require a cabin on cranes for the protection of the operator against noise and weather

.

2.3.10.2 If required or fitted, the cabin shall comply the following:

— adequate size and protection against weather and other environmental exposure.
— provision for the operator an adequate view of the area of operation including hook and hook position.
— Have windows capable of being readily and safely cleaned inside and outside and to have defrosting and
defogging means. Outdoor cranes shall have windscreen wipers fitted to all windows necessary for the crane operator's free view when operating the crane.
— well tempered (heated, cooled) and ventilated according to local conditions.
— Be of fireproof construction, have doors that shall be readily opened from both inside and outside.
— In the case of a derrick crane access/exit shall not be obstructed by any boom elevation.
— Noise and vibration shall remain within acceptable limits.
— Have a comfortable and purpose-designed seat from which all operations can easily be controlled. Foot rests shall be arranged where necessary.
— Have the crane controls marked and lit to show their respective function.

note:
It is recommended that the design complies with international recognized standard/code (i.e. EN-13557).

2.4. Derrick Systems

For derrick systems, in addition to the requirements of [6.2.1], the following drawings, documents and information are to be submitted:

• the minimum topping angle of the derrick booms is to be mentioned on forces diagrams for approval
- Construction drawings of the masts (derrick posts) giving every detail needed to check their scantlings.
For complicated type structures, relevant computerized calculations shall be required.
- Construction drawings of the derrick booms.
- Drawings of structural parts of structure carrying the luffing tackle and the hinged pin of the boom, boom structure, structure of mast

2.4.1 Derrick systems Types and parts described as follows

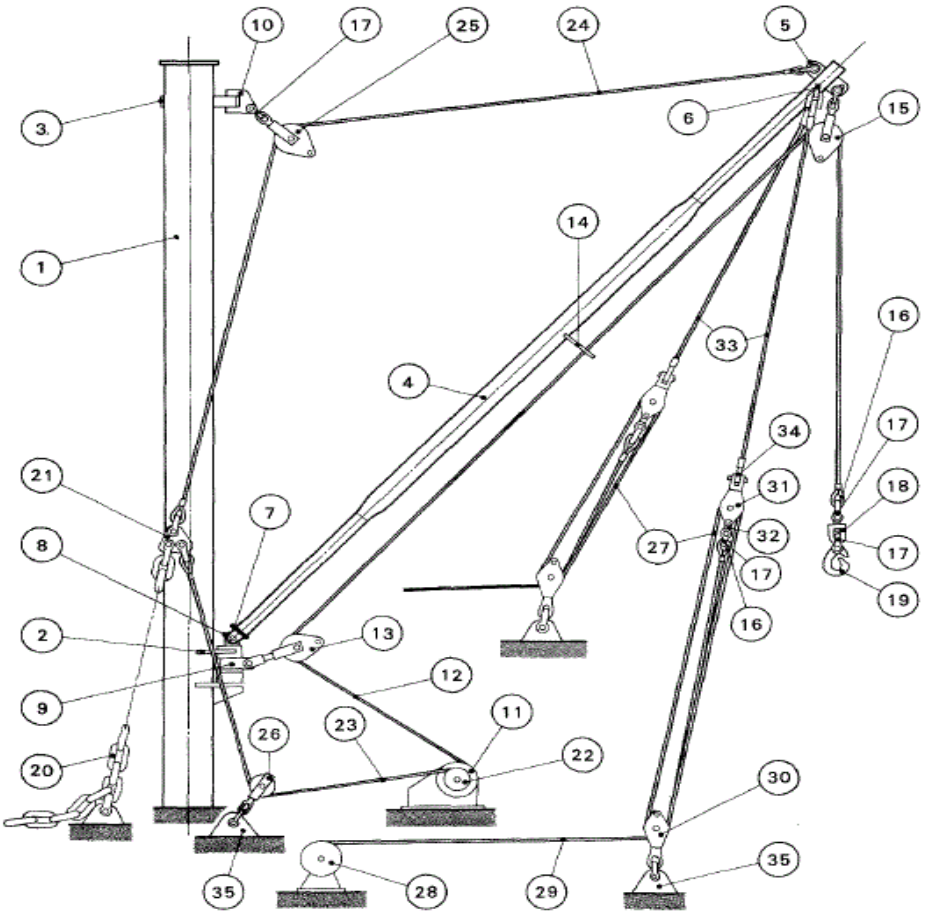
1. Derrick rig for light lifting loads

2. Derrick rig for medium lifting loads

3. Twin span tackle derrick for heavy loads

4. Union purchase rig arrangement

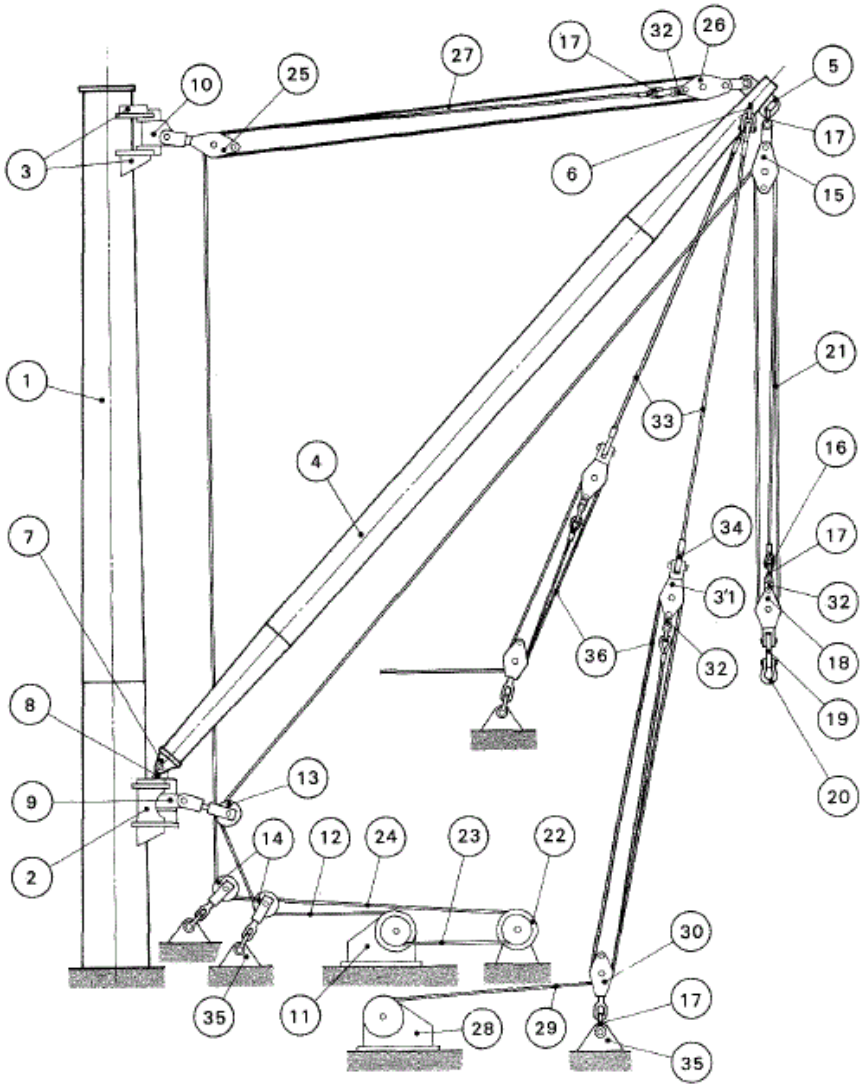
1.Derrick rig for light lifting loads



Parts Table: Derrick rig for light lifting loads

1	Mast (or derrick post)	13	Derrick heel cargo lead	25	Mast head span block
2	Gooseneck seating (or gooseneck bearing bracket)	14	Cargo runner guide	26	Deck topping lead block (may be a snatch block)
3	Mast head span bearing	15	Derrick head cargo block	27	Slewing guy tackles (or
4	Derrick boom	16	Thimble (heart thimble)	28	slewing winch (or guy
5	Derrick head fitting for cargo block and span rope	17	Shackle	29	Slewing guy rope
6	Derrick head slewing guy	18	Swivel	30	Lower slewing guy block
7	Derrick heel fitting	19	Cargo hook (D-hook or Liverpool hook)	31	Upper slewing guy block
8	Gooseneck	20	Span chain	32	Becket
9	Derrick heel cargo lead block bearing	21	Topping triangle plate	33	Slewing guy pendants (or gang pen- dants)
10	Span trunnion	22	De-clutchable cargo winch warping end (used for	34	Thimble (solid thimble)
11	Cargo winch	23	Topping rope (not used	35	Deck eye plates
12	Cargo runner (or cargo rope, or hoisting rope, or lifting rope, or cargo fall)	24	Fixed (or standing) span rope		

2 Derrick rig for medium lifting loads

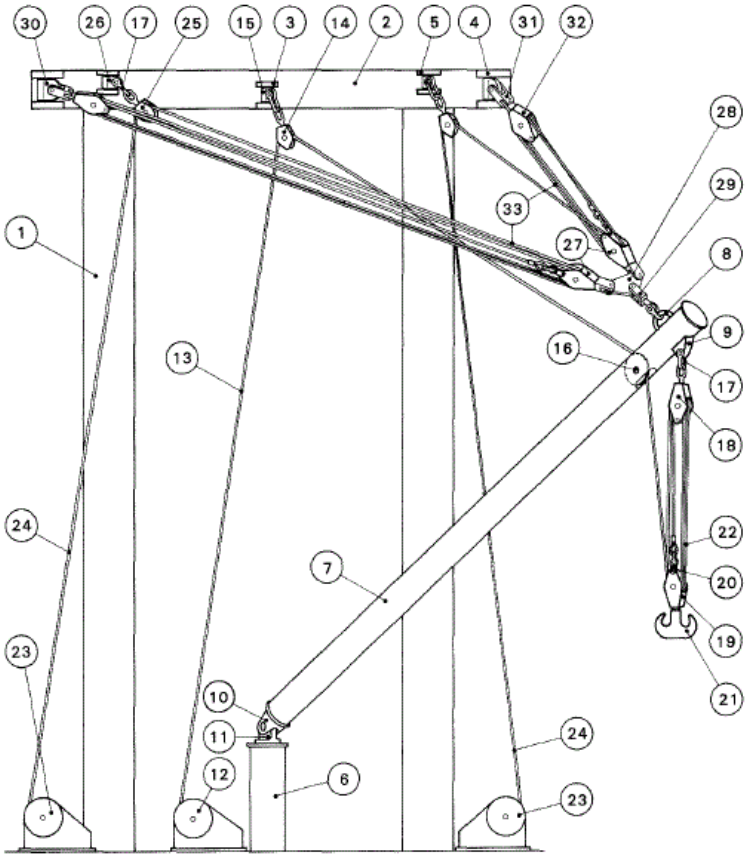


Derrick rig for medium lifting loads

1	Mast (or derrick post)	13	Derrick heel cargo lead block	25	Mast head span (purchase) block (or
2	Gooseneck seating (or gooseneck bearing	14	Deck lead blocks	26	Derrick head span (purchase) block (or
3	Mast head span bearing bracket	15	Upper cargo (purchase) block (or derrick head	27	Span tackle
4	Derrick boom	16	Thimble (heart thimble)	28	Slewing winch (or guy
5	Derrick head fitting for cargo block and span	17	Shackle	29	Slewing guy rope
6	Derrick head slewing guy fitting	18	Lower cargo clock (or lower cargo purchase	30	Lower slewing guy block
7	Derrick heel fitting	19	Link eye plate	31	Upper slewing guy block
8	Gooseneck	20	Bow shackle (or cargo	32	Becket
9	Derrick heel cargo lead block bear- ing	21	Cargo tackle	33	Slewing guy pendants (or gang pen- dants)

10	Span trunnion	22	Indirectly powered topping winch (not used	34	Thimble (solid thimble)
11	Cargo winch	23	Messenger rope (or topping winch driving	35	Deck eye plates
12	Cargo runner (or cargo rope, or hoisting rope, or lifting rope, or cargo fall)	24	Fixed (or standing) span rope	36	Slewing guy tackles (or gang tackles)

3. Twin span tackle derrick for heavy loads

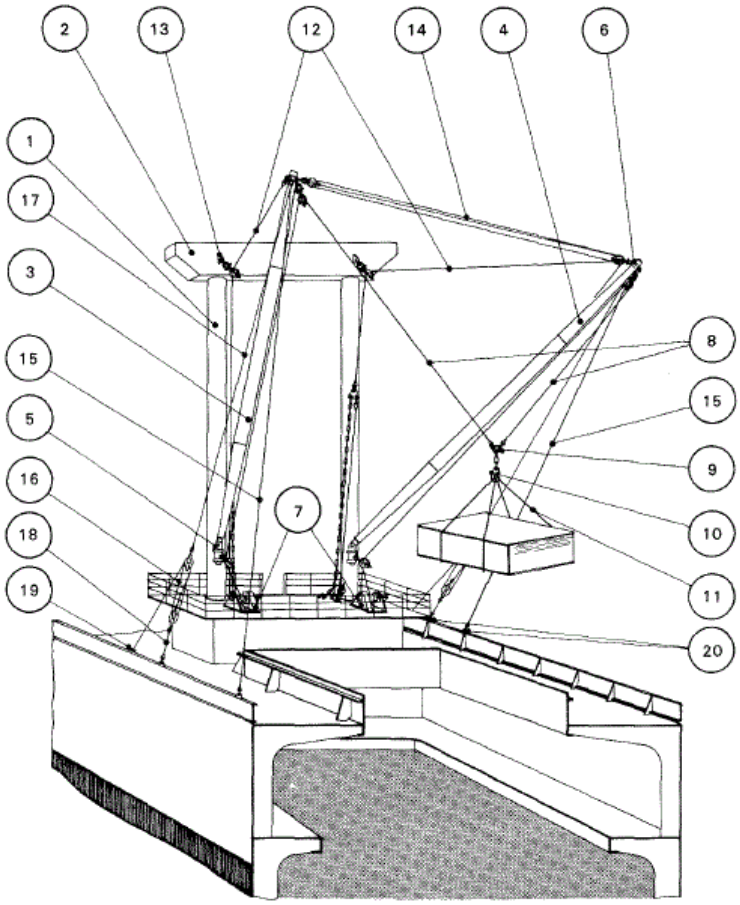


Parts Table : Twin span tackle derrick for heavy loads

1	Portal mast (or portal derrick post)	12	Cargo winch	23	Span winches (used also for slewing motions)
2	Cross tree (or upper transverse beam	13	Cargo runner (or cargo rope, or hoisting rope, or lifting rope, or cargo fall)	24	Span ropes
3	Mast head cargo lead block bearing bracket	14	Mast head cargo lead block	25	Mast head span lead block
4	Mast head span bearing	15	Cargo lead block trunnion	26	Span lead block trunnion
5	Mast head span lead block bearing bracket	16	Derrick head built-in sheave	27	Derrick head span (purchase) block (or lower

6	King post	17	shackles	28	Span triangle plate
7	Heavy derrick boom	18	Upper cargo (purchase) block (or derrick head cargo	29	Swivel
8	Derrick head span fitting	19	Lower cargo block (or lower cargo purchase	30	Span block trunnion
9	Derrick head cargo fitting	20	Becket	31	Double connecting fork
10	Derrick heel fitting	21	Ramshorn hook	32	Mast head span (purchase) block (or upper span
11	Gooseneck trunnion	22	Cargo tackle	33	Span/slewing tackles

4. Union purchase rig arrangement



Parts Table : Union purchase rig arrangement

1	Portal mast (or portal derrick	8	Cargo runners (or married	15	Preventer (or standing) guys
2	Cross tree (or upper	9	Cargo triangle plate	16	Slewing guy tackles (or vang
3	Derrick boom positioned over the hatch (inboard boom)	10	Cargo hook	17	Upper slewing guy pendants
4	Derrick boom positioned outside the ship (outboard	11	slings	18	Lower slewing guy pendants
5	Derrick heel gooseneck fitting	12	Fixed (or standing) span	19	Belaying (or horn) cleat

6	Derrick head fitting	13	Mast head span fitting	20	Deck eyeplates
7	Cargo winches	14	Schooner guy tackle (or boom head guy tackle)		

2.5. Special Purpose Cranes

2.5.1 Davits

Davits for non-life saving applications are to meet the applicable requirements for shipboard cranes .When the davit is subjected to dynamic loads due to motion of the vessel/unit or when there may be motion relative to the other vessel/unit during davit operations, then the davit is to meet the applicable requirements for offshore cranes.

2.5.2 Monorail Hoists/Engine Room Overhead Cranes

Monorail hoists/engine room cranes are to meet the applicable requirements for shipboard cranes. When monorail hoists/engine room cranes are subjected to dynamic loads due to motion of the vessel/unit, then they are to meet the applicable requirements for offshore cranes

2.5.3 Provision Cranes

Provision cranes are to meet the applicable requirements for shipboard cranes. When provision cranes are subjected to dynamic loads due to motion of the vessel/unit or when there may be motion relative to the other vessel/unit during crane operations, then they are to meet the applicable requirements for offshore cranes.

2.5.4 Union Purchase

Lifting gear for union purchase is to meet the applicable requirements for shipboard cranes. When union purchase is subjected to dynamic loads due to motion of the vessel/unit or when there may be motion relative to the other vessel/unit during union purchase operations, then the lifting gear is to meet the applicable requirements for offshore cranes .

The safe working load for union purchase should be determined with due regard for the swinging safe working loads for which the individual booms are certified. In no case is the safe working load for union purchase to exceed the safe working load of either of the individual booms and their associated gear for swinging loads. The boom head locations for the certification of union purchase conditions should reflect realistic operating conditions for the particular gear and hatch configuration.

The path of the load hook between booms for analysis and testing is to be a straight line parallel to the deck. The height of the path above the deck is to be the lowest height at which the angle between the cargo runners equals 120 degrees. Where sufficient hook clearance above coamings and bulwarks can be obtained using a lesser height, such a height may be approved. The angle between the cargo runners is not to exceed 120 degrees.

SECTION 3 LOOSE GEARS

Contents

3.1. Loose Gear and Removable Accessories

3.1.1. Definition of loose gear and other removable accessories

3.1.1.1. Loose gear includes all those items which are not permanently attached to the structures of the lifting appliances and which must be separately tested in conformation to the provisions of chapter 4 Section [2.7] of this part. These items may be such that they can be interchanged amongst various apparatus. Following are the items of loose gear:

- blocks
- hooks
- shackles
- swivels
- chains
- triangle plates
- rings
- rigging screws
- slings
- lifting beams
- hand operated tackles with pitched chains, rings, hooks, shackles and swivels permanently attached to other movable items with similar usage as the items listed above.

3.1.1.2. Removable accessories are the ones which are not submitted to individual tests before fitting onboard, for example goosenecks, span trunnions etc.

3.1.2. Materials

3.1.2.1. If construction materials used for making loose accessories are not in conformation to the specification, they must comply with the requirements of some international or national standards or other approved specifications.

For Society's acceptance, the selection of materials shall be submitted.

3.1.2.2. The steel used to make chains for lifting purposes fall into five (5) quality grade marks as depicted in Table2.3.1 as per ISO standard 1834 - 1980.

3.1.2.3. Other loose gear items, whose mean breaking stress cannot be defined, use the quality grade marks are given in Table 2.3.2

Table 2.3.1: Steel quality grade marks of chains for lifting purposes according to ISO 1834 – 1980

Quality grade mark	Steel grade	Mean breaking stress σ_m of a chain sample, in N/mm^2
L	Mild steel	$315 \leq \sigma_m < 400$
M	High tensile steel	$400 \leq \sigma_m < 500$
P	Alloy steel	$500 \leq \sigma_m < 630$
S	Alloy steel	$630 \leq \sigma_m < 800$
T	Alloy steel	$800 \leq \sigma_m < 1000$

Table 2.3.2: Steel quality grade marks of items of loose gear (chains excluded)

Quality grade mark	Steel grade	Tensile strength R, in N/mm^2
L	Mild steel	$\sigma_Y<400$
M	Ordinary steel	$400 \leq \sigma_Y<500$
P	High tensile steel	$500 \leq \sigma_Y<630$
S	Very high tensile steel	$630 \leq \sigma_Y<800$
T	Special steel	$800 \leq \sigma_Y<1000$
V	Special steel	$\sigma_Y \geq 1000$

Note1: These quality grade marks are only defined for marking of items of loose gear as stated in Pt 13 ch 4 Sec1.

3.1.2.4. For materials inspection at works, provisions of Part 9 chapter 4 section [2.3].1of this rule are referred.

3.1.3. Construction

3.1.3.1. The welding of loose gear items used in lifting appliances (in case of welded accessories) is to be as per the provisions of Part 9 chapter 4 section [2.2] of this rule. The inspection of welding is to be made as per the provisions of Part 9 chapter 4 section [2.3.2] and [2.3.5] of this rule.

3.1.3.2. If feasible, loose gear and other accessories are to be so designed and built that they reduce stress concentration factors.

3.1.3.3. Lubrication of all bearings shall be as instructed by the manufacturer.

3.1.3.4. It is recommended that for same items, same dimensions are maintained, as much as possible, irrespective of their position in the rig to facilitate their checking and interchangeability.

After each examination, it must be ascertained that items are used in that position for which they were originally designed.

3.2. Definition of the individual SWL of items

3.2.1. General

3.2.1.1. Loose gear items are to be chosen in conformation to recognized national or international standards.

3.2.1.2. The loose gear items viz.blocks and head fittings, shackles, triangle plates etc. may be calculated using the rules given in Part 9 chapter 2 section [3.3] of this rule.

3.2.2. Definition of the individual SWL

3.2.2.1. As per Part 9 chapter 1 section [3.1.4] of this rule. The SWL (safe working load) of a loose gear item is the maximum mass that it is designed to carry vertically, except for single sheave block whose SWL is defined as indicated in [3.2.2.3], with regard to [3.2.2.2] of this section.

3.2.2.2. It is recommended that SWL of all blocks, especially that of single sheave blocks and associated shackles is determined considering that the hauling part of rope is parallel to other parts even if this theoretical disposition does not exactly correspond to the actual one.

When this recommendation is followed, it is not required that the efficiency of the block is considered before determining its SWL.

Note 1: The SWL of blocks and associated shackles shall be determined on the basis of sectorial composition of forces that is exerted by all rope parts reeved on the block and considering the most unfavorable direction of the hauling part. Attention is drawn to the drawbacks of this procedure in case the direction of the hauling part of rope is modified later (for example, moving of a lead block for reasons of space), and then the SWL of block and associated shackle may become inadequate.

3.2.2.3. Single sheave blocks a)

a) The SWL of a single sheave block (with or without becket) is equal to half the maximum mass that the block is designed to carry vertically, when this mass is attached to the head fitting of the block, as shown in Fig 2.3.1 (a) and Fig 2.3.2 (a).

Note 1: If the recommendation in [3.2.2.2] of this section is not followed, i.e. when the direction of the hauling part of rope is not considered parallel to the other parts of rope, the SWL of a single sheave block is not to be less than half of the maximum load exerted on its head fitting.

Note 2: The head fitting of a block is considered as a part of the block end consequently it is unnecessary to assign an individual SWL. However, it should be kept in mind that this item is to be given scantlings for a load equal to double the SWL of the block, for a single sheave block.

b) For single sheave block without becket, Fig 2.3.1 (b) shows that it is only allowed to lift a mass equal to the SWL of the block, when this mass is attached to one of the ends of the rope fitted to the block and when the hauling part of rope is parallel to the rope part supporting the load.

c) For single sheave block with becket (SWL = P), Fig 2.3.2 (b) illustrates that it is feasible to lift a load equal to 4/3 M, when the load is applied on two parts of the rope reeved on the block and when the hauling part of rope is parallel to the two parts supporting the load. The becket is to be assigned an individual SWL equal to 2/3 P.

Note 3: If the recommendation in [3.2.2.2] is not carried out, that is when the hauling part of rope is not considered parallel to the other parts, the becket is to be assigned a SWL equal to the maximum load exerted by the rope.

Note 4: Attention is drawn to the definitions concerning single sheave blocks with becket which differ from the one of the contemporary Rules.

Consequently, prior to using a single sheave block with becket, it is required to ascertain that the block is suitable for the intended service, by checking using the force diagrams that the maximum force which will be applied to it, is compatible with the test load indicated on the test certificate. A simple check of the SWL stamped on the block is not adequate.

If under national regulations in the country of ship registry, a different definition is in force, this may be used for the latter.

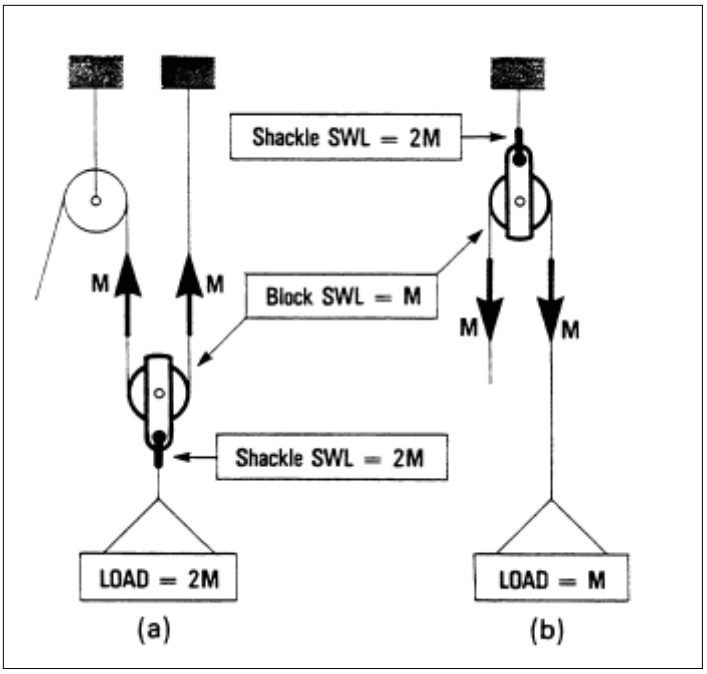


Figure 2.3.1: Load which can be lifted with a single sheave block without becket

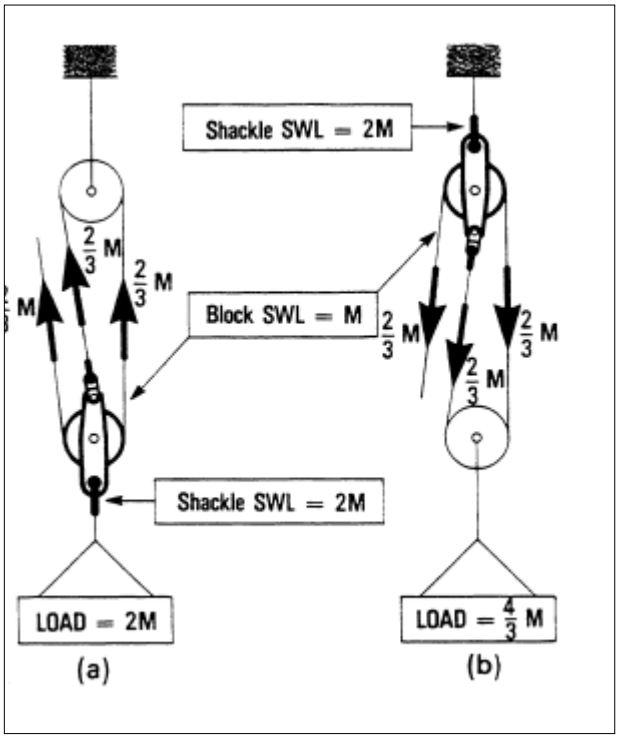


Figure 2.3.2: Load which can be lifted with a single sheave block with becket

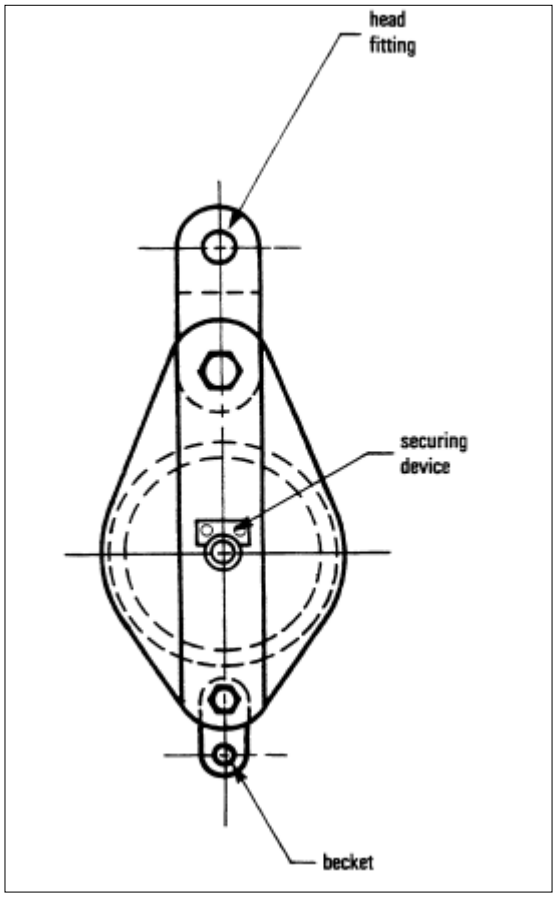


Figure 2.3.3: Blocks

3.2.2.4. The SWL of a multiple sheave block is the maximum resultant load permissible on its head fitting (refer to the recommendation stipulated in [3.2.2.2] in this section.

For multiple sheave block with a becket, an individual SWL is to be assigned to the becket. It is defined, taking into account the efficiency of the sheaves using tension just as defined in Part 9 chapter 3 Table3.4.3 of this rule, in lowering condition.

3.2.2.5. The SWL of a spreader, lifting beam or similar lifting aid is the maximum load that the device is able to lift.

Therefore, these elements are to be only used at full load and on lifting appliances for which the SWL is at least equal to the SWL of the item under consideration and increased by the weight of the lifting beam.

There are lifting beams which may have several SWL corresponding to various different modes of suspending the load and/or corresponding to different lifting systems.

An individual SWL is to be assigned to component items, such as shackles, hooks, rings, chains or slings.

3.3. Items of loose gear

3.3.1. Blocks and head fittings

3.3.1.1. General

The head fittings of blocks may be oval eyes, double lugs, round eyes. For scantling rules, refer to [3.1.2] of this section. The safety coefficient of the different elements constituting the block with regard to the breaking strength is not to be less than 4 when the item is supporting its SWL, as a Rule. For SWL definition, refer to Part 9 chapter 2 section [3.2.2] of this rule.

Some elements (pins, straps bearings, head fittings, etc.), as per Fig 2.3.3 and Fig 2.3.4, may be calculated using rules defined in [3.3.1.3] of this section.

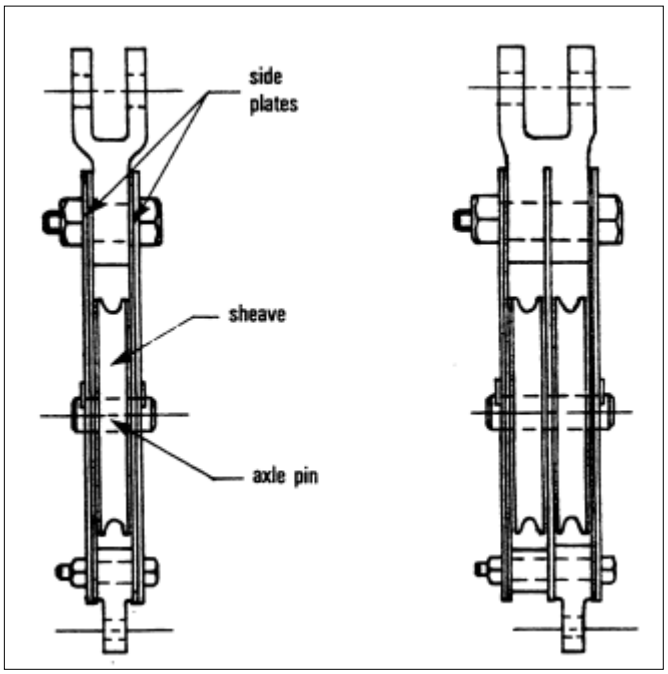


Figure 2.3.4: Blocks

3.3.1.2. Construction

a) Diameter of sheave (measured to the base of the rope groove).

Sheave diameters are depend on rope diameters and the ratio between the sheave diameter and the rope diameter is defined in Part 9 chapter 3 section [4.4.2] of this rule.
For masts and posts with derrick booms put to use in loading and unloading of ships, the sheave diameter is, at least, equal to 14 times the diameter of the wire rope when the wire rope is operated under load.
This ratio is to be at least equal to 9 when the wire rope is not operated under load (e.g. in derrick systems where topping is not adjusted under load).
For blocks used with fiber ropes, the sheave diameter is at least equal to 5 times the diameter of the fiber rope used.

b) Groove of sheaves

The groove must be defect free which is likely to damage ropes. The depth of groove is normally equal to the diameter of the associated rope.
The groove radius must be 8% greater than the radius of the wire rope. Where fiber ropes are used, the groove radius must be at least 8% greater than the radius of the fiber rope and also the sheave's groove depth is not to be less than one third of the diameter of the fiber rope.

c) Axle pins are to be protected against rotation and lateral movement.

d) Blocks must be so designed that ropes do not get jammed between sheaves and don't get slipped off the sheave.

e) Blocks with hook-type head fittings are not permitted.

f) All sheave bearings are to be provided with means for lubrication. Permanently lubricated bearing are exempt from this requirement.

3.3.1.3.Scantling rules

a) In reeving calculations, a loss due to friction of 5% for sheaves with bushed bearings and 2% for sheaves with roller bearings must be considered. (refer Part 9 chapter 3 section 4 of this rule.

b) Sheave bearings
During operations, the radial pressure on the sheave bearings is not to be greater than 0.15 times the yield stress.

c) Sheave axles
Using direct calculations, the sheave axles are calculated. The bending moment is calculated using the formula given below:

$$M_f = \frac{F}{4}\left(s + 2j + \frac{v}{2}\right) 10^{-3}$$

v not taken as greater than 2D.

The shear stress is:

$$\tau = \frac{16F}{3\pi D^2} 10^3$$

where:

s, v, j, D, F: dimensions, in mm, as per Fig 2.3.5

F : Maximum force, in kN, acting on the axle pin in operational condition.
The allowable stresses for the axle pins are:

- Bending stress:

  when F≤ 250: 0.45 σ_Y

  when 250 < F < 1600: $0.45 \left(\frac{F}{0.6\,F+100}\right) \sigma_Y$

when F>1600: 0.68 σ_Y

- Shear stress:

  F < 250: 0.34σ_Y

  250 < F < 1600: 0.36σ_Y

  F ≥ 1600: 0.38σ_Y

  σ_Y is the design yield stress.

The formulae given above are suitable for constructional arrangements, as discussed before and may be applied for items of similar design. However, for special examination by Society, substantially different arrangements are required to be submitted.

d) Side plates of blocks
As a Rule, the mean diametrical bearing pressure of axle pin on the side plates of blocks is not to exceed the yield stress, in test loading conditions (bearing without rotation and secured), where:
F : the tensile force acting on the side plate, in kN
s, b, t : Dimensions in mm, as per Fig 2.3.6.

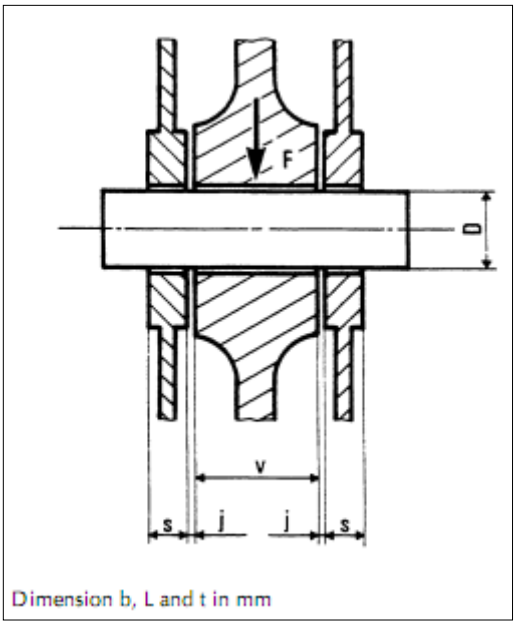


Figure 2.3.5: Axle pin

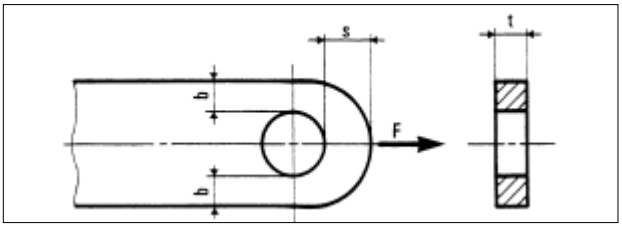


Figure 2.3.6: Hinge

- The tensile stress σ, is equal to:

$$\sigma = \frac{F}{2bt}10^3$$

is to be not greater than: when F ≤ 250: 0.25 σ_Y

when 250 < F < 1600: $0.25\left(\frac{F}{0.6F+100}\right)\sigma_Y$

when F≥1600: 0.38 σ_Y

- The shear stress τ, equal to:

$$\tau = \frac{F}{2st}10^3$$

is to be not greater than:

when F≤250: 0.20 σ_Y

when 250 < F < 1600:

$$0.20\left(\frac{F}{0.6\,F+100}\right)\sigma_Y$$

when F≥1600: 0.30 σ_Y

e) Block head fittings
These are required to meet national or inter-national standards. For guidance, these components can be illustrated in Fig 2.3.7, Fig 2.3.8, Fig 2.3.9 and calculated as follows:

If F is the total tensile force applied to the head fitting, corresponding to its SWL, it can be checked that:

for F 250 kN: D ≥ 4.7 √F
for 250 kN< F < 1600 kN: $D \geq 4.7\sqrt{0.6\,F+100}$

D is the minimum bolt diameter at bottom of threads, in mm:

$$D = D_0 - 1.227\,p$$

where D_o and p are, in mm, the nominal diameter and the thread pitch, respectively.
These formulae are for mild steels. They can be reduced when using high tensile steel, by multiplying the here before formulae by:

$$k = \sqrt{\frac{235}{\sigma_Y}}$$

The design yield stress σ_Y in N/mm, is defined in Part 9 chapter 3 section [4.1.3] of this rule.

Nuts are required to be fitted with competent locking devices and also have dimensions adequate for bolt diameters. The depth of nuts will be almost equal to their diameter.

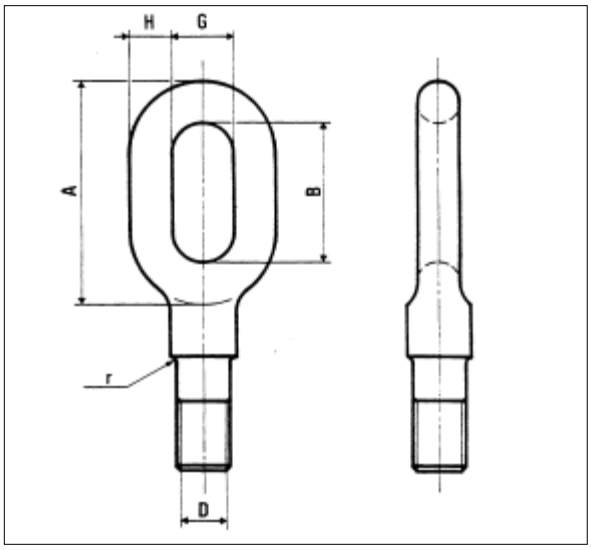


Figure 2.3.7: Oval eye

D : As calculated in this item e)

$$H = 0.8\,k^{2/3}d$$
$$G = 1.1\,d + 4$$
$$B = 3.1\,d + 4$$
$$A = B + 2\,H$$
$$r = 0.15\,d$$

k : Defined in this item (e)

d : Diameter of the associated shackle pin determined as specified in [3.2.6] for mild steel.

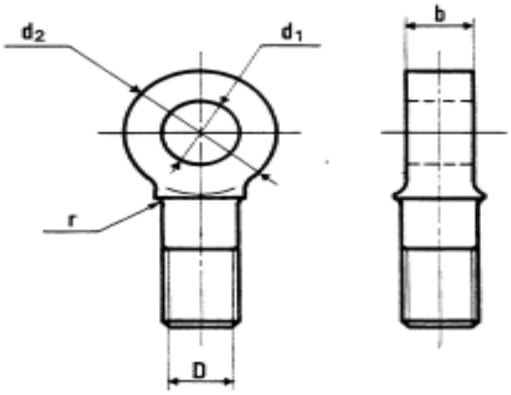


Figure 2.3.8: Round eye

D : As calculated in this item e)

$$d_1 = 1.07\,d + 3$$
$$d_2 = d_1 + kd$$
$$b = kd$$
$$r = 0.15\,d$$

k : Defined in this item e)

d : Diameter of the associated shackle pin determined as specified in [3.3.2.6] for mild steel.

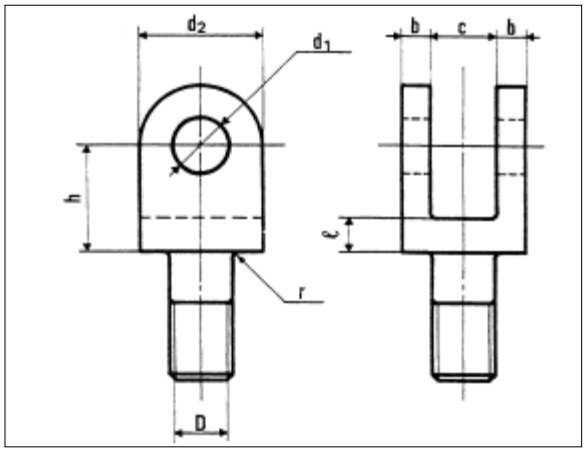


Figure 2.3.9: Double lugs

D : As calculated in this item e)

$$d_1 = 1.07\,d + 3$$
$$d_2 = d_1 + kd$$
$$b = 0.5\,kd$$
$$c = 1.1\,d + 4$$
$$l = 0.6\,k\,d$$
$$h = 1.15\,d + l + 5$$
$$r = 0.15\,d$$

k : Defined in this item e)

d : Diameter of the associated shackle pin determined as specified in 3.3.2.6 for mild steel.

f) Beckets

The beckets as per Fig 2.3.10may be calculated as:

$$d_1 = 1.07\,d + 3$$
$$d_2 = d_1 + kd$$
$$a = k\,d$$

where:

k : Defined in item e)

d : Diameter of the associated shackle pin determined as indicated in [3.3.2.6] for mild steel.

The dimension b is to be as per the breadth of the sheave and at least equal to the value a defined above.

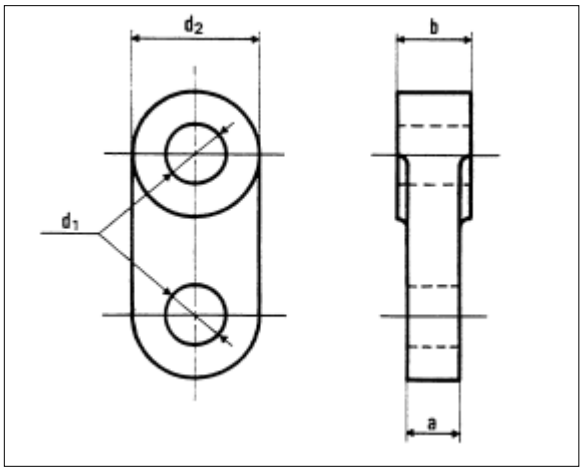


Figure 2.3.10: Beckets

3.3.2. Shackles

3.3.2.1. The SWL is defined in [3.2.2].

3.3.2.2. The pin shall be screwed into the eye of the shackle body or it may have a bolt with head and nut or a pin with a securing pin. Pins must be secured properly.

3.3.2.3. Pins of bolt type should be used for fastening the span blocks, cargo blocks, guy blocks, and also the rope ends to the derrick head fittings, beckets and mast eyes (for stayed masts).

3.3.2.4. Bow shackles may be used as cargo shackles.

3.3.2.5. As a rule, shackles used for cargo hooks and cargo hook swivels should have pins without nuts screwed in the shackle body.

3.3.2.6. The scantlings of the straight shackles and of the bow shackles are given below, where:
F_{shk} : SWF of the shackle, in kN.

a) Straight shackles as per Fig 2.3.11
The following formulae are given for mild steels (σ_Y= 235 N/mm^2)
d : Diameter of the shackle pin, equal to:
when F_{shk} ≤250 kN: $d = 4.4\sqrt{F_{shk}} + 2$
when 250kN < F_{shk} < 1600 kN:

$$d = \left(4.4\sqrt{F_{shk}}\sqrt[3]{0.6 + \frac{100}{F_{shk}}} + 2\right) \times \sqrt{\frac{235}{\sigma_Y}}$$

when F_{shk} ≥1600 kN: $d = 3.9\sqrt{F_{shk}}$
$d_1 = 0.9d$
$a = 1.4d$ (see 3.3.2.7 of this section)
$b = 3.6d$
$d_2 = 1.01\,d + 1$
$d_3 = 2d$
$r = d$
with d, d_1, d_2, d_3, a, b and r in mm.

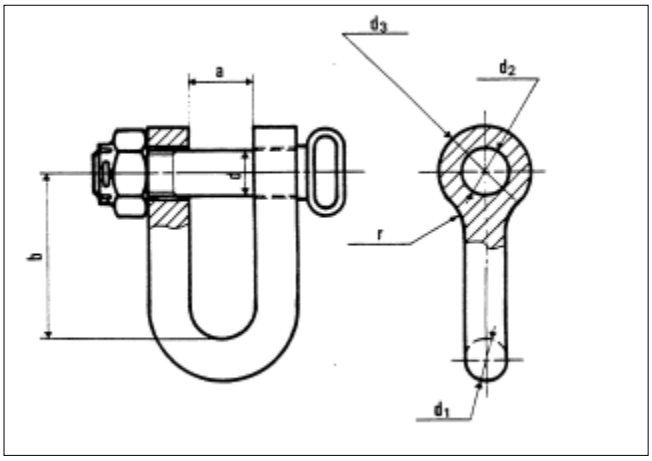


Figure 2.3.11: Straight shackle

b) Bow shackles as per Fig 2.3.12

The formulae given below are given for mild steels (σ_Y=235N/mm^2):

d :Diameter of the shackle pin, equal to values given in a) above for straight shackles

$d_1 = d$

$a = 1.4d$ (see 3.3.2.7 of this section)

$b = 4d$

$d_2 = 1.01d + 1$

$d_3 = 2d$

$r = d$

$r_1 = 0.8a$ (see 3.3.2.8 of this section)

$r_2 = r_1 + d_1$

With d,d_1,d_2,d_3,a,b,r,r_1 and r_2 in mm.

When using high tensile steel, values d,d_1,d_2 and d_3 may be reduced in the proportion$(235/\sigma_Y)^{1/3}$

The design yield stress σ_Y, in N/mm^2, is defined in Part 9 chapter 3 section [4.1.3] of this rule.

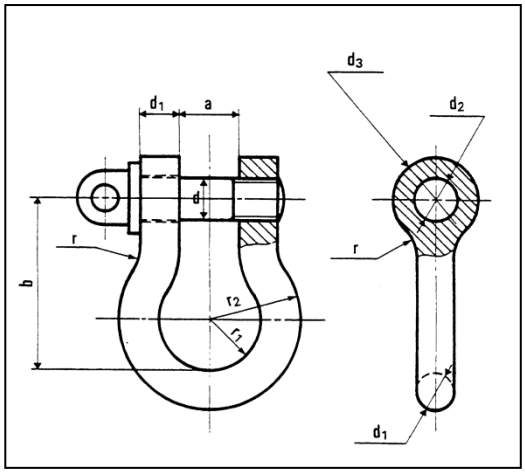


Figure 2.3.12: Bow shackles

3.3.2.7. When the width of jaw is greater than the value a given in [3.3.2.6] of this section (a>1.4d),the diameter d of the shackle pin, determined as in [3.3.2.6] of this section is to be increased in the proportion$(a/1{,}4d)^{1/3}$.

One can determine other shackle dimensions using the formulae given in [3.3.2.6] of this section in terms of the increased diameter d.

3.3.2.8. When the inside width radius of a bow shackle body is greater than the value $r_1$given in [3.3.2.6] of this section(r_1>0,8a),the diameter $d_1$of the shackle body, determined as in [3.3.2.6] of this section and possibly in [3.3.2.7] of this section, is to be increased in the proportion$(r_1/0{,}8a)^{1/3}$.

3.3.3. Triangle plates

The triangle plates, as per Fig 2.3.13, may be calculated as given below.
F_{tp} : SWF of the triangle plate, in kN
d: Diameter of the associated shackle pin deter-mined as indicated in [3.3.2.6] of this section for mild steel in terms of SWFF.
The formulae are given for mild steels:

$$d_1 = 1.1d + 3a = 0.7d + 2$$

$$b = 2.5d + 20$$

$$r = 0.5d_1 + 0.8d$$

With d,d_1,a,b and r in mm.
When using high tensile steel, the value a may be reduced.

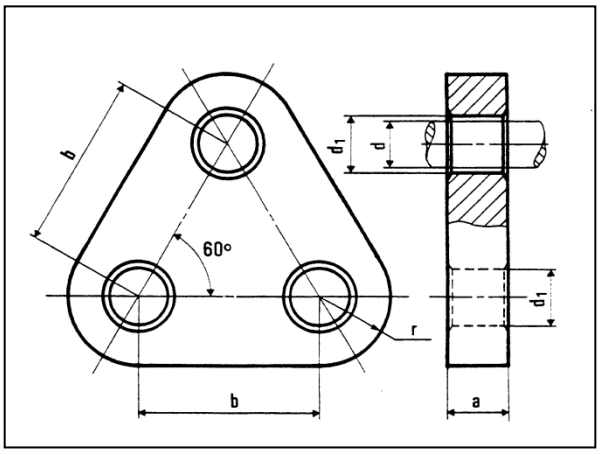


Figure 2.3.13: Triangle plate

3.3.4. Other removable accessories(not submitted to individual tests)

As a Rule, loose accessories not submitted to tests, such as goosenecks, span trunnions, etc., will be chosen as per some national or international standards.

3.4. Lifting beams

3.4.1. General

3.4.1.1. For Society's approval, constructional drawings of lifting beams are to be submitted and that is also required to meeting the requirements of Part 9 chapter 1 section [2.3] of this rule. SWL and test loads are to be illustrated on these drawings.

3.4.1.2. The SWL of a lifting beam is the maximum load that the device is able to lift.

3.4.1.3. As far as possible, it is recommended that loads are uniformly distributed between different lifting points.

3.4.1.4. Steels used in construction are to be indicated on the scantling drawings. They are to meet the requirements of [3.1.3]. Welding and its inspection must meet the requirements of Part 9 chapter 4 section [2.3] to [2.4] of this rule.

3.4.1.5. Lifting beams are to be designed to reduce stress concentration factors.

3.4.2. Determination of scantlings

3.4.2.1. Using direct calculation, lifting beam scantlings are determined considering loads and angles of the slings. If the slings are oblique, the stresses due to the horizontal component are to be combined with bending stresses.

3.4.2.2. The combined stress at any point on the lifting beam is not to exceed the values shown in Table 2.3.3.

The design yield stress σ_Y is defined in Part 9 chapter 3 section [4.1.3.1] of this rule.

3.4.2.3. The strength of lifting beams against buckling is to be justified mainly when used in high tensile steel is used.

For strength verification with respect to buckling of the whole structure, the strength criteria defined in Part 9 chapter 3 section [4.1.3.4] of this rule. Can be applied. For the above mentioned criterion, the coefficient η will be taken equal to σ_a/σ_Y.

For verifications with respect to local buckling, provisions of Part 9 chapter 3 section [4.1.5] of this rule can be applied.

Table 2.3.3: Allowable stresses

SWL of the lifting beam, int	**Allowable stress σ_a**
SWL≤10 10 <SWL<160 SWL≥160	0.40σ (0.002SWL+0.430)σ_Y 0.75 σ_Y

3.5. Ropes

3.5.1. General

3.5.1.1. Application

This deals with the manufacture of the wire and synthetic fiber ropes used in various parts of the cargo gear.

3.5.1.2. General

a) All wire and fiber ropes which are reeved through blocks, wound on winches or belayed on cleats are considered as part of the running rigging even when they are remain unmoved under load.

b) Ropes which are not part of the running rigging such as stays, shrouds, guy pendants and preventer guys, belong to the standing rigging.

c) Lengthening of ropes by splicing or clamps is not allowed ropes are to be made in one continuous length.

d) The diameter of a fiber rope or wire is the diameter of the circumscribed circumference of its cross-section.

e) The utilization coefficient of a wire rope or fiber rope is equal to its actual breaking force (which is to be proved by breaking tests) divided by the maximum tensile force calculated as per the provisions of Part 9 chapter 3 sec 1 to 4 of this rule (taking into account the efficiency of the sheaves and tackles as given in Part 9 chapter 3 sec [1.1.2] of this rule.

f) It is builder's duty and responsibility to select the type of wire ropes or fiber ropes according to the contemplated use, the diameters of the blocks and winch drums, the number of turns on the drums for the lifting appliance as per the instructions of the manufacturer and meeting the requirements and recommendations given herein.

g) Use of wire ropes or fiber ropes, the materials, manufacturing or characteristics of which are not as per the requirements mentioned here shall be accepted subject to special examination by the Society.

3.5.2. Materials and manufacture of steel wire ropes and fiber ropes

3.5.2.1. Steel wire ropes

Steel wire ropes are to meet the requirements of Part 4, chapter 3 section 7

Steel wire ropes and wire locks for cranes shall generally be manufactured and tested in compliance with the requirements stipulated in the following, as well as EN 13414-1 *Steel wire rope slings – Safety* and EN 13411-3 *Terminations for steel wire ropes*, respectively

3.5.2.2. Fiber ropes

Fiber ropes are to meet the requirements of ,Part 4,chapter 3 section 7

3.5.3. Running rigging

3.5.3.1. General

a) It is recommended to use steel regular lay ropes with parallel wires (Seal, Warrington, Filler or Warrington-Seal ropes) for running rigging.

b) The ropes must have at least six strands around a center core usually made of fibers. However, if the rope is to be wound around the winch drum in two, three or more layers, the use of a rope with metal core is recommended.

c) The number of wires in each strand for ropes with fiber core and metal core is not to be less than 19 and 31 respectively.

d) The tensile grades 1570, 1770,1960,2160 are recommended. For ropes with large diameter, the tensile grade1960 shall be used.

3.5.3.2. Safety coefficients

a) Steel wire ropes
The coefficient of utilization η of a wire rope used in running rigging of a lifting appliance of SWLP is not to be less than the value given in Part 9 chapter 3 section [4.4.1] of this rule.

When a lifting appliance has different SWL, for example P_1 and P_2, the breaking force of a steel wire rope used in running rigging of this appliance is not to be less than:

- $\eta_1 T_1$ if the wire rope is stressed by the $SWLP_1$only
- $\eta_2 T_2$ if the wire rope is stressed by the SWL P_2 only
- the greater of the two above mentioned values if the wire rope may be stressed either by the $SWLP_1$or $SWLP_2$, unsimultaneously
- $\eta_2(T_1+T_2$ if the wire rope may be stressed simultaneously by the $SWLP_1$ and P_2, in considering $P_2 \geq P_1$

3.5.3.3. Cargo runners

a) The cargo runners should have steel regular lay ropes.
b) The use of Lang lay ropes with one layer of strands only is not permitted.
c) Preformed wire ropes are not to be used for single rope lifting.
d) Only if mandatory, non-rotating ropes are to be used (see Part 9 Ch 4 section [2.5.2] of this rule.
e) The length of the cargo runner is to be adequate to allow the appliance to lower the cargo down to the bottom of the hold and also to the sea level, the crane jib being at the maximum authorized topping angle. In such conditions, at least three (3) safety turns of rope are to be wound on the cargo winch drum.

3.5.3.4. Span ropes

a) The span tackle ropes must have steel wire ropes.
b) The length of the span tackle rope is to be such that, when the crane is at its maximum outreach position, at least three (3) safety turns of rope are required to be wound on the span winch drum. In stowed position, two (2) safety turns are adequate.

3.5.3.5. Slewing guy ropes

For higher forces, steel wire ropes are used. However, synthetic fiber ropes may be used in the slewing guy tackles, provided slewing winches are not motorized or the force applied on the guy unit does not exceed 40kN.

3.5.4. Wire and fiber rope terminals accessories

3.5.4.1. General
All rope terminations are to be spliced on thimbles or fitted with sockets or equivalent excluding terminations connected to winch drums and belayed over cleats or bollards which may be fitted with packing or with pressed sleeves.

3.5.4.2. Spliced terminal loops

a) The splices of termination loops of wire or fiber ropes are to comprise of at least five tucks out of which three (or four) are to be done with all the strands before cutting half of them; the two(or single)following tucks being done with the half of the remaining strands. The splice terminations are to be strongly tied up by a seizing or by a sleeve.

b) Where cable-laid ropes are concerned, specially for the termination loops of single slings, the splices are to be made as per [3.5.4.1] of this section with unit ropes of the cable-laid rope instead of the strands.

c) Terminal loops with splices done using other methods or with pressed sleeves or terminated by a combination of splice and sleeve may be accepted, provided they are equivalent in strength. Breaking tests may be done on a sample of such loops wherein breaking is not to occur under a load lower than 0,9 times the guaranteed breaking load of the wire or fiber rope.

3.5.4.3. Thimbles

a) The thimbles are to meet recognized standards and shall be suited to the diameter and the breaking load of the associated wire or fiber rope. They are to be galvanized also.

b) Solid thimbles are recommended when they are connected with straight pins (e.g. shackle pin).

c) For connection with curved parts (e.g. shackle body), heart-shaped thimbles with open or welded point are recommended..

d) Normally, individual tests of thimbles are not required, provided they meet the requirements laid out for loose gear (see Part 9 chapter 4 Sec [2.7] of this rule).

3.5.4.4. Rope terminations with sockets

a) Terminations of ropes with sockets are to fulfill recognized standards. The safe working force of a socket is not to be lower than the maximum tension determined in the associated fiber rope or wire rope.
Sockets or similar end connections (either through sleeving and/or jamming) which do not meet such standards are to be submitted to the Society for approval. Breaking tests may be done on a sample.

b) The termination sockets are required to be tested just as loose gear (refer Part 9 chapter 4 Sec [2.7] of this rule). If these tests are not done, a breaking test shall be done for one socket of each size to prove that the critical strength of the connection is not less than 0.9 times the required actual breaking force of the associated fiber rope or wire.

3.5.4.5. Clamps

a) The rope termination pressure connections with rope fasteners or other clamps are not allowed in the various parts of the lifting appliances dealt herein, without seeking prior permission of the Society which may require special tests to be done to ascertain the efficiency of the connection.

b) The use of rope fasteners is forbidden to lengthen the rope.

3.5.4.6. Accessories

Accessories for wire or fiber rope connections such as shackles, chains, rings, swivels, beckets, rigging screws, etc. are required to meet the requirements of Sec 5 and are to be tested as specified in Part 9 chapter 4 Sec [2.7] of this rule.

3.5.5. Slings and grommets

3.5.5.1. General

a) Slings of usual type are illustrated in Fig 2.3.14.
b) Special type slings are especially considered by the Society.

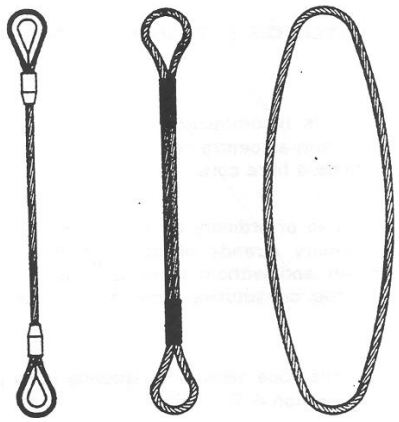


Figure 2.3.14: Usual types of slings

c) The SWL of a sling or grommet is the maximum mass it can carry vertically in a straight line.
d) When they are not used in a straight line, for example to surround a load, the slings and grommets shall not come in contact with sharp edges.
e) The material used, type of slings, its construction and its SWL are to be suitable to the contemplated use and shape of the package to be slung up. To determine the SWL of the sling, the angles formed by the sling and the vertical and the fording radii or the parts of the sling in contact with the slung load are to be taken into consideration.
f) The end loops of the single slings may have heart shaped thimbles or solid thimbles. When the loops don't have thimbles, they are not to be connected to pins of diameter lower than the diameter of the wire rope or cable-laid wire rope forming the sling.

- The double slings and grommets end loops are not to pass on pins with diameter less than six (6) times the diameter of the constitutive wire rope or cable-laid wire rope.

- Their other parts are not to be folded on pins of diameter lower than four (4) times the diameter of the constitutive wire rope or cable- laid wire rope. Moreover, the double slings are to be bent only in the plane perpendicular to the plane of the end loops.

When any of the two requirements given above are not met, the slings or grommets used are to have a SWL higher than the one resulting from the force diagram to compensate for the strength loss due to bending.

g) Slings and grommets are considered as loose gear and are therefore tested separately to meet the requirements in Part 9 chapter 4 Sec [2.7] of this rule.

3.5.5.2. Materials and construction

a) Slings intended to be bent around a load or pin are to be of flexible construction. They may be made of fiber ropes, wire ropes or cable-laid ropes (cable-laid rope is a lay rope obtained by closing six (6) unit ropes around a seventh one or, more scarcely, around a fiber core), these latter ropes fulfilling the requirements of Part 9 chapter 2 Sec [3.5.2.1] and [3.5.2.2] or as applicable.
b) When the slings or grommets have single wire rope, usually the rope is to be of the lay type with 6 or 8 strands including at least 19 wires and laid around a metal or fiber core.
c) The single slings of heavy SWL may comprise of cable-laid ropes made of 6 ropes of regular lay or Land lay type. If the diameter is same, the use of Lang lay ropes for making of cable-laid ropes is recommended due to their greater flexibility.
d) Grommet lay, i.e. a single strand turned six (6) times upon itself (or of a single rope to make a cable-laid rope) are to be used to make double slings and grommets to obtain so-called invisible splices. In such a case, it is to be noted that the strand forming the center core (or the center rope when a cable-laid rope is concerned) is discontinuous and is not to take into account determination of the breaking load. The place where the ends or the metal core are butted together is to be located on the grommet opposite to where the ends of the strand (or rope) are inserted inside the cable-laid rope. To prevent the grommets from being bent in way of these weak points, these sites are to be marked.
Core is to be butted and ends of strand (or rope) inserted near seizing of end loops of double slings (refer Fig 2.3.15).

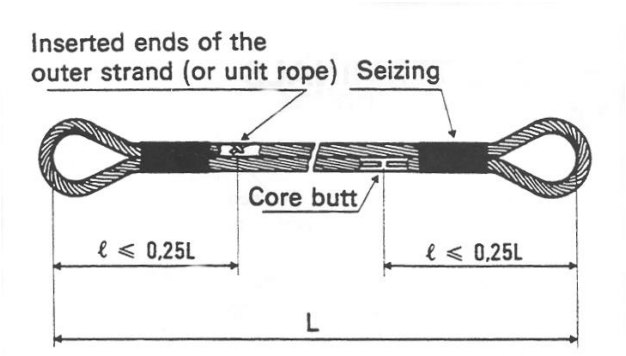


Figure2.3.15: Double sling

a) Splices of end loops of single slings are to meet the requirements of [3.5.5.2] of this section.

3.5.5.3. SWL and utilization coefficients

a) The SWL of a single sling comprised of wire rope, fiber rope or cable-laid rope is not to be greater than the guaranteed breaking load (proved by a test on a sample) of the constitutive wire ropes divided by the utilization coefficient η as per [3.5.5.3] (d) or (e) of this section for a wire or fiber sling respectively.

When the breaking load of a cable-laid rope cannot be proved by a breaking test on a sample of the completed cable-laid rope, its breaking load shall be considered equal to 0,85 times the total of the guaranteed breaking loads of the constituent wire ropes. Breaking tests are to prove these guaranteed breaking loads (the coefficient 0,85 represents the strength loss due to spinning of the cable-laid rope).

b) The SWL of a double sling or of a grommet as per Part 9 chapter 2 section [3.5.5.2] (d) of this rule (grommet lay) is to be considered equal to 10 times the breaking load of the outer strand or rope divided by the utilization coefficient η as per [3.5.5.3] (d) or e) of this section for a steel or fiber sling, respectively (coefficient 10 considers the strength loss due to spinning and to grommet lay).

c) SWL of slings or grommets the making of which does not conform to the requirements given herein will be specially considered by the Society.

d) The utilization coefficient η of slings or grommets made of steel wires, with respect to their SWL Q, is depicted in Table 2.3.4.

e) The utilization coefficient η of fiber slings or grommets, with respect to their diameter φ and their SWL Q, is depicted in Table 2.3.4.

Table 2.3.4: Utilization coefficients of steel slings

P =SWL,int	P≤25	25 <P<150	P ≥150
η	5	$3+\frac{50}{P}$	3,33

Table 2.3.5: Utilization coefficients of fiber slings

ϕ=sling diameter, in mm	ϕ< 24	24 ≤ϕ <40	ϕ≥40		
Q =SWL, int	Q ≤25			25<Q< 150	Q ≥150
η	8	7	6	$3.6+\frac{60}{Q}$	4

CHAPTER 3 DESIGN CALCULATIONS

CONTENTS

SECTION 1 GENERAL INFORMATION

Contents

1.1. Definition

1.1.1. General

1.1.1.1. The calculation of the scantlings of shipboard lifting appliances is to be made considering the static and dynamic loads applied under contemplated operating conditions.

1.1.1.2. Considering the forces due to the following, strength calculations of the various components of cranes are to be made:

- SWL as per chapter 1 section [3.1] of this part increased by the permanent attachments and dead weight of the lower purchase block and provided to hook loads (shackle, hook, permanent lifting beam, spreader or similar lifting aid, etc.)
- dead weight of structure and accessories of the crane
- ship's static list and trim
- ship's dynamic list in operating conditions
- dynamic amplification factor due to operating conditions
- vertical dynamic effect due to hoisting of load (the effects of vertical accelerations due to lifting motions and of vertical oscillations due to snatch and putting down of load are assumed to be included in the vertical dynamic effect)
- Plus, depending on the type of appliance, other significant effects are to be considered (for e.g. horizontal tangential acceleration due to slewing motion).
- For slewing crane, radial (centrifugal) acceleration due to slewing motion shall be disregarded.

1.1.1.3. Main characteristics of cranes and their operating conditions are to be specified, especially:

- Depending on kind and rate of service contemplated, duty category
- SWL or diagram of lifting capacity according to jib radius
- Maximum permissible trim and list angles
- dead weight of crane component parts and their respective centers of gravity, in particular weight of lower purchase block and hook, weight of crane jib and weight distribution over jib length, weight of counter-balance, if applicable, and crane's total weight
- hoisting speed
- horizontal tangential acceleration at jib head with crane at maximum radius due to slewing motion, or, alternatively, angular slewing speed and minimum braking time
- maximum wind speed authorized during operation
- type of block sheaves (sheaves with plain or roller bearings)
- dynamic amplification factor.

1.1.1.4. To determine the maximum forces in hoisting and topping ropes, the efficiency of sheaves and tackles shall be considered as per the requirements of [3.2.1.2] and [3.2.1.3] of this chapter.

1.1.2. Duty categories

1.1.2.1. Depending on the nature of their duty and the operational rate, the Lifting appliances are divided in the following four categories:

- **Category I**: these appliances are very seldom used at their nominal capacity for instance, the cranes intended for the handling of spare parts, stores or equipment and appliances intended for the handling of flexible hoses onboard oil tankers or for discharging equipment onboard gas carriers

- **Category II**: these appliances are regularly used for loading and unloading cargoes and are operated at less than 75% of their nominal capacity, e.g. multi-purpose cranes
- **Category III**: these appliances are extensively used for loads approaching their maximum capacity, such as those intended for the handling of containers when their lifting capacity is approximately same as that of the weight of containers that it handles
- **Category IV**: these appliances are used in grab application for handling loose or granulated products.

1.1.2.2. During calculations, the nature and the intensity of intended crane duty are considered by increasing the loads considered (except wind loads) using coefficient ψ_0 defined in Table 3.1.1 and depending on the duty category as given in [1.1.2.1] of this chapter.

Table 3.1.1: Work Coefficient ψ_0

Duty categories	ψ_0
I	1.00
II	1.06
III	1.12
IV	1.20

1.1.3. Dead weights

1.1.3.1. The dead-weights are considered during calculations are to be given by manufacturers and shipbuilder.

1.1.3.2. For lower capacity lifting appliances, the weight of the cargo tackle may not be considered while determining the maximum tension in the cargo runner.

1.1.4. Secondary structure

Secondary structure (cabins, decks) are to sustain the dead loads, live loads and climatic effects.

Dead loads and live loads are given under the responsibility of the designer.

The operating load on decks or platforms is not to be taken less than 400 kg/m2.
Environmental conditions to be considered are the same as those considered for main structures

SECTION 2 INFLUENCES

Contents

2.1. Influence of Self Motions

2.1.1. Influence of slewing motion of cranes

2.1.1.1. The value of acceleration γ_0, in m/s², at the jib head is derived by the following.

$$\gamma_0 = \frac{2\pi N x_0}{60 t_b}$$

where:
x_0 : Maximum outreach radius, in m, of the crane (see Fig 3.3.1)
N : Maximum slewing speed, in r/min, at maximum radius x_0
t_b : Braking time, in s, of slewing motion when the crane withstands the SWL corresponding to radius x_0
Acceleration γ_{Gi} affecting jib dead weight may be determined as follow for the radius $x_i = x_1$

$$\gamma_{Gi} = \gamma_0 \frac{X_i}{X_0}$$

where x_i is the distance, in m, between the center of gravity of the dead weight of the item and the vertical crane axis (refer Fig 3.3.1).

2.2. Influence of External conditions (Two Condition)

2.2.1. The influence of external conditions experienced by the Lifting appliances and its hull structures shall be categories as.

- effect of dead weights due to ship motion (roll and pitch)
- effect of loads due to environmental conditions (sea states)
- effect of wind force on structure of lifting appliances

SECTION 3 DESIGN LOAD

Contents

3.1. Standard loading conditions

3.1.1. Design loading

3.1.1.1. On the basis of design loads, structure scantlings and characteristics of cables and loose gears are considered.

3.1.1.2. Directions of forces being considered are defined with respect to a system of orthogonal axes (X, Y, Z) related to the lifting appliance axes X and Z defining longitudinal vertical plane. For instance, in cranes, axes X and Z defines a vertical plane where jib axis is included as illustrated in Figure 3.3.1

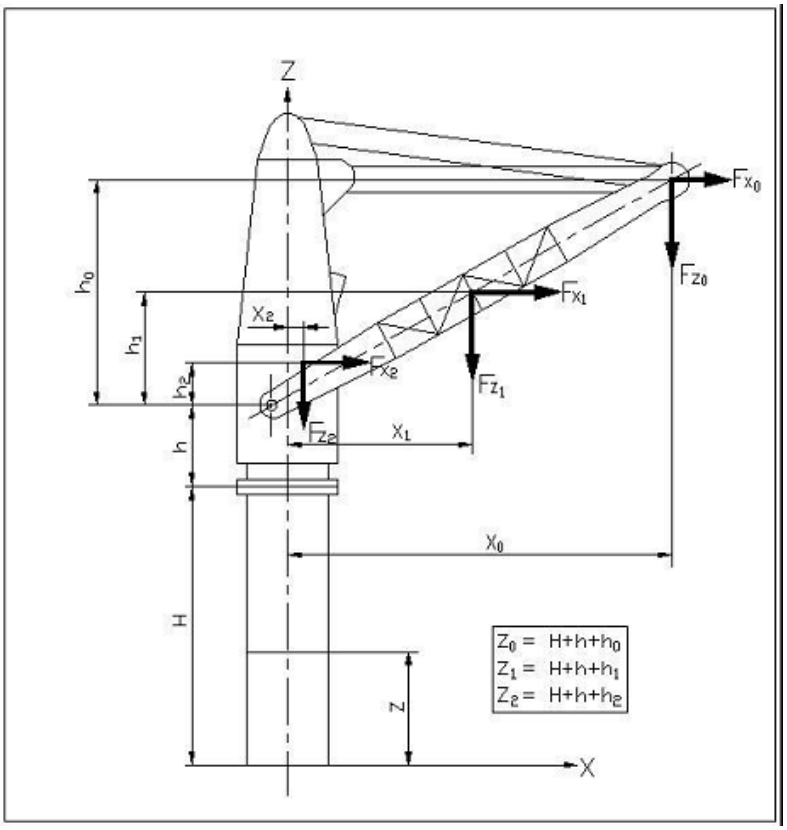


Figure 3.3.1: Main dimensions loads and axes

3.1.1.3. Following four types of forces are to be considered:

- Type F_X, F_{X0} and F_{XI} forces acting along X axis, and respectively applied on hoisted load and on each dead weight
- Type F_Y: F_{Y0} and F_{YI} forces acting along Y axis
- Type F_Z: F_{Z0} and F_{ZI} forces acting along Z axis
- Type F_W: forces due to maximum permissible wind in operating condition, may be evaluated as per [4.2] of this chapter.

3.1.1.4. The critical forces acting on Lifting appliances and associated ship's structure during operations arte given below,

Vertical Load F_{Z0} = $\left\{F_s + g + \left(\frac{M}{A_{WP}}\right) S_{dkv}\right\} k$

Horizontal Load F_{X0} = $(F_s + G_0)\left(\frac{2\pi}{60}\right)\left(\frac{N \times X_0}{t}\right)$ for rotating motion

$$= \quad (F_s + G_0)\,\frac{v}{t} \qquad \text{for linear motion}$$

Where.

F_s : safe working force, in kN, corresponding to SWL.
G_0 : forces, in kN, due to weight of cargo purchase for handling of loads.
Δ : moulded displacement, in t, of the vessel in salt water
A_{WP} : water plane area, in m^2, of the vessel at working draught.
S_{dkv} : area of deck, in m^2, under influence of vertical loads.
k = 1 for harbour operations,
= 1.5 for operations out at sea.

3.1.2. Loading condition.

3.1.2.1. It is required to determine the scantlings of crane components taking into account the most severe results of loading conditions defined in Table 3.3.1, under service conditions and with respect to loads as specified in [4.1] of this section.

Table 3.3.1: Loading conditions

Loading case N°	Combination of loads (see note 1)
I_a	$\psi_0 (F_Z+F_X)$
I_b	$\psi_0 (F_Z-F_X)$
(1) for the direction of loads considered, in particular F_X type loads, see Figure 3.3.1..	

3.1.2.2. For each loading condition defined in [4.1.2.1] of this section the efficiency of sheaves and tackles in the hoisting and lowering conditions motions is to be considered. Refer to [1.1.4] of this chapter.

3.1.2.3. When calculations that for the maximum permissible wind in service condition are taken, only loading condition needs to be considered with wind in the same direction as FY type forces, that is, along Y axis.

3.2. Efficiencies of sheaves and tackles

3.2.1. General

3.2.1.1. Application

Efficiency of sheaves and tackles is to be considered to determine the maximum efforts transmitted to the structure at the maximum ropes tensions.

3.2.1.2. Efficiency of sheaves

It is assumed that the for normal-sized sheaves, efficiency coefficient k for sheaves with plain or bushed bearings is equal to 0,95 and for those on ball-bearings or roller-bearings is equal to 0,98 respectively

3.2.1.3. Efficiency of the tackles

a) The efficiency of the tackles depends on the number of parts of rope ‘n’ of the purchase.

Figure 3.3.2(a) and (b) determine the tensions t_0, t_1, ...,t_i, ..., t_{n-1} and tn in each part of rope of the tackle subjected to unit force. All the tackles depicted on these figures have same number of parts of rope 'n' and are equivalent.

b) The tensions t_0, t_i, t_n and t_{n-1} for a tackle with n parts of rope may be derived by applying the following formulae:

- when lowering the load:

$$t_0 = \frac{1-k}{1-k^n}$$
$$t_i = t_0 k^i$$
$$t_n = k^n \frac{1-k}{1-k^n}$$
$$t_{n-1} = \frac{t_n}{k}$$

- when hoisting the load:

$$t_0 = k^{n-1} \frac{1-k}{1-k^n}$$
$$t_i = \frac{t_0}{k^i}$$
$$t_n = \frac{1}{k} \frac{1-k}{1-k^n}$$
$$t_{n-1} = t_n k$$

The formulae giving the tension ti in the rope when a unit force is applied to the tackle remain valid when i > n and allow direct calculation of the rope tension when it is reeved on lead blocks after the tackle. The rope tension at the j^{th} lead block after the tackle is:
when hoisting:
when hoisting:

$$t_{n+j} = \frac{t_0}{k^{n+j}}$$
$$t_{n+j} = t_0 k^{n+j}$$

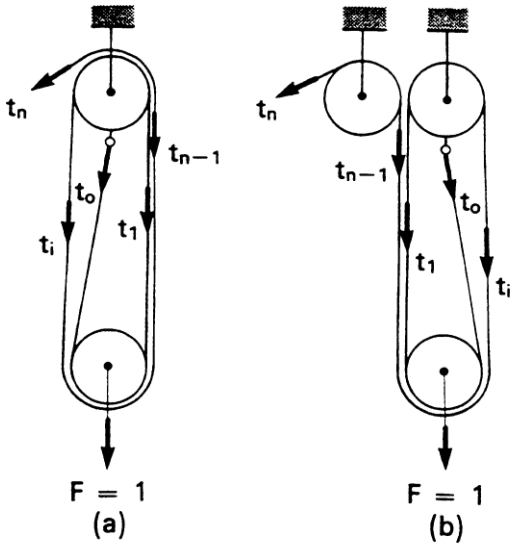


Figure3.3.2: Tension in the rope parts of a tackle

c) Table 3.3.1 gives the values for t_0 , t_{n-1} and t_n, upon hoisting and lowering when a unit force is applied to the tackle.
For a non-unit force F, the rope tensions T_i are:

$$T_i = F\, t_i$$

d) The efficiency of the tackles and lead blocks is to be considered to determine the minimum breaking load of the steel and fiber ropes.

e) Normally, the efficiency of the tackles and lead blocks is considered while determining the SWL of the items of loose gear. However, it may be neglected partially or wholly when its effect is insignificant for choosing standard items of loose gear.

Table 3.3.1: Tension in rope parts of a tackle

Number of parts of rope n	Roller bearing blocks k=0.98						Plain bearing blocks k=0.95					
	Hoisting			Lowering			Hoisting			Lowering		
	t_0	t_{n-1}	t_n	t_0	t_{n-1}	t_n	t_0	t_{n-1}	t_n	t_0	t_{n-1}	t_n
1	-	1.0	1.02	-	1.0	0.98	-	1.0	1.05	-	1.0	0.95
2	0.495	0.505	0.515	0.505	0.495	0.485	0.487	0.513	0.540	0.413	0.487	0.463
3	0.327	0.340	0.347	0.340	0.327	0.320	0.316	0.351	0.369	0.351	0.316	0.301
4	0.242	0.258	0.263	0.258	0.242	0.238	0.231	0.270	0.284	0.270	0.231	0.220
5	0.192	0.208	0.212	0.208	0.192	0.188	0.180	0.221	0.233	0.221	0.180	0.171
6	0.158	0.175	0.189	0.175	0.158	0.155	0.146	0.189	0.199	0.189	0.146	0.139
7	0.134	0.152	0.155	0.152	0.134	0.132	0.122	0.166	0.174	0.166	0.122	0.116
8	0.116	0.134	0.137	0.134	0.116	0.114	0.104	0.149	0.156	0.149	0.104	0.099
9	0.102	0.120	0.123	0.120	0.102	0.100	0.090	0.135	0.142	0.135	0.090	0.085
10	0.091	0.109	0.112	0.109	0.091	0.089	0.079	0.125	0.131	0.125	0.079	0.075
11	0.082	0.100	0.102	0.100	0.082	0.080	0.069	0.116	0.122	0.116	0.069	0.066
12	0.074	0.093	0.095	0.093	0.074	0.073	0.062	0.109	0.114	0.109	0.062	0.059
13	0.068	0.087	0.088	0.087	0.068	0.067	0.055	0.103	0.108	0.103	0.055	0.053
14	0.062	0.081	0.083	0.081	0.062	0.061	0.050	0.098	0.103	0.098	0.050	0.048
15	0.058	0.076	0.078	0.076	0.058	0.056	0.045	0.093	0.098	0.093	0.045	0.043
16	0.053	0.072	0.074	0.072	0.053	0.052	0.041	0.089	0.094	0.089	0.041	0.039
17	0.050	0.069	0.070	00.69	0.050	0.049	0.038	0.086	0.090	0.086	0.038	0.036
18	0.047	0.066	0.067	0.066	0.047	0.046	0.035	0.083	0.087	0.083	0.035	0.033
19	0.044	0.063	0.064	0.063	0.044	0.043	0.032	0.080	0.085	0.080	0.032	0.030
20	0.041	0.060	0.061	0.060	0.041	0.040	0.029	0.078	0.082	0.078	0.029	0.028

SECTION 4 ACCEPTANCE CRIETERIA

Contents

4.1. Stability and strength criteria

4.1.1. General

4.1.1.1. Based on the loads and loading conditions defined in Chapter 2 of this rule, forces and stresses applied on constituent parts of cranes are determined and that is to ascertain safety with respect to the following risks:

- if yield stress of materials used is exceeded.
- crane jib (danger of jack-knifing, i.e. risk of inopportune jib-raising) functional stability
- loss in stability due to overall or local buckling of structures or plates.

4.1.1.2. Structures are safe with respect to risks of excessive yielding and of overall or local buckling. refer [4.1.1.5] of this section. when strength criteria defined in [4.1.3.2] and [4.1.3.3] of this section are met.

4.1.1.3. Structures are safe with respect to local buckling of plate panels when constructional arrangements defined in Chapter 1 section [1.10] of this part are met. If above arrangements are not satisfied, for any reason, safety with regard to local buckling is to be checked as per criteria defined in [4.1.5] of this section.

4.1.1.4. Strength criteria's defined here are applicable only if overall tests of cranes are executed as per provisions of Chapter 4 section 1 and 2 of this part. If severe testing is required by National Authorities, scantlings are to be determined accordingly. In that case, compliance with structural arrangements as per Chapter 2 Section1would not be adequate to guarantee construction safety.

4.1.1.5. It is to be noted that "buckling" refers to beams and is used to indicate the loss of elastic stability of an entire structure but it is also used to indicate the loss of elastic stability of a substructure or a part thereof. For instance, the strength of a crane jib partly made of two separate lattice structures (refer Figure 3.4.1) is to be checked with respect to:

a) buckling of the entire jib structure
b) individual buckling of the sub-structure consisting of one leg, taking into account additional stresses due to the buckling of the entire jib structure
c) local buckling of a constituent member of legs, taking into consideration both the buckling of the entire jib and the buckling of the leg. The compressive stress σ (to be multiplied by the buckling coefficient ω – [4.1.4.3] of this section for the structure "a" of the entire jib is calculated on the basis of the overall compressive force applied on the jib. The compressive stress σ_c for the structure "b" of the jib leg is calculated on the basis of the compressive force applied on the considered jib leg, determined according to the overall compressive force and bending moments applied on the jib, that is, according to the jib heel pin response to the forces applied.

   The compressive stress σ_c for the constituent member "c" is calculated on the basis of the compressive force applied on this member, determined according to the compressive force and bending moments applied on the jib heel.

   The verifications are only indicated as examples and need not be performed unless they are found necessary due to the slenderness ratio of the element concerned and due to the calculated compression stresses.

4.1.2. Functional stability of crane jib

4.1.2.1. The risk of inopportune raising of the crane jib (jack-knifing) exists mainly for cranes in which the lifting rope is reeved in one or several parts of rope between the jib head and the upper part of the crane, thus relieving the luffing force required to maintain the jib in a balanced position in the vertical plane. If there is such a danger, then verifications required in [4.1.2.2] or [4.1.2.3] of this section, as applicable, are to be made.

4.1.2.2. For rope supported jib cranes, it is to be checked that the tension in the luffing tackle remains positive for loading case I_b replacing loading F_{X_0} by loading $F_{X'_0}$so that:

$$F_{X'0} = \left(1 + \frac{0.047}{1.2}\right) F_{X0}$$

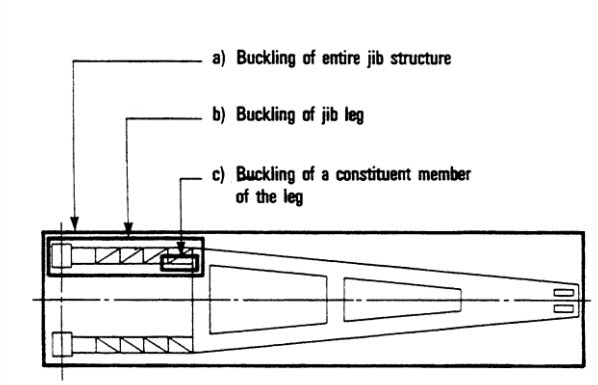


Figure 3.4.1: Verification with respect to buckling

Normally, this calculation is to be made with the jib at the minimum radius (maximum topping angle) and taking into consideration the efficiency of the lifting tackles heaves in the “hoisting” condition.

In a number of special cases, calculations may be required under different conditions to the satisfaction of the Society.

4.1.2.3. For hydraulic jack supported jib cranes it is to be checked, taking into account the requirements of [4.1.2.2] of this section, that the thrust in the luffing jack remains positive. An exemption to this requirement is, however, possible if the shipbuilder can prove that with the existing arrangements there is no danger of jack-knifing of the jib and they are such that if a pulling force is applied to the jack instead of a compressive force, there is no danger of false maneuver.

4.1.3. Strength criteria

4.1.3.1. The following notations are used concerning strength criteria:

a) Stresses, in N/mm^2,calculated in a particular point:
   σ_t: Normal tensile stress due to an overall tensile force($\sigma_t \geq 0$)
   σ_c: Normal compressive stress due to an overall compressive force($\sigma_C \leq 0$)
   σ_f: Normal bending stress due to a bending moment ($\sigma_f \geq 0$ when

tensile stress, $\sigma_f \leq 0$ when compressive stress)

τ: Total tangential shear stresses due to shear forces and torsional moment: $\tau = \tau_X + \tau_Y + \tau_0$

b) Efficiency η, defined as follows:
- for calculation of load carrying structures (crane pedestal excluded):
  η=0.67 for loading conditions specified in Chapter 3 of this part.
  η=0.75 when effects of wind permitted in service are taken into account
- for calculation of crane pedestal refer [4.2.1] of this section.
  η=0.63 for loading conditions specified in Sec 3
  η=0.71 when effects of wind permitted in service are taken into account

c) σ_Y, in N/mm^2, is the design yield, taken equal to:
- $\sigma_Y = \sigma_{Y\,0.2}$ if $\sigma_{Y\,0.2} < 0.7\sigma_Y$
- $\sigma_Y = 0.417\,(\sigma_{Y\,0.2} + R_r)$ if $\sigma_{Y\,0.2} \geq 0.7\sigma_Y$

where $\sigma_{Y\,0,2}$ is the yield stress at 0.2% strain and R_r is the tensile strength.

4.1.3.2. Stresses indicated in [4.1.3.1] of this section are determined by classical calculation methods of strength of materials, within the elastic limit.

4.1.3.3. The following strength criterion is to be complied within each considered cross-section of structures or structure components which are not subject to an overall compressive force:

$$\sqrt{(\sigma_t + \sigma_f)^2 + 3\tau^2} \leq \eta\sigma_Y$$

4.1.3.4. Structure or structural components subject to an overall compressive force are to comply with the following strength criteria at point (s) M corresponding to the middle of the effective length of buckling (see Figure 3.4.3):
- When $\sigma_f \leq 0$ criterion (1)

$$\sqrt{(\omega\sigma_c + \sigma_f)^2 + 3\tau^2} \leq \eta\sigma_Y$$

- When $\sigma_f > 0$ criterion (2)

$$\sqrt{[\sigma_c(2-\omega) + \sigma_f]^2 + 3\tau^2} \leq \eta\sigma_Y$$

$$\sqrt{[\sigma_c(2-\omega) + \sigma_f]^2 + 3\tau^2} \leq \eta\sigma_Y$$

- when $\sigma_f < 0$ criterion (3)

$$\sqrt{\left(\sigma_c\left[1 + \frac{V'}{V}(\omega - 1)\right] + \sigma_f\right)^2 + 3\tau^2} \leq \eta\sigma_Y$$

where:

ω : Buckling coefficient specified in [4.1.4.3] of this section.

v : Distance, in mm, from the neutral axis of the considered cross-section, to the farthest point of the section.

v' Distance, in mm, between neutral axis and the point opposite to the one at distance v (refer Figure 3.4.2).

Verification of criterion (1) is sufficient when the section under consideration is symmetrical with respect to neutral axis or when the bending moment compresses the farthest point at distance v in case of asymmetrical section.

Criteria (2) and (3) are to be checked in case of asymmetrical section only when the bending moment compresses the point at distance v'.(Criterion (1) is then not applicable in such a case). The points of the cross-section (at distance v or v') subject to the combined stress specified by strength criteria (1), (2) or (3) are shown in Figure 3.4.2.

Strength criteria (1), (2) and (3) can be applied at any point at a distance x, in m, from the end of the buckling length (refer Figure 3.4.3) by buckling coefficient of:

$$1 + (\omega - 1)\sin\left|\frac{180x}{l}\right|$$

where:

l : Buckling length, in m. Defined in [4.1.4.1] of this section.

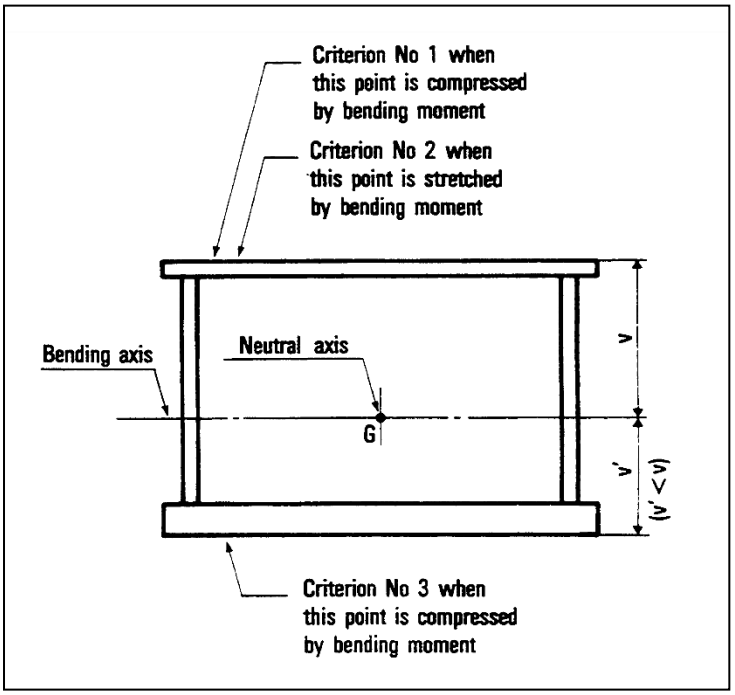


Figure 3.4.2: Asymmetrical cross-section

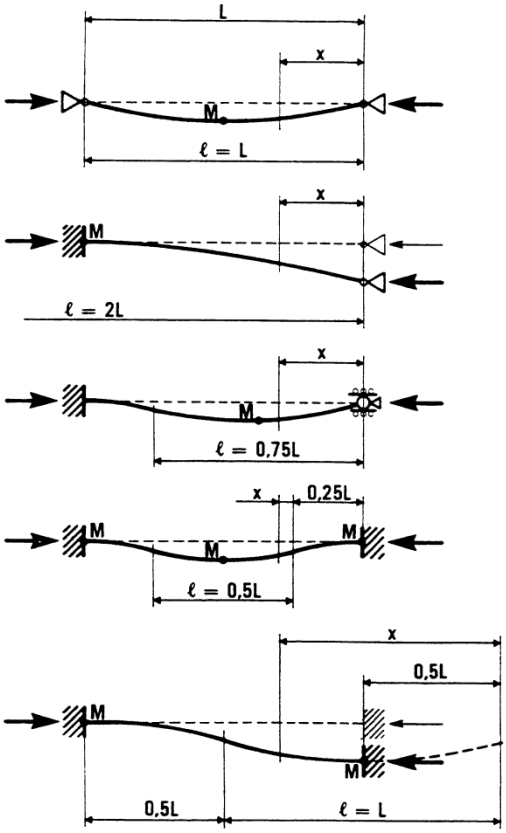


Figure 3.4.3: Effective length of buckling

4.1.4. Buckling coefficient for beams

4.1.4.1. Effective length of buckling

The effective length of buckling l is defined in Figure 3.4.3 with respect to the length L of the component under consideration.

4.1.4.2. Slenderness ratio

Slenderness ratio of the beam is equal to the following value:

$$\lambda = 100l\sqrt{\frac{S}{I}}$$

where:

l : Buckling length, in m, defined in [4.1.4.1]. of this section.

I : Moment of inertia, in cm^4, of the considered cross-section

S : Cross-sectional area, in cm^2.

4.1.4.3. Buckling coefficient

The buckling coefficient ω is determined with the following formula:

$$\omega = B + \sqrt{B^2 - A}$$

Where:

$$A = 112.8x10^{-6}\lambda^2\frac{R_e}{235}$$

$$B = 0.5(A+1) + \xi\left(\sqrt{A} - 0.2\right)$$

with:

σ_Y : Design yield stress, in N/mm^2,defined in [4.1.3.1] of this section.
λ : Slenderness ratio defined in [4.1.4.2] of this section (where λ < 30 $(235/\sigma_Y)^{1/2}$,ω=1maybeapplied)
ζ : 0.1forclosed cross-section beams (tubes. box beams, etc.)
ζ : 0.17 for open cross-section beams (lattice beams, angle bars, I, Tor U-shape sections, etc.).

For convenience, the values of ω for closed cross section beams are listed in Table 3.5.1 and those for open cross-section beams in Table 3.5.2. These ω values are calculated with a slenderness ratio λ‘ corrected according to the yield stress σ_Y of the steel used:

$$\lambda^1 = \lambda \sqrt{\frac{R_e}{235}}$$

4.1.5. Plate panels against buckling

4.1.5.1. As a rule, the verifications of plane plate panels are only required when the constructional arrangements as per Chapter 2 of this rule are not complied with.In such a case, strength against buckling of plane plate panels and of their possible stiffening is to be proved by calculations in accordance with applicable provisions of Part 3 of the Rules for Steel Ships. Strength criteria as defined in Part 3 of the Rules for Steel Ships are to be applied multiplying by 1.20 the determination of stresses σ and τ in the considered element. Any other verification methods in compliance with recognized standards or codes may be accepted by the Society.

4.1.5.2. As a rule, cylindrical plate panels need not to be especially checked. For these plates, the structural arrangements as per chapter 1 section [1.9] of this part are to be complied with.

Table 3.4.1: Buckling coefficient ⌉ for beams with closed cross-section

Corrected slenderness ratio $\lambda'=\lambda(R_e/235)^{1/2}$	Values of ω									
	λ′+0	λ′+1	λ′+2	λ′+3	λ′+4	λ′+5	λ′+6	λ′+7	λ′+8	λ′+9
20	1.003	1.005	1.007	1.009	1.012	1.014	1.017	1.019	1.021	1.024
30	1.026	1.029	1.032	1.034	1.037	1.040	1.043	1.045	1.048	1.051
40	1.054	1.057	1.061	1.064	1.067	1.071	1.074	1.078	1.082	1.086
50	1.090	1.094	1.098	1.102	1.107	1.111	1.116	1.121	1.126	1.131
60	1.136	1.142	1.148	1.154	1.160	1.166	1.173	1.180	1.187	1.194
70	1.202	1.210	1.218	1.226	1.235	1.244	1.254	1.263	1.273	1.284
80	1.295	1.306	1.317	1.329	1.342	1.354	1.367	1.381	1.395	1.409
90	1.424	1.439	1.454	1.470	1.487	1.503	1.521	1.538	1.556	1.575
100	1.593	1.613	1.632	1.652	1.673	1.693	1.714	1.736	1.758	1.780
110	1.803	1.826	1.849	1.873	1.897	1.921	1.946	1.971	1.996	2.022
120	2.048	2.074	2.101	2.128	2.155	2.182	2.210	2.238	2.267	2.296
130	2.325	2.354	2.383	2.413	2.444	2.474	2.505	2.536	2.567	2.599
140	2.630	2.663	2.695	2.728	2.760	2.794	2.827	2.861	2.895	2.929
150	2.963	2.998	3.033	3.068	3.104	3.140	3.176	3.212	3.248	3.285
160	3.322	3.359	3.397	3.435	3.473	3.511	3.549	3.588	3.627	3.666
170	3.706	3.746	3.786	3.826	3.866	3.907	3.948	3.989	4.030	4.072
180	4.114	4.156	4.198	4.241	4.284	4.327	4.370	4.414	4.458	4.502
190	4.546	4.590	4.635	4.680	4.725	4.771	4.816	4.862	4.908	4.955
200	5.001	5.048	5.095	5.143	5.190	5.238	5.286	5.334	5.383	5.432
210	5.480	5.530	5.579	5.629	5.679	5.729	5.779	5.830	5.880	5.931
220	5.983	6.034	6.086	6.138	6.190	6.243	6.295	6.348	6.401	6.455
230	6.508	6.562	6.616	6.670	6.725	6.780	6.835	6.890	6.945	7.001
240	7.057	7.113	7.169	7.226	7.283	7.340	7.397	7.454	7.512	7.570
250	7.628	7.687	7.745	7.804	7.863	7.922	7.982	8.042	8.102	8.162

Note1: Intermediate values can be obtain be by linear interpolation.

Table 3.4.2: Buckling coefficient ω for beams with open cross-section

Corrected slenderness ratio $\lambda'=\lambda(R_e/235)^{1/2}$	Values of ω									
	λ′+0	λ′+1	λ′+2	λ′+3	λ′+4	λ′+5	λ′+6	λ′+7	λ′+8	λ′+9
20	1.004	1.008	1.012	1.016	1.020	1.024	1.028	1.032	1.036	1.041
30	1.045	1.049	1.054	1.058	1.063	1.067	1.072	1.077	1.082	1.087
40	1.092	1.097	1.102	1.108	1.113	1.119	1.125	1.131	1.137	1.143
50	1.149	1.156	1.163	1.170	1.177	1.184	1.191	1.199	1.207	1.215
60	1.223	1.232	1.240	1.249	1.258	1.268	1.277	1.287	1.298	1.308
70	1.319	1.330	1.341	1.353	1.365	1.377	1.390	1.403	1.416	1.429
80	1.443	1.457	1.472	1.487	1.502	1.518	1.534	1.550	1.567	1.583
90	1.601	1.618	1.637	1.655	1.674	1.693	1.712	1.732	1.752	1.772
100	1.793	1.814	1.836	1.858	1.880	1.902	1.925	1.948	1.972	1.996
110	2.020	2.044	2.069	2.094	2.120	2.146	2.172	2.198	2.225	2.252
120	2.279	2.306	2.334	2.362	2.391	2.420	2.449	2.478	2.508	2.538
130	2.568	2.598	2.629	2.660	2.691	2.723	2.755	2.787	2.819	2.852
140	2.885	2.918	2.952	2.986	3.020	3.054	3.088	3.123	3.158	3.194
150	3.229	3.265	3.301	3.338	3.374	3.411	3.448	3.486	3.523	3.561
160	3.599	3.638	3.676	3.715	3.754	3.794	3.834	3.873	3.914	3.954
170	3.995	4.035	4.077	4.118	4.160	4.201	4.244	4.286	4.328	4.371
180	4.414	4.458	4.501	4.545	4.589	4.633	4.678	4.723	4.768	4.813
190	4.858	4.904	4.950	4.996	5.043	5.089	5.136	5.183	5.231	5.278
200	5.326	5.374	5.423	5.471	5.520	5.569	5.618	5.668	5.718	5.768
210	5.818	5.868	5.919	5.970	6.021	6.072	6.124	6.176	6.228	6.280
220	6.333	6.385	6.438	6.492	6.545	6.599	6.653	6.707	6.761	6.816
230	6.871	6.926	6.981	7.037	7.093	7.149	7.205	7.262	7.318	7.375
240	7.432	7.490	7.548	7.605	7.664	7.722	7.781	7.839	7.898	7.958
250	8.017	8.077	8.137	8.197	8.257	8.318	8.379	8.440	8.501	8.563

Note1: Intermediate values can be obtained by linear interpolation.

4.2. Calculations for special components

4.2.1. Crane pedestals

4.2.1.1. Scantlings of crane pedestals are to be determined taking into account the calculated conditions indicated in Chapter 3 of this part and strength criteria in [4.1.3] of this section.
It is to be noted that crane pedestals are, in any case, considered as part of the normal ship classification.

4.2.1.2. Alternatively, it may be verified that any cross-section of the crane pedestal satisfies the following condition

$$1000\left(\frac{M}{W}+\frac{Q}{S}\right)\leq 0.60R_e$$

Z : Bending modulus, in cm^3, of the considered cross-section

S : Cross-sectional area, in mm^2, of the considered cross-section

$$M=\Psi_0\sum_{i=0}^{i=2}[SZ_i x_i+SX_i(z_i-z)]$$

$$Q=\Psi_0\sum_{i=0}^{i=2}SZ_i$$

$\psi_0 FX_i$, FZ_i: Defined in Chapter 3

$x_i z_i$: Distances, in m, defined in Chapter 3,Fig 3.4.1

z : Distance, in m, from the considered cross section to the uppermost supporting deck. This method of verification can only be applied if the height H + h of the crane, in m (refer Chapter 3,Fig 3.4.1), is less than $0.01b(235/\sigma_Y)^{1/2}$, where b, in mm, is the external diameter of the crane pedestal. Other case may be considered especially by the Society.

4.2.2. Slewing rings

4.2.2.1. The scantlings of slewing ring bearings are to be given considered scantlings taking into account the overturning moment M and the compressive force Q calculated as per 4.2.1.2 of this chapter at the ring level in working conditions.

4.2.2.2. It is the responsibility of the crane builder to give an attestation from the ring manufacturer finalizing the maximum permissible values for overturning moment and vertical force in the working conditions. These values are not to be lower than those calculated in [4.2.1.2] of this chapter. The maximum permissible slewing torque is also to be specified.

4.2.3.Holding-down arrangement of cranes

4.2.3.1. The steel quality of bolts used for securing cranes to crane pedestals or for connection of slewing rings is not to be less than grade (property class) 8.8.
The threading of screws is to be formed by rolling. An attestation is to be handed over to the Surveyor certifying that bolts and nuts used are in compliance with recognized national or international standards.

4.2.3.2. The effective cross-sectional area (nominal stress area), in mm^2, of the threaded part of a bolt will be equal to the following value:

$$S_b = \frac{\Pi}{4}(d_b - 0.94)^2$$

where:

d_b : Nominal bolt diameter, in mm

p : Thread pitch, in mm.

If the diameter of the screw body is less than d_b - 0,94p the nominal stress area of the bolt is to be taken as equal to the cross-sectional area of the screw body.
If the thread pitch is not indicated, it is assumed that it is an ISO metric threading complying with the ISO 898/1-1978: Mechanical properties of fasteners - Part I: standard. Bolts, screws and studs, the pitch values (coarse thread) of which are indicated in Table 3.4.3 according to the nominal diameter of the bolt.

Table 3.4.3: ISO metric thread value of thread pitch

Nominal diameter d_b of the bolt, in mm			Thread pitch (coarse thread) p, in mm
10			1.5
12			1.75
14	16		2
18	20		2.5
24	27	22	3
30	33		3.5
36	39		4

4.2.3.3. The nominal stress area S_b, in mm^2, of each bolt is to be not less than the following value refer [4.2.3.2] of this section.

$$S_b = \frac{2150}{nR_e}\left(\frac{4000M}{D_P} - Q\right)$$

where:

M : Maximum overturning moment of the crane, in kN.m, calculated as per [4.2.1.1] or [4.2.1.2] of this section.

Q : Maximum vertical force, in kN, calculated under the same conditions as M

d_p : Pitch circle diameter of bolts, in mm

n : Total number of bolts assumed regularly distributed on the pitch circle diameter D_p

σ_Y : Yield stress of bolts, in N/mm^2 (refer chapter 1 Sec [1.7].1of this part.)

4.2.3.4. The tightening of bolts is to be checked by suitable means and the pre-stress applied is to be between 70% and 80% of the yield stress of the bolts used.
When the tightening is checked by measuring the torque applied, then its value is to be specified. If the value, in daN.m, is not included between the minimum value C_{min} and the maximum value C_{max}, given hereunder, detail explanations may be requested:

$$C_{min} = 0.14\ 10^{-4} S_b D_b R_e$$
$$C_{max} = 0.14\ 10^{-4} S_b D_b R_e$$

where:

S_b : Nominal stress area, in mm^2, of the bolt as per 4.2.3.2 of this section

d_b : Nominal diameter, in mm, of the bolt

σ_Y : Yield stress, in N/mm^2, of the bolt corresponding to its steel quality grade (see chapter 1 Sec 1.6.1of this part.)

The values given above for tightening torques are valid for bolts (screws, nuts and washers) suitably cleaned, without dust or rust, and slightly oiled.

4.2.4. Structural axles and hinges

4.2.4.1. The axles and hinges are calculated by direct calculation so that arrangements may be submitted to the Society for examination.

4.2.4.2. The allowable stresses for axle pins are given in Table 3.4.4

Table 3.4.4: Allowable stresses for axle pins

Allowable stresses, in N/mm^2	
Bending	Shear
$0.65R\sigma_Y$	$0.34\sigma_Y$

4.2.4.3. For simple arrangement, as shown in Figure 3.5.4, the bending moment and shear stress may be calculated as given below:

$$M = \frac{F}{4}\left(s + 2j + \frac{v}{2}\right)10^{-3}$$

$$\tau = \frac{16(8)F}{3\pi D^2}10^3$$

where:

d, v, j, s : Dimensions in mm, as per Fig 3.4.4

F = Maximum force, in kN, acting on the axle pin.

4.2.4.4. The mean diametrical bearing pressure of axle pin on hinges should not exceed the yield stress in test loading conditions of the appliance (bearing without rotation and secured).

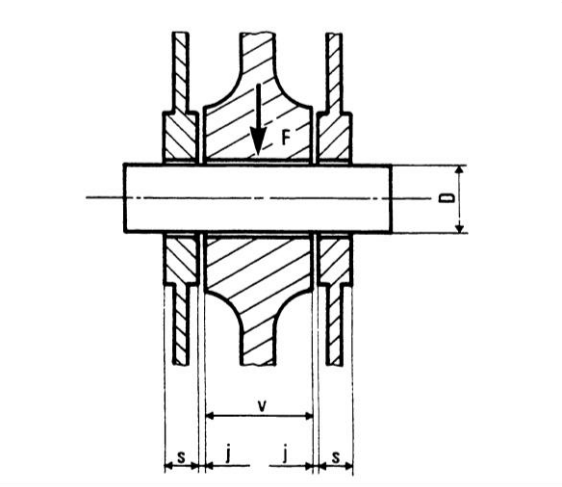


Figure 3.4.4: Axle Pin

4.2.4.5. Tensile stresses σ and τ are equal to:

$$\sigma = \frac{F_h}{2bt} 10^3 < 0.65 R_e$$

$$\tau = \frac{F_h}{2st} 10^3 < 0.34 R_e$$

where:

F_h : Maximum tensile force acting on the hinge, in operational conditions, in kN

s,b,t : Dimensions in mm, as per Fig 3.4.5.

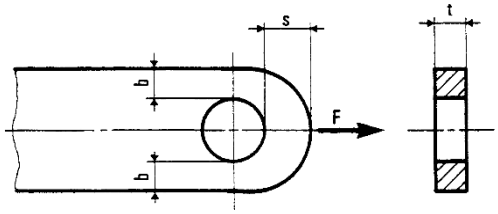


Figure 3.4.5: Hinge

4.2.5. Crane jibs

4.2.5.1. Scantlings of crane jibs are to be checked as per the calculation calculated conditions specified in Chapter 3 of this part and strength criteria specified in [4.1.2] of this section.

4.2.5.2. The risks of buckling of the jib are to be considered on the vertical plan (plane XZ of Chapter 3, Figure3.4.1) and on the plane perpendicular to XZ including the longitudinal axis of the jib.
In the former, jib shall be considered hinge supported at both ends and in the latter, fully constrained (both against rotation and translation) at heel.

4.2.5.3. When the moment of inertia of the jib is not constant, the buckling coefficient ω defined in [4.1.4] of this chapter can be calculated using a fictitious moment of inertia if obtained as follows:

$$l_f = \xi l_m$$

Where:

$$\xi = \xi_a = \left[\left(1-\sqrt{\mu}\right)^2\left(0.0255+\frac{4}{(ln\mu)^2}\right)\right]^q$$

Where $q = (\cos 90v)$

When the jib is as shown in figure (a) of Table 3.4.5

$\xi = \xi_b = (0.210^{-3}+\mu)^q \quad with\ q = 0.27(1-v)^{2.2}$

when the end constraint conditions and form of the jib are as shown in figures (b) or (c) of Table 3.5.5. In these two formulae, the values μ and v are as follows:

$\mu = \frac{l_1}{l_m}$ and $v = \frac{l_m}{L}$

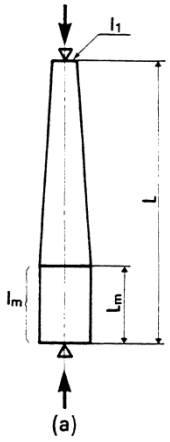
where

l_1 : Moment of inertia, in cm^4, at one end of the jib length L, in m

l_m : Moment of inertia, in cm4, which is considered as constant on jib part of length L_m (refer Table3.5.5).

For both cases considered here before, the numerical values of ξ are given in table with respect to the values of μ and v.

Table 3.4.5: Crane jib with variable inertia - Coefficient ξ

	Jibs as per figure(a)-Values of ξ_a									
μ v	0	0.2	0.4	0.5	0.6	0.7	0.8	0.9	1.0
	0.01	0.173	0.212	0.357	0.479	0.629	0.784	0.911	0.983	1.0
	0.02	0.211	0.254	0.401	0.520	0.663	0.806	0.921	0.985	1.0
	0.03	0.240	0.284	0.431	0.549	0.685	0.820	0.927	0.986	1.0
	0.04	0.263	0.308	0.456	0.571	0.702	0.831	0.932	0.987	1.0
	0.06	0.303	0.348	0.495	0.605	0.729	0.847	0.939	0.988	1.0
	0.08	0.336	0.382	0.526	0.632	0.749	0.859	0.944	0.989	1.0
	0.10	0.365	0.411	0.552	0.654	0.766	0.869	0.948	0.990	1.0
	0.15	0.427	0.472	0.606	0.699	0.798	0.888	0.956	0.992	1.0
	0.20	0.480	0.523	0.649	0.734	0.823	0.903	0.962	0.993	1.0
	0.30	0.570	0.609	0.718	0.789	0.862	0.925	0.971	0.995	1.0
	0.40	0.647	0.681	0.774	0.833	0.891	0.941	0.977	0.996	1.0
	0.50	0.716	0.745	0.822	0.869	0.915	0.955	0.982	0.997	1.0
	0.60	0.780	0.803	0.864	0.901	0.936	0.966	0.987	0.998	1.0
	0.80	0.896	0.907	0.937	0.955	0.971	0.985	0.994	0.999	1.0
	1.00	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0

The slenderness ratio of the jib is calculated by the following formula:

$$\lambda = 100L\frac{S_m}{l_f}$$

where $S_m$is the cross sectional area, in cm^2, of the jib.

4.2.5.4. For calculation of jibs with lattice webs in the buckling plane, distortions due to shear forces are to be considered. In that case, the calculation methods given in 4.2.5.5 to 4.2.5.8 of this section can be applied.

4.2.5.5. Two examples of cross-sections of beams with lattice webs are illustrated in Figure 3.4.6. The longitudinal elements are hereafter called members (elements of cross sectional areas or S).

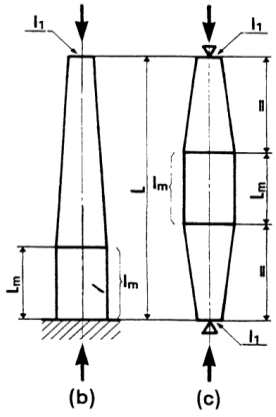
4.2.5.6. The slenderness ratio λ of the entire jib is calculated with the following formula:

$$\lambda = \sqrt{\left(\frac{100l}{r}\right)^2 + 26\frac{S+s}{A}}$$

Where

A : Sectional area, in cm, of the fictitious solid web equivalent to the two lattice webs with regard to jib distortions due to shear forces. Table 3.4.6 gives the value of a, in cm^2, of the area of the fictitious solid web equivalent to the lattice web depending on the type of lattice. Generally, when the jib is made up of two identical lattice webs, A=2a.When the two lattice webs are not identical, $A=a_1+a_2$with $a_1$and $a_2$being the values of a, respectively, for each of the two webs

S, s : Sectional areas, in cm^2, defined by Figure3.4.6

	Jibs as per figure (b)and(c)-Values of ξ_b									
	μ	0	0.2	0.4	0.5	0.6	0.7	0.8	0.9	1.0
	0.01	0.29	0.46	0.66	0.76	0.84	0.91	0.96	0.99	1.0
	0.02	0.34	0.52	0.71	0.79	0.86	0.92	0.97	0.99	1.0
	0.03	0.38	0.56	0.73	0.81	0.88	0.93	0.97	0.99	1.0
	0.04	0.42	0.58	0.75	0.82	0.89	0.94	0.97	0.99	1.0
	0.06	0.46	0.62	0.78	0.84	0.90	0.94	0.97	0.99	1.0
	0.08	0.50	0.65	0.80	0.86	0.91	0.95	0.98	0.99	1.0
	0.10	0.53	0.68	0.81	0.87	0.92	0.95	0.98	0.99	1.0
	0.15	0.59	0.73	0.84	0.89	0.93	0.96	0.98	0.99	1.0
	0.20	0.64	0.76	0.86	0.91	0.94	0.97	0.98	0.99	1.0
	0.30	0.72	0.82	0.90	0.93	0.95	0.97	0.99	0.99	1.0
	0.40	0.78	0.86	0.92	0.94	0.96	0.98	0.99	0.99	1.0
	0.50	0.82	0.89	0.94	0.96	0.97	0.98	0.99	0.99	1.0
	0.60	0.87	0.91	0.95	0.97	0.98	0.99	0.99	0.99	1.0
	0.80	0.94	0.96	0.98	0.98	0.99	0.99	0.99	0.99	1.0
	1.00	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0

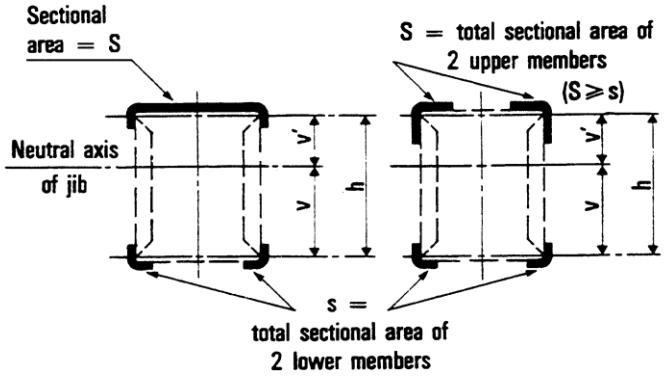


Figure 3.4.6: Cross-sections of beams with lattice webs

l: Effective length of buckling of the jib, in m, corresponding to the buckling plane under consideration (see4.2.5.2 of this section)

r : Radius of gyration of the jib, in cm, equal to:

- when moment of inertia of the jib is constant over its whole length:

$$r = \frac{h}{S+s}\sqrt{Ss}$$

- when moment of inertia of the jib is constant .refer [4.2.5.3] of this section

$$r = \sqrt{\frac{4}{S+s}}$$

h : Factious-height, in cm, of the lattice web equal to the distance between the neutral axes of the members

I_f : Fictitious moment of inertia, in cm^4,calculated as indicated in [4.2.5.3] of this according to the moment of inertia in cm^4

$$l_m = \frac{h^2 Ss}{S+s}$$

Of the jib for the length L_m (see Table 3.4.5).

4.2.5.7. The members are to satisfy the following strength criteria at the middle of the effective buckling length of the jib.

$$\left(\frac{10F_c\omega}{S+s} + \frac{1000M_f}{hs}\right)\omega_s \leq \eta\sigma_Y \text{condition (1)}$$

$$\left(\frac{10F_c(\omega-2)}{S+s} + \frac{1000M_f}{hs}\right) \leq \eta\sigma_Y \text{condition (2)}$$

$$\left(\frac{10F_c}{S+s}\left[1+\frac{s}{S}(\omega-1)\right] + \frac{1000M_f}{hs}\right)\omega_s \leq \eta\sigma_Y \text{condition (3)}$$

where:

ω : Buckling coefficient of the entire jib calculated as specified in [4.1.4] of this section for open cross-section beams .referTable3.4.2, according to the slenderness ratio λ defined in [4.2.5.6] of this section.

ω_S and ω_s: Individual buckling coefficients of the members with, respectively, sectional areas s and S. These coefficients are determined, as indicated in [4.1.4] of this section, considering an effective buckling length equal to (seeTable3.4.6) and the minimum moment of inertia of the member considered

F_c : Overall compressive force, in kN, applied to jib

M_f : Bending moment, in kN.m, calculated at the middle of the effective buckling length of the jib

h : Pseudo-height, in cm, of the web of the cross-section considered (see Figure 3.4.6)

S,s : Sectional areas, in cm^2,of members as defined in the Fig 3.4.6

η,σ_Y : Defined in [4.1.3.1] of this section

Verification of condition (1) is sufficient when these section considered is symmetrical with respect to neutral axis(S=s) or when the bending moment compresses the members of areas at distance v, in case of an asymmetrical section.

condition (2) and (3)are to be checked only in case of asymmetrical section when the bending moment compresses the members of area S at distance v' (then criterion (1) is not applicable in this case).

Strength criteria(1),(2)and(3) can be applied at any point at a distance x,in m, from the end of jib buckling length (refer Figure 3.4.6), by replacing ω with:

$$1 + (\omega - 1)\sin\left|\frac{180x}{l}\right|$$

Where l is the buckling length, in m, defined in [4.1.4.1] of this section

4.2.5.8. Forces F_1 and F_2, in kN ,in lattices(diagonals or struts) with areas $S_1$and S_2respectively (refer Table 3.4.5) are determined using the following formulae attends of the effective buckling length of the jib:

- for diagonals with areas$_1$of all types of lattices:

$$F_1 = \frac{T_f + T}{\sin\Theta_1}$$

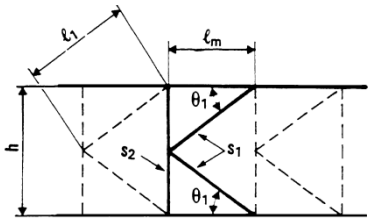
- for diagonals with areas$_2$ of asymmetrical V shape lattices.

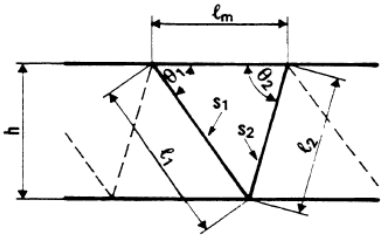
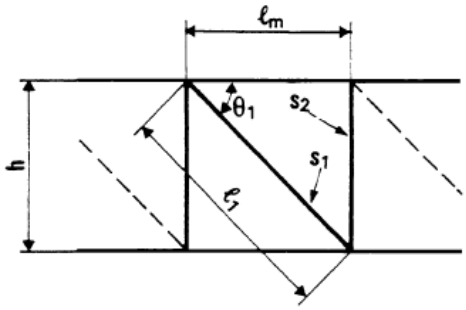
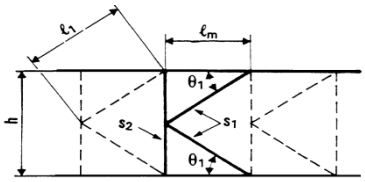
$$F_2 = T_f + T$$

Where

$$T_f = \frac{\pi F_c(\omega - 1)hs}{100l(S + s)}$$

Table 3.4.6: Area a of the solid web equivalent to a lattice web

Type of lattice	Value of a, in cm^2
	$a = 1{,}3h^2 l_m \frac{s_1}{l_1^3}$ $or\ a = 1{,}3 s_1 \sin 2\theta_1 \sin\theta_1$

	$a = 2{,}6h^2 l_m \frac{s_1 s_2}{s_1 l_2^3 + s_2 l_1^3}$ *or* a $= 2{,}6 \sin(\theta_1 + \theta_2) \frac{s_1 s_2 sin^2\theta_2}{s_1 s_2 sin^3\theta_1 + s_1 s_2 sin^3\theta_2}$
	$a = 2{,}6h^2 l_m \frac{s_1 s_2}{s_1 h^3 + s_2 l_1^3}$ *or* $a = 2{,}3 \sin 2\theta_1 \frac{s_1 s_2 \sin\theta_1}{s_1 s_2 sin^3\theta_1 + s_2}$
	$a = 10{,}4h^2 l_m \frac{s_1 s_2}{s_1 h^3 + 8 s_2 l_1^3}$ *or* $a = 2{,}6 \sin 2\theta_1 \frac{s_1 s_2 \sin\theta_1}{s_1 s_2 sin^3\theta_1 + s_2}$

where:

F_i : Force, in kN, calculated as specified above, for lattice with area S

ω_i : Individual buckling coefficient of the diagonal or strut considered. This coefficient is calculated, as specified in [4.1.4] of this section, with an effective buckling length equal to l (or h for struts :refer Table3.4.6 and the minimum moment of bending inertia of the lattice concerned

η, σ_Y : Defined in [4.1.3.1] of this section.

4.3. Hull connections

4.3.1. General

4.3.1.1. The ship structure is to be reinforced in the area of crane attachments so that excessive local stresses or buckling of the deck plating is prevented.

4.3.1.2. Normally, crane pedestals are attached to two decks at least, or to one deck and a deckhouse. In the latter case, the deckhouse is required to be of good quality construction and strongly attached to the ship structure to give efficient fastening to the crane in all directions.

It is also important to facilitate lower part of crane pedestals with efficient supports to withstand the vertical forces they have to bear. So, it is recommended that cranes are fitted in way of a transversal or longitudinal bulkhead.

4.3.1.3. As per Ch-2, Sec-1, [1.12.2], all through the uppermost deck, where they are attached, the structure of crane pedestals should be continuous.

4.3.2. Direct calculations

4.3.2.1. The following strength criteria is to be met when direct calculations are made to check the scantlings of the local structures to which the crane is attached:

$$\sqrt{\sigma^2+3\tau^2} \leq 0.63\sigma_{e(d)}$$

Or with the wind effect:

$$\sqrt{\sigma^2+3\tau^2} \leq 0.71\sigma_{e(d)}$$

Where:

σ : Normal stress, in N/mm^2, calculated considering the bending moments and the tensile and compressive forces

τ : Shear stress, in N/mm^2, calculated considering the torsional moment and the shear forces

σ_y : Yield stress of the local structure concerned.

4.3.2.2. The overturning moment M_d, in kN-m, is to be taken equal to the value of M as per [4.2.1.2] of this section.

4.3.2.3. The total compression force C, in kN, is the force exerted by the pedestal on the ship structure and it is taken equal to the following value, or as applicable:

Value of Q is determined as indicated in [4.2.1.2] of this section increased by the dead weight of the crane pedestal (the dead weight, in kN, of the crane pedestal may be taken $= 0.3 \times H \times b \times t \times 10^{-3}$ and H, b and t are defined in [4.2.1.2] of this section).

The horizontal reaction R_d, in kN, exerted by each attachment deck is calculated as:

$$R_d = \frac{M_d}{H'}$$

where H' = Tween-deck height (in m).

4.3.2.4. As a Rule, the reaction force of the deck entirely transmits to the crane pedestal by shear forces. When crane pedestal of circular cross-section is concerned, calculation of the shear stress in the deck (or on the weld) requires that a deck (or weld) sectional area of efficient length equal to 2/3 the external diameter of the crane pedestal is to be considered on both sides of the latter.

4.4. Equipment and machinery

4.4.1. Ropes and steel wire ropes

4.4.1.1. The guaranteed effective breaking force of a wire rope is not to be less than: $\frac{\eta T}{1.2 \times \Psi_0}$

where:

η : Safety coefficient as per Table-3.4.7.

T : Maximum rope tension, in kN, calculated on the base of loads and load cases defined in Sec-4 of this chapter.

Ψ_0 : Defined in Chapter 3 Sec-1.[1.2.2] of this chapter.

Table 3.4.7: Safety coefficient for ropes

Conditions		Material				
		Steel				Synthetic
Harbor	No lifting of personnel	P = SWL(t)	P < 10t	10t < P < 160t	P > 160t	4.5
		Running rigging	5.0	$\frac{1000}{0.885\,P+191}$	3.0	
		Standing rigging	4.0	$\frac{1000}{0.885\,P+191}$	2.7	
Offshore	Lifting of personnel	4.0				5.0
	No lifting of personnel	3.0				4.5
Lifting of submarine crafts	Manned craft	4.0				5.0
	Unmanned craft	3.5				4.5

Note 1:
The attention of the owners, the Operators and the Manufacturers is drawn to the fact that National regulations may include more stringent provisions in this respect. In particular, French Flag Authorities have the following requirements for utilization of synthetic ropes:

- for $d \le 12$ $\eta = 12$
- for $12 < d \le 17$ $\eta = 10$
- for $17 < d \le 23$ $\eta = 8$
- for $23 < d \le 39$ $\eta = 7$
- for $d > 39$ $\eta = 6$

4.4.2. Diameter of block sheaves

4.4.2.1. As a Rule, the diameter D of block sheaves measured to the base of the rope groove is not to be less than the values given in Table 3.4.8, depending on the nominal diameter d of the rope and the duty category of the crane .refer Sec 1, [1.1.2] of this chapter).

4.4.2.2. When the coefficient of utilization η' of a rope reeved on a block is greater than the minimum value η required by Table 3.4.8, the minimum diameter D_{min} of the sheaves can be reduced to:

$$D_{min} = D\left(\frac{\eta}{\eta'}\right)^{1/2}$$

D_{min} : minimum diameter in mm,

η' : coefficient of utilization of a rope reeved on a block $(\eta/\eta')^{1/2}$ is not to be taken less than 0.89.

Table 3.4.8: Diameter of block sheaves

Duty category	Diameter D of block sheaves
I	17d
II	18d
III	19d
IV	20d

4.4.3. Accessories

4.4.3.1. The applicable requirements of Ch-2, Sec-3 are to be met by the accessories used for cranes.

4.4.3.2. The SWL of each item of loose gear can be determined on the basis of the most severe results of the loading cases I_a and I_b are as defined in Sec 3, [3.1.2.1] of this chapter, considering that coefficients Ψ_o is equal to 1 except for grab cranes for which coefficient Ψ_o will be taken as 1.20 and $G_0 = 0$.

4.4.4. Winches

4.4.4.1. Winches complying with the applicable requirements of Ch-2, Sec-2, [2.1] are to be used.

4.4.4.2. Winches manufactured by a sub-contractor of the crane manufacturer are to be tested as per the requirements of Ch-2, Sec-2, [2.1] at sub-contractor's works, unless otherwise agreed with the crane manufacturer.

Yet, the necessity of conducting the individual tests of the winches as required by provisions of Ch-4, Sec-2 is mandatory when the winches are fitted on the crane.

4.4.5. Electrical installations and hydraulic systems

4.4.5.1. Electrical installations and hydraulic and pneumatic systems are to meet the requirements of Ch-2, Sec-2.

4.4.5.2. The scantlings of the hydraulic luffing cylinders are especially defined in Ch-2, Sec-2, [2.2.6].

4.4.6. Safety devices

4.4.6.1. Following the general principles specified in Ch-2, Sec-2, [2.3], cranes are to be designed in such a manner that any damage to pump, motor, monitoring system, electrical or hydraulic fluid supply will not cause the load to drop or the appliance to be out of control thereby endangering the life of operators or the personnel onboard.

4.4.6.2. Cranes are to be specifically fitted with automatic devices so that their position is maintained when electrical power failure occurs or any hydraulic fluid pipe under pressure ruptures. Even in such unfortunate cases, means shall be there to lower the load at controlled speed.

CHAPTER 4 SURVEYS

CONTENTS

SECTION 1 MARKING

Contents

1.1. General

1.1.1. The followings are aimed for Marking of lifting appliances, their component parts, materials used, items of loose gear and equipment's:

- Categorizing the elements which shall be needed at the time of surveys at works such as inspections of materials, construction surveys, final inspections and, if any, tests prior to putting into operation
- Identifying characteristics such as SWL working pressure quality grade of materials, etc.
- Defining the location either of an item of loose gear on a lifting appliance or of an appliance aboard the ship.

1.1.2. For identification in accordance with the provisions of [2.3.1.7] materials are needed to be marked.

1.1.3. Equipment's which are not considered as part of loose gear. Refer [2.5.1.1]) are to be marked for identification as per [1.3].

1.1.4. Items of loose gear defined in [2.5.1.1] are to be marked in accordance with the provisions of [1.4].

1.1.5. In order to avoid confusion of SWL for an item of loose gear or a lifting appliance, as a rule, is to be marked; the proof load is not to be marked unless it is preceded by the notation PROOF LOAD written out in full.

1.1.6. To locate elements onboard the ship, reference is to be made to the hold served by its number; the holds are generally numbered from forward. When a hold is served by several lifting appliances, the position of the appliance is to be defined in adding to the hold number the marking F or A depending on the portion of the hold served by the appliance (fore or aft) or/and the letter P or S depending on the location of the appliance to portside or starboard side. For example, a crane located to star- board and serving the fore part of hold number 3 may be marked 3FS.

1.2. Recommendations of marking equipment's or accessories

1.1.2.1. Marks are to be stamped in places where there is no stress concentration and clear of welds.

1.1.2.2. The stamps used are to have rounded edges and are not to be applied more deeply than is required to obtain a legible and durable mark.

1.1.2.3. When the marks are stamped directly on the element, the number of letters, figures and symbols is to be reduced to a minimum and the sizes of stamps are not to exceed the values shown in Table 4.1.1.

Table 4.1.1: Sizes for stamps

Type of element	Size, in mm
Elements of circular cross- section: diameter ≤ 13 mm 13 mm < diameter ≤ 26 mm diameter > 26 mm	 3.0 4.5 6.0
Other elements: SWL ≤ 2 t 2 t < SWL ≤ 8 t SWL > 8 t	 3.0 4.5 6.0

1.1.2.4. When the marks cannot be stamped directly on the element due to its shape or nature, they are to be affixed to a suitable support fixed permanently such as a small plate or ferrule made of durable material.

1.1.2.5. The SWL is to be given in kilograms (abbreviation kg) when they are lower than 1000 kg and in tonnes (abbreviation t, 1 t = 1000 kg) when they are greater than or equal to 1 t with the following accuracy:

- integer number without decimal for the SWL lower than 1000 kg
- integer number or number with a single decimal for the SWL laying between 1 t and 10 t except for the values which end with 0.25 or 0.75
- integer number or number with a single decimal which should be 5 for the SWL laying between 10 t and 100 t
- integer number for the SWL greater than or equal to 100 t.

1.1.2.6. If required by the national regulations, marking of the SWL may be replaced by marking of the SWF in deca-Newtons (abbreviation daN) for the SWF lower than 10000 daN or in kilo-Newton's (abbreviation kN) for the SWF greater than or equal to 100 kN. In such cases, no decimal is to be indicated.

1.3. Marking of equipment's after construction survey or final inspection

1.1.3.1. The minimum data to be marked on the materials which have been surveyed during manufacturing or finally inspected, prior to their leaving the workshops, are as follows:

- Stamp "IS" affixed by the Surveyor of the Society
- Date (month by the number and year) of the final inspection
- Number of the inspection certificate or identification number which must be mentioned on the inspection certificate.

Moreover, it is recommended to mark also the grade of steel used proceeded by the letters MAT: for example MAT-A (steel grade A) or MAT-DH36 (steel grade DH36) on the structures or the accessories made of one material only.

1.1.3.2. The crane jibs are to be marked near the heel fitting.

1.1.3.3. Wire and fiber ropes are to be marked on a plate or ferrule set on the rope. When the wire or fiber ropes are fitted with end sockets, marking of these elements must be completed by the SWL (or SWF) of these elements.

1.1.3.4. In addition to the marking as per [1.3.1], the rated characteristics of the equipment's tested at works (exclusive of the loose gear as per [2.5.1.1] for which reference is to be made to the provisions of [1.4]) are to be shown on the manufacturer's plates.

In particular, the SWF and possibly the maximum holding force are to be shown on the winches. The working pressure and the test pressure are to be indicated (in bar) on the hydraulic cylinders and pumps. The type and rated characteristics of the electric motors are to be marked.

1.4. Marking of loose gear

1.1.4.1. The following marks are to be affixed to each item of loose gear:

- Stamp "IS" affixed by the Surveyor of the Society
- date (month by the number and year) of the test
- number of the test certificate or identification number (or reference number) which must be mentioned on the test certificate
- Steel quality grade mark (L, M, P, S, T or V) in accordance with Ch-2, Sec-3, Table 2.3.1 or Table 2.3.2depending on whether a lifting chain or another accessory is concerned refer [1.4.2])
- SWL of the accessory preceded by the letters SWL: for example SWL 10 t or SWL 500 kg
- Additional marking:
  - blocks: refer [1.4.3]
  - lifting beams: refer [1.4.4].

1.1.4.2. When an accessory consists of several elements made of steel of various grades, the quality grade is to be marked on each element, for instance the side plates of a block may be marked M, its head fitting P and the sheave pin S.

1.1.4.3. The maximum diameter, in mm, of rope for which the block is provided is to be marked (e.g.: 22 mm). Blocks are to be marked on the side plates.

1.1.4.4. The actual self-weight (tare) of the lifting beams, spreaders or other equivalent lifting aids is to be stamped on these elements when their weight is greater than 100 kg.

In addition, the SWL and the actual self-weight (tare) are to be painted with easily legible letters and figures at least 75 mm high.

Example: TARE 1.5 t – SWL 22 t

When several slinging methods are provided for hanging the load (or the lifting beam) in relation to different SWL elements are to be properly marked to reduce to a mini- mum the risk of improper use.

1.5. Marking of the lifting appliance prior to putting into service

1.1.5.1. In addition to the marking of the component parts in accordance with the provisions of [1.3] and [1.4],the lifting appliances are to be marked with easily legible letters (for example with light colored letters on a black ground) at least 75 mm high as mentioned in [1.5.2]. They are to be marked too as mentioned in [1.5.3].

1.1.5.2. Marking of cranes

The SWL, minimum and maximum radius, in m, of cranes are to be marked on jib. When a crane is equipped with a main boom and an auxiliary jib, the SWL and corresponding radii of the main hook located at the end of the main boom are to be marked on the main boom; the SWL and corresponding radii of the auxiliary hook located at the end of the auxiliary jib are also to be marked on the auxiliary jib.

For variable load / radius cranes, the diagram of the lifting capacities is to be posted at the control station. Table 4.1.2 gives some examples for marking the cranes.

Table 4.1.2: Marking of cranes

Marks	**Corresponding use (at port)**
SWL 15 t (4 m - 22 m)	Crane of 15 t constant SWL for range of radii between 4 m and 22 m
SWL 50 t (5 m - 8 m) SWL 10 t - 30 m	Crane of variable load/radius Maximum capacity 50 t for range or radii between 5 m and 8 m - Capacity 10 t at maximum radius 30 m. Diagram of lifting capacities versus radius is to be posted at the control station.

1.1.5.3. The following marks are to be stamped near the crane jib pins:

- stamp “IS” affixed by the Surveyor of the Society
- date (month by the number and year) of the overall tests of the lifting appliance
- number of the test certificate or identification number (or reference number) which must be mentioned on the test certificate
- marks similar to those as per [1.5.2] (SWL, minimum topping angle for derrick booms, minimum and maxi- mum radii for cranes).
- If the crane is approved for varying capacities, crane capacity rating chart indicating the maximum safe working loads are to be conspicuously posted near the controls and visible to the operator when working the gear. These charts should indicate the various working angles of the boom and the maximum and minimum radii at which the boom may be safely used, for each boom length intended

1.1.5.4. Exclusive arrangement for offshore crane

For the SWL marking, two options are left to the crane manufacturer discretion:

i) indicating, for all the elements, the allowable load corresponding to operation in port (still water condition). In this case, the derating to be applied, approved according to operating conditions, will be clearly indicated in the Crane Manual and relevant instructions brought to the knowledge of the operator and the personnel using or serving the appliance

ii) indicating, only for hooks, the allowable load corresponding to use in open sea and approved according to the operating condition.

The first option is acceptable for supply cranes on board mobile units operating in ports as well as in open sea.

The second one is appropriate for work cranes specially designed to operate in open sea.

1.1.5.5. Marking for lifting of personnel

The SWL in lifting of personnel mode is to be marked on the crane in addition to the SWL marking for cargo lifting

SECTION 2 SURVEY

Contents

2.1. General provisions

2.1.1. Application

2.1.1.1. This Section deals with:

- inspection at works of materials and welding
- construction survey at the shipyard or at the manufacturer's works of the lifting appliances, their accessories and their foundations
- final inspection and tests at works prior to fitting onboard
- testing and inspection of loose gear prior to fitting onboard
- survey of fitting onboard
- survey of overall tests onboard and inspection after testing prior to putting into service
- marking of equipment's and accessories after inspection and tests mentioned here above.

2.1.1.2. It is the responsibility of the shipyard to inform the local representatives of the Society in due time to enable them to perform the interventions as per [2.1.1]. In particular, the shipyard shall ascertain that the Society survey is specified on the orders for materials placed with subcontractors.

2.1.1.3. Construction survey, final inspection, testing and marking may possibly be carried out simultaneously.

2.2. Welding

2.2.1. General

2.2.1.1. Welding of load carrying structures, fittings and items of loose gear of lifting appliances is to comply with the requirements of Part 4 unless otherwise stipulated in this Section.

2.2.1.2. The elements for which the materials are required to be inspected by the Society itself. Refer Ch-2, Sec-1, [1.1.1.3] & [1.1.1.5]) are to be welded by agreed welding procedures and by welders qualified by the Society in compliance with the requirements of the Rules for Steel Ships.

The welding consumables used are to comply with the requirements of Part-2,.Ch-5,Sec-8 [8.5.6] & Ch-3, Sec 2 [2.1.3]

2.2.1.3. As a rule, only basic coated electrodes shall be used for manual welding.

2.2.1.4. All welds of load carrying structural elements shall be continuous and without end crater. They have to pass round the edge of the plates without interruption.

2.2.1.5. Connections by means of plug-welds or slot-welds are to be avoided; they may be accepted on exceptional cases only.

As a rule, overlapping welds (lap-joints) are forbidden. They may be accepted in special cases only.

2.2.1.6. The included bevel angle of butt welds and of half penetration or full penetration fillet welds is to be sufficient to allow sound welding at weld root. The bevel angle is not to be lower than 40°.
Moreover, a sufficient edge preparation root gap is to be provided to ensure adequate penetration at weld root.

2.2.1.7. Repair by welding of broken, cracked, worn or corroded elements cannot be contemplated without the consent of the Surveyor of the Society who may require the approval of the Society. In any cases, such repairs are to be made under the Surveyor's supervision.

2.2.1.8. In general, type, dimensions and possibly edge preparations for welds are to be mentioned on the construction drawings submitted for approval.

2.2.2. Butt welds

2.2.2.1. Butt welds are to include the whole thickness of the thinnest plate. Half-penetration welds are not accepted.

2.2.2.2. Butt welds are to be in accordance with Part-2,Ch-3, Sec-2, [2.4].

2.2.3. Fillet welds and angle welds

2.2.3.1. All the fillet welds of load carrying structures, fittings and items of loose gear of lifting appliances are to be continuous. They may be with partial penetration or full penetration.

2.2.3.2. The dimension a of the throat thickness of the weld fillet is measured as shown on Fig 4.2.1 (a) and (b) for the fillet welds without bevels and half-penetrated welds with bevels.

2.2.3.3. Full penetration welds normally of the K or V-type may be required for heavily stressed elements, especially if the thickness of the abutting plate is above 15 mm (refer Fig 4.2.2) or when access to one side of the plate is either difficult or impossible (refer Fig 4.2.3 and Fig 4.2.4).

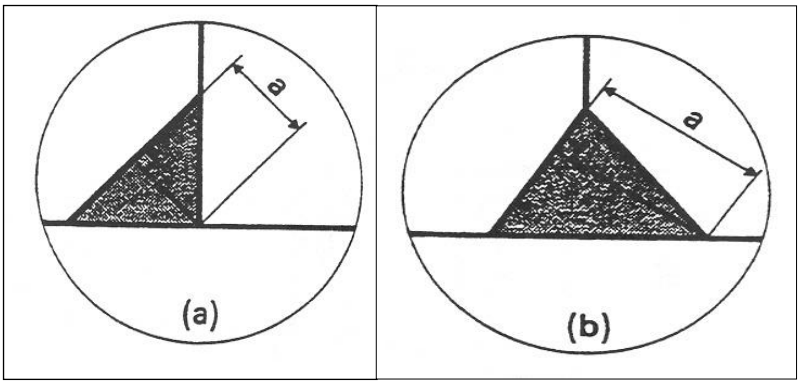


Figure 4.2.1: Definition of the throat thickness

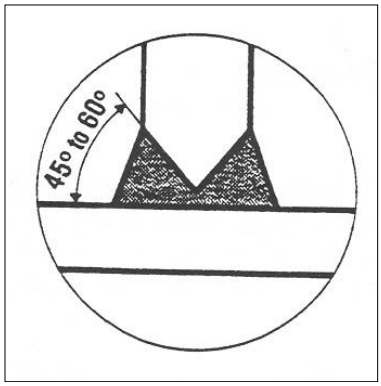


Figure 4.2.2: k-type weld

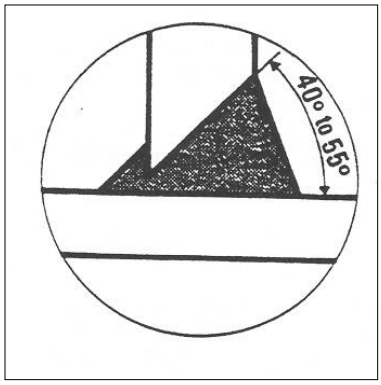


Figure 4.2.3: V-type weld

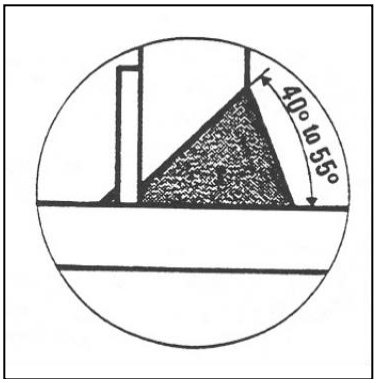


Figure 4.2.4: V-type weld with becking flat bar

2.2.3.4. Half-penetration welds may sometimes be accepted instead of full penetration welds. In such a case, the throat thickness a of the weld, measured as shown on Fig 4.2.1 (b), is not to be less than 0.5 times the thickness of the abutting plate.

2.2.3.5. In general, the throat thicknesses of the double fillet welds are to be neither less than 3.5 mm nor higher than 0.7 times the thickness of the thinnest plate of the assembly. Normally, it is unnecessary to provide for throat thicknesses greater than 0.5 times the thickness of the plate included between the two fillet welds except for special cases either when the throat thickness is reinforced against corrosion or when the two weld fillets are unsymmetrical.

When slot-welds or overlap welds are authorized, as a rule, the throat thickness is to be equal to 0.7 times the thickness of the edge welded plate.

2.2.3.6. Considering the requirements of [2.2.3.5] the throat thickness a of the double symmetrical fillet welds is to be, as a rule, equal to the following value which varies with the thickness t of the thinnest plate of the assembly considered:

- a = 0.45 t; for welds of heavily stressed elements when full penetration weld is not required (for example, for elements under tension the strength continuity of which is to be ensured or for elements heavily stressed in shear such as webs of girders of small depth or attachments of fittings)
- a = 0.40 t; for welds of brackets or of faceplates of girders with single web (I beams)
- a = 0.35 t; for welds of webs of box-girders or for welds of stiffeners.

The Society retains the right to modify these requirements according to the nature or level of the stresses in the element concerned.

2.2.3.7. When the two fillet welds are asymmetrical, in general, the throat thicknesses a_1 and a_2 may be dimensioned so that $a_1 + a_2 = 2a$ (where a is as specified in [2.2.3.6]) provided that a_1 and a_2 comply with the requirements of [2.2.3.5].

2.2.4. Heat-treatment

2.2.4.1. For different kinds of materials and especially when welds on compact parts are concerned, in general, pre-heating is to be carried out before welding.

2.2.4.2. As a rule, compact parts such as goose-necks or trunnions, when they are of welded construction, are to be stress relieved after welding.

2.2.4.3. In some cases, the Society may require stress-relieving of important joints of welded structures.

2.3. Inspection at work

2.3.1. Inspection of materials and welding at works

2.3.1.1. The materials used to manufacture the elements considered as part of the ship structure i.e. the elements as per Ch-1, Sec-2, [2.1.3.2] which are within the scope of the ship classification are to be inspected in compliance with the provisions of Part-2, Materials and Welding.

2.3.1.2. The materials used to manufacture:

- load carrying structural elements of the lifting appliances
- fittings and items of loose gear not submitted to individual tests as per Ch-2, Sec 3, [3.3.4] (exclusive of built-in block sheaves)
- crane slewing rings
- locking devices required for stability of the lifting appliances
- cylinders of load carrying hydraulic cylinders
- pressure pipes of class I
- winch shafts
- elements the functions of which are essential or similar to those of the above mentioned elements are to be:
  - Either inspected and certified by a Surveyor of the Society in compliance with the requirements of Part-2, Materials and Welding for class.CG(H) /CG(O)

- Or identified by a certificate of the supplier given to the Surveyor and showing, on the one hand, the guaranteed chemical and mechanical characteristics and, on the other hand, the results of the tests performed for certification/inscription on cargo gear register.

2.3.1.3. For the elements as per Ch-2, Sec-1, [1.1.1.5] of this part, the Society shall require inspection of the materials by its Surveyors.

2.3.1.4. In general, the provisions of [2.3.1.2] and possibly of [2.3.1.3] apply to items of loose gear of SWL above 25 t. However, for items of loose gear of SWL within 25 t and 100 t a simple attestation of conformity of the material used shall be accepted.

In any case, the supplier shall specify the steel quality grade used to manufacture loose gear, in accordance with the provisions of Ch-2, Sec 3,[3.1.2.] of this part.

2.3.1.5. Anyhow and, especially when there is a doubt concerning identification of the material, check tests may be required by the Surveyor's at his discretion.

2.3.1.6. Notwithstanding the here before provisions, the Society retains the right to require particular inspections or tests of the materials used for the manufacture of lifting appliances and their accessories.

2.3.1.7. For materials which have been satisfactorily tested and inspected in accordance with the requirements of the Society, an Inspection Certificate signed by a Surveyor of the Society is delivered.

The materials are identified by reference to the delivered Inspection Certificate and marked either by a stamp "IS" affixed in the presence of the Surveyor or, after the Society's agreement, by a workshop stamp @ which does not require the Surveyor's attendance.

2.3.2. Inspection of welds

2.3.2.1. Materials, workmanship, structures and welded connections are to be subjected, at the beginning of the work, during construction and after completion, to inspections by the Manufacturer suitable to check compliance with the applicable requirements, approved plans and standards. (Society's Surveyors cannot be expected to act as a substitute to such department).

2.3.2.2. Non-destructive examinations are to be carried out with appropriate methods and techniques suitable for the individual applications, to be agreed with the Surveyor on a case by case basis.

2.3.2.3. The manufacturer is responsible for ensuring that the operating conditions, welding procedures and work schedule are in accordance with the applicable requirements, approved plans and recognized good welding practice.

2.3.2.4. After completion of the welding operation and work-shop inspection, the structure is to be presented to the Surveyor for visual examination at a suitable stage of fabrication.

As far as possible, the results on non-destructive examinations are to be submitted.

2.3.3. Dimensional checking and visual inspection

All the welds involved in strength of the lifting appliances or their supports and their accessories are to be visually inspected.

The welded seams are to be uniform and without end crater. The weld fillets are not to be convex and butt welds are not to be hollowed or concave.

2.3.4. Non-destructive examinations

2.3.4.1. The extent and the nature of the non-destructive examinations are to be determined by agreement between the manufacturer and the Surveyor of the Society taking into account [2.3.4.2] to [2.3.4.6] the following requirements. For this purpose, the places to be examined and the nature of the examinations are to be mentioned on drawings or documents handed to the Surveyor.

Upon approval of the drawings, non-destructive examination of special places may be compulsorily required by the Society without relieving the manufacturer of the requirement to carry out the normal examinations on other structural parts.

2.3.4.2. The methods and acceptance criteria for radiographic and ultrasonic tests must comply with the requirements of the Rules for Steel ships.

2.3.4.3. For butt welding of transverse sections of isostatic (non-redundant connections) structures or parts, mainly stressed under tension, bending or torsion, the following percentages of the whole welded length should at least be submitted to non-destructive examinations:

- 10% for radiographic tests
- 40% for ultrasonic tests
- 20% for crack detection.

For cranes with SWL higher than 25 t, radiographic examinations shall be replaced by ultrasonic examinations after agreement with the Surveyor; however, in the latter case, the ultrasonic examinations are to cover of each transverse joint.

When longitudinal welds end on (or cross with) a transverse weld, the corresponding joints are to be included among those to be examined.

2.3.4.4. When cross welded joints are accepted instead of butt welds as per [2.2.2.1], i.e. when one of the plates is tensile stressed in the through thickness direction, as well as in the case of restrained joints, internal examinations by non- destructive methods are to be carried out on of the weld and of the heat affected zone in order to reduce the risk of lamellar tearing. Moreover, systematic crack detection is to be carried out by dye-penetrant test and/or by magnetic particle detection.

Note 1: Important: plates which are stressed in the through thickness direction are to be submitted to 100% non-destructive examination prior to welding all along the contemplated welding line in order to ascertain that no lamination defect exists .refer also Ch-2, Sec-1, [1.2.8].

2.3.4.5. Welds of large cross section, especially those executed on steel castings, steel forgings, heavily stressed welded joints, connecting welds for fittings as well as the welds carried out in critical conditions (for example, over-head welds) are to be submitted to suitable examinations after agreement with the Surveyor.

2.3.4.6. In some special cases, the Surveyor or the Society may require inspections after completion of the load tests as per [2.8] of this section.

2.3.5. Repair of defects and final decision

2.3.5.1. The Surveyor is to be informed of every defect detected upon examinations.

Unacceptable defects are to be eliminated and, if their number is too important, the weld is to be entirely re-executed, taking the usual precautions.

After repair, new examinations are to be carried out.

2.3.5.2. Important repairs are to be carried out in agreement with the Surveyor.

2.3.5.3. The repairs decided by the manufacturer are to be communicated to the Surveyor. Results of the original examination and of the examination after repair are to be submitted to him.

2.3.5.4. When numerous or repeated defects are detected, the examinations are to be extended to the Surveyor's satisfaction to arrive at a reliable conclusion concerning execution of all welds.

2.3.5.5. The final decision as to extent of inspections defects to be eliminated, repairs to be made and final acceptance of the welds is subject to the agreement of the Surveyor of the Society.

2.4. Construction survey of the lifting appliances and of their accessories

2.4.1. Survey of the elements within the scope of ship classification

2.4.1.1. The fixed parts of the lifting appliances as per Ch-1, Sec-2, [2.1.3.2] (crane pedestals, winch foundations, etc.) and the elements which connect them with the ship structure are to be surveyed at the shipyard during construction by the Surveyors of the Society within the scope of ship classification.

2.4.1.2. The Surveyor checks that the elements are built in compliance with the drawings approved by the Society and that the materials are used correctly and in accordance with relevant provisions of [2.2] and [2.3].

The shipyard is to provide the Surveyor with adequate identification and inspection and testing documentation of material, in accordance with the provisions of [2.2] and [2.3].

2.4.1.3. If the origin of constituent materials (even material previously controlled), the soundness of an element, the quality of welding or the results of non-destructive tests are doubtful, the Surveyor may require either a complete or partial repeat of the tests or inspections already carried out or the carrying out of additional tests or non-destructive examinations.

2.4.2. Survey of the components outside ship classification

2.4.2.1. When classification of the lifting appliances is requested, as a rule, a construction survey is required for the following elements which are outside ship classification:

- main load carrying structures of lifting appliances
- fittings and accessories not submitted to separate tests
- loose gear with SWL greater than or equal to 100 t
- lifting beams, lifting frames and equivalent lifting aids
- hydraulic cylinders of the luffing and slewing devices of the crane jibs
- locking devices required for stability of the lifting appliances

- winches (prototypes)
- other elements, the functions of which are essential or similar to those of the elements listed above.

2.4.2.2. When required, the construction survey is carried out at the manufacturer's works according to the procedure as per [2.4.1].

2.4.2.3. In some cases, for example if mass production elements are concerned, the construction survey required in [2.4.2.1] shall be replaced by a final inspection as per the requirements of [2.6] of this section.

2.5. Inspection and testing at works of ropes

2.5.1. Steel wire ropes

2.5.1.1. All the wire ropes used in running rigging or standing rigging are to be inspected at the manufacturer's works in the presence of a Surveyor of the Society.

2.5.1.2. The wire ropes submitted to the Surveyor for examination are to be smooth and clean, free from oxidizing trace, with no sign of broken or projecting wires and without scratching or crushing.

2.5.1.3. Precautions are to be taken upon paying out the wire ropes from reels or coils in order to avoid the making of kinks which would result in refusing the rope.

The unwound wire rope must neither ripple nor twist when it is not in tension.

2.5.1.4. For each continuous length to be inspected, a series of tests is to be carried out, according to .Part 4/chapter 3/sect 7[7.3]

2.5.1.5. As an alternative, tests and checks carried out in compliance with international or national standards may be accepted if they are considered as equivalent to the requirements of this Section. In particular the provisions of standard ISO 3178-1988: Steel wire ropes for general purposes

- Terms of acceptance are acceptable to the Society.

2.5.2. Fiber ropes

2.5.2.1. All synthetic fiber ropes are to be inspected at the manufacturer's works.

2.5.2.2. An inspection is to be carried out for each continuous length submitted to the Surveyor, according to Part 4,/chapter 3/sect 7[7.3]

2.6. Final inspection and testing at works prior to fitting onboard

2.6.1. Final inspection prior to fitting onboard

2.6.1.1. Prior to fitting onboard, a final inspection is to be carried out at the supplier's works, for the following elements:

- elements listed in [2.4.2.1] with all their fittings and main equipment (for example equipped cranes)
- all loose gear and other movable accessories
- wire ropes and fiber ropes
- all winches with their motors and reduction gear
- electrical motors and equipment

- pumps, hydraulic motors and equipment
- other elements of primary importance or similar to those listed above.

2.6.1.2. The supplier is to provide the Surveyor with the certificates or attestations relating to materials in accordance with the provisions of [2.3.1].

2.6.1.3. The Surveyor checks that efficient arrangements are provided to prevent the swivels or the suspending devices of the accessories from being accidentally unscrewed; they ascertains too that the various pins are locked in translation.

If deemed necessary, the Surveyor may ask to improve efficiency of the arrangements provided to this effect.

2.6.1.4. When tests are required .refer [2.7.2]) the Surveyor surveys testing and inspects again the concerned elements to make sure that they have undergone neither damage nor permanent deformation.

2.6.1.5. When the results of the inspections as per [2.7.1] and of the tests as per [2.7.2] are satisfactory, the Surveyor marks the concerned elements as per Sec-1 of this chapter and delivers an inspection certificate.

2.6.2. Tests prior to fitting onboard

The requirements from [2.7.3] to [2.7.6] determine the test procedures to be followed for the elements to be tested within the scope of the final inspection prior to fitting onboard.

2.6.3. Loose gear

2.6.3.1. Every item of loose gear defined in Ch-1, Sec-3, [3.1.3] is to be submitted to an overload test prior to fitting onboard under the conditions as per [2.7].

2.6.3.2. When they are integral part of the lifting appliance or when the items are designed for very heavy loads (as a rule for SWL ≥ 160 t) and when it is practically impossible to carry out an individual test, exceptional waiving of individual tests before fitting onboard shall be accepted by the Society but additional checks or non-destructive tests may be required.

In such a case, these items are to be tested on the lifting appliance when overall proof testing is carried out as per [2.9.3.1] of this section on board.

2.6.3.3. The SWL allowed to each item under these conditions is not to be higher than the static load applied upon overall proof testing less the test overload.

2.6.3.4. The items fixed or incorporated permanently in the structure of the lifting appliance (such as built-in sheaves, trunnions, goosenecks and derrick heel cargo lead block bearings, jib heel pins) are not regarded as part of loose gear.

2.6.3.5. **Certificates**

Articles of loose gear are to have a certificate furnished by the manufacturer. The certificate is to show the distinguishing number or mark applied to the article of gear, description, kind of material, carbon content, date of test, proof load applied, and safe working load. Loose gear certificates are to be inserted in the Register of Lifting Appliances. The safe working load SWL is to be marked on the hoist blocks

2.6.4. Locking devices

In some cases, the Society may require testing of the main parts of the locking devices designed to ensure stability of the lifting appliance; as a rule, the proof load is to be in conformity with that required for loose gear and/or a part is to be submitted to a destructive test under loading conditions as near as possible to the working load conditions

2.6.5. Cylinders and hydraulic equipment

2.6.5.1. The hydraulic cylinders, the functions of which are the lifting, luffing or slewing of the crane jibs are to be submitted to an hydraulic test under a pressure at least equal to 1.5 times the design pressure.
When more than one cylinder is used for each motion, such as luffing, folding and telescoping, arrangements are to be provided to equalize the pressure and exerted loading among the cylinders. Otherwise, it is to be demonstrated through design analysis that the most severe loading on each cylinder is taken into account for the design of the cylinders

2.6.5.2. The pumps are to be submitted to a hydraulic at a test pressure P_H , in MPa, equal to the following value:

$P_H = 1.5\ P$ when $P \leq 4$

$P_H = 1.4\ P + 0.4$ when $4 < P \leq 25$

$P_H = P + 10.4$ when $P > 25$

where P is the design pressure, in MPa.

2.6.5.3. Piping's, welded joints and accessories (shut-off valves, block-valves, etc.) are to be submitted to a hydraulic test at a pressure equal to 1.5 times the design pressure. This test may however be carried out after fitting onboard.

2.6.6. Other equipment's

2.6.6.1. The electrical equipment are to be submitted to inspections and tests as per Ch-2, Sec-2, [2.1.6].

2.6.6.2. Winches and their equipment are to be submitted to inspections and tests as per Ch-2, Sec-2, [2.1.6].

2.7. Testing and inspection of loose gear prior to fitting onboard

2.7.1. General

2.7.1.1. The loose gear concerned in this article is defined in Ch-1, Sec-3, [3.1.3]. It includes the following items:

- blocks
- hooks
- shackles
- swivels
- chains
- rings
- rigging screws
- slings

- lifting beams
- hand-operated tackles used with pitched chains, rings, hooks, shackles and swivels permanently attached to.
- other loose gear fulfilling similar functions to those listed above.

2.7.1.2. Each item of loose gear defined in [2.7.1.1] is to be granted an individual SWL and must be submitted to an overload test, prior to being fitted onboard. These tests must normally be performed before painting, in the presence of a Surveyor of the Society.

2.7.1.3. Test shall be carried out by applying certified weights; their values must be justified to the Surveyor's satisfaction.

Tensile testing machines of a type approved by the Society and calibrated every year may also be used.

The guaranteed accuracy of these machines must be ± 2%. A difference of ±2% is acceptable in the value required for the proof load.

2.7.1.4. When a weight is applied for testing, its value, in t, (Proof Load = PL) is defined in [2.7.2].

2.7.1.5. When a force is applied for testing, the value, in kN, of the Test Force TF is deduced from the provisions of [2.7.2]in considering TF = 10 PL.

2.7.1.6. Several items of loose gear attached together may be tested simultaneously provided that the arrangements ensure that during testing each of them is actually submitted to a load (or a force) equal to the proof load (or test force) required according to its SWL.

Attention is drawn to the fact that sometimes this condition is not complied with for the shackle connecting the rope with the becket of a block: in such cases, this shackle must be tested separately.

2.7.2. Proof loads

When a load is applied for testing, the proof load, in t, for each item of loose gear is defined in Table 4.2.1 according to its own SWL.

2.7.3. Blocks

2.7.3.1. For definition of SWL of blocks, reference is to be made to Ch-2, Sec-3. The special definition of SWL for single sheave blocks with and without becket is to be noted. The proof loads for every block are the loads to be applied to their head fitting during testing.

2.7.3.2. In general, it is unnecessary to give a separate SWL to the head fitting of the block since this element is an integral part of the block.

2.7.3.3. When there is a becket, a separate SWL is to be granted to it, as stated in Ch-2, Sec-3.

2.7.3.4. In general, blocks with beckets are to be tested in two phases, as shown on Fig 4.2.5 and Fig 4.2.6.

2.7.3.5. The shackles of the blocks and those used to fasten the ropes on the becket are to be considered as special items of loose gear. Refer [2.7.1.6].

Note 1: When the recommendation of Ch-2, Sec-3, [3.2.2.2] is complied with (i.e. when SWL of the block is determined considering that all parts of rope are parallel) it can be accepted that the block and the becket are tested in one single operation under the proof load as per Table 4.2.1 (a) for single sheave blocks or Table 4.2.1 (b) for multiple sheave blocks.

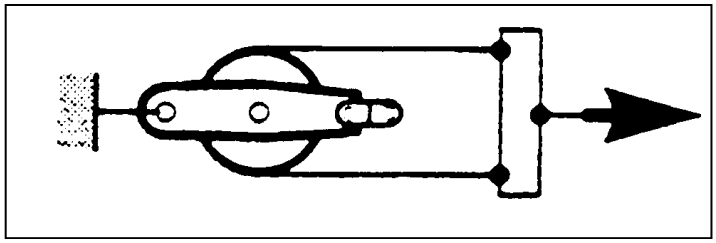


Figure 4.2.5: Testing of blocks head fitting and block pin
[Proof load as per Table 4.2.1 (a) or (b), as the case may be]

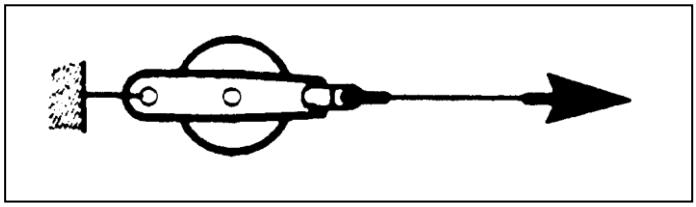


Figure 4.2.6: Testing of becket
[Proof load as per Table 4.2.1 (e)]

2.7.4. Chains

2.7.4.1. The whole length of the chains with short and long links is to be submitted to a proof load in accordance with the requirements of Table 4.2.1.

Table 4.2.1: Proof loads of loose gear

Sl. No.	Elements / SWL, in t	Proof load / PL, in t
(a)	Single sheave blocks: (see note 1) SWL < 13 13 ≤ SWL < 80 SWL ≥ 80	 4 SWL 1.866 SWL + 27 2.2 SWL
(b)	Multiple sheave blocks: (see note 2) SWL ≤ 25 25 < SWL < 160 SWL ≥ 160	 2 SWL 0.933 SWL + 27 1.1 SWL
(c)	Hand operated tackles used with pitched chains and rings, hooks, shackles and swivels permanently attached to:	1.5 SWL
(d)	Lifting beams, lifting frames, spreaders and similar lifting aids: SWL ≤ 10 10 < SWL < 160 SWL ≥ 160	 2 SWL 1.04 SWL + 9.6 1.1 SWL

(e)	Other items of loose gear: hooks, shackles, swivels, chains, rings, rigging screws, slings, etc.: SWL ≤ 25 SWL > 25	 2 SWL 1.22 SWL + 20

Note:
1) SWL of single sheave block, with or without becket, is equal to half the maximum load that the block is allowed to carry by means of its head fitting (refer Ch-2,Sec-3, [3.2.2]).
2) When a permanent built-in accessory (hook, swivel, head fitting, etc.) is part of the block, generally this accessory does not need to be tested separately (refer [2.7.1.6]).

2.7.4.2. Moreover, it is to be checked on a sample including at least three links that the chain can withstand a load equal to 4 times its SWL without being broken. As a rule, continuance of the test until breaking is not required, but the tested sample is to be discarded.

2.7.5. Ramshorn hooks

2.7.5.1. Ramshorn hooks may be tested in one operation if the proof load (PL) as per Table 4.2.1 is suspended as shown on Fig 4.2.7. If this arrangement is not adopted, the test are to be carried out in two phases: on the one hand, in applying the proof load PL vertically (see Fig 4.2.8) and, on the other hand, in applying horizontally a force corresponding to half the proof load .refer Fig 4.2.9.

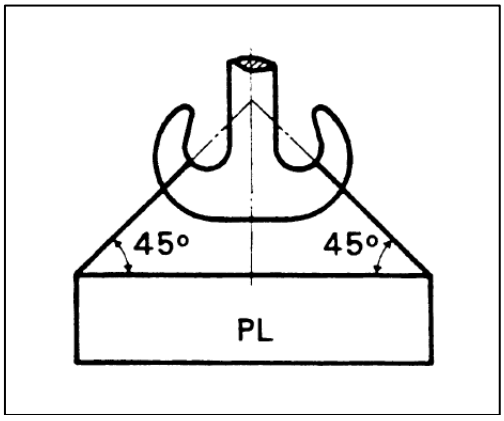


Figure 4.2.7: Single phase testing

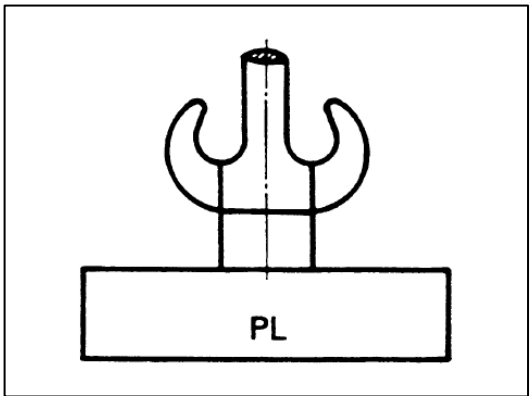


Figure 4.2.8: Testing in first phase

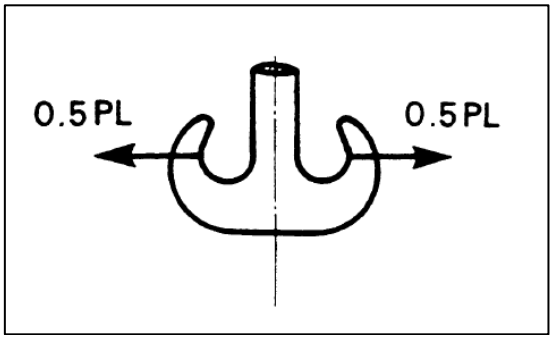


Figure 4.2.9: Testing in second phase

2.7.6. Lifting beams, lifting frames and similar lifting aids (spreaders)

2.7.6.1. The test procedure of a lifting beam or similar item is to be provided so that the proof load induces in its various structural parts inclusive of the connecting elements, forces proportional to and of the same direction as those which result from actual working conditions. This means that the following elements are to be taken into account: direction of application of the weight corresponding to the mass of the lifting beam, slinging method provided for handling the service load and suspension method of the whole lifting beam.

2.7.6.2. In the case of lifting beams with several SWL's and/or several possibilities for slinging the load and/or several possibilities for suspension from the lifting appliance, every special working arrangement are to be tested with an over- load. To this end, a test programme are to be proposed to the Surveyor who have right to ask for its submission for examination by the Society.

2.7.6.3. The test forces may be applied by hydraulic cylinders. In such a case, proof is to be given to the Surveyor that the applied forces are really those required within acceptable limits of accuracy.

2.7.6.4. The various components of lifting beams such as hooks, shackles, rings, chains or slings are to be regarded as special items of loose gear and must therefore be tested separately.

2.7.7. Thorough examination after testing

2.7.7.1. After testing, every item of loose gear must be thoroughly examined by a Surveyor of the Society.

2.7.7.2. Thorough examination aims at checking that the item has not been damaged or permanently deformed by testing and that there is no apparent defect likely to impair its reliability in service.

2.7.7.3. Thorough examination consists of a visual inspection completed by other means, if need be, such as dismantling or various non-destructive tests which may be required by the Surveyor.

2.7.7.4. The pins and sheaves of blocks must be dismantled for inspection. However, in the case of a batch of identical blocks, only dismantling of one or several of these blocks taken at random from the batch may be required by the Surveyor.

2.7.7.5. The items which include mobile parts must operate freely. Especially, it must be ascertained that the sheaves of the blocks as well as the swivels rotate freely around their axle.

2.7.7.6. When damages such as cracks are detected after testing of an item of loose gear, as a rule, this item is to be discarded. Moreover, if this item is a part of a batch of identical elements the other elements of this batch are to be examined very carefully to the Surveyor's satisfaction either by dye penetrant test or by magnetic particle test if cracks end at the surface or near to the surface or by ultrasonic or radiographic tests if the damages result from internal defects.

Repairs may be contemplated only in agreement with the Surveyor who may possibly refer to the Society in this respect. Any element the strength of which may have been affected by repair are to be re-tested.

2.7.7.7. When the result of the examination is satisfactory, the Surveyor has the item marked for identification in accordance with the provisions of Sec-1 of this chapter.

A certificate will be issued subsequently as per Ch-1, Sec 2, [2.2].

2.8. Survey of fitting onboard

2.8.1.1. Fitting onboard of cranes, gantry-cranes, winches and associated accessories is to be surveyed by the Surveyors of the Society.

Survey of the fitting onboard of the fixed parts of the lifting appliances .refer [2.4.1]) is carried out within the scope of ship classification.

2.8.1.2. It is the responsibility of the shipyard to inform the local office of the Society of the beginning of installation works onboard and to acquaint it with the scheduled programme in this respect.

2.8.1.3. Intervention of the Society is limited to survey of satisfactory carrying out of the connections of the lifting appliances with the ship structure, to checking of correct rigging of the accessories and of good working of the driving equipment. It does not concern handling or scaffolding required to set up the lifting appliances.

2.8.1.4. The Surveyor checks that the materials, the loose gear and the various equipment used have been duly submitted to the inspections and tests required in this Section and ascertains that they are suitably identified by their marks. The relevant certificates are to be made available for the Surveyor.

2.8.1.5. It is also checked that the loose gear is located in accordance with the lay-out drawing of the rigging elements and that the wire and fiber ropes are suitably rigged.

Precautions are to be taken to avoid kinks when reels of ropes are uncoiled.

The ropes, hinges, bearings, roller or ball bearings, swivels and various pins are to be suitably greased with the lubricants recommended by the manufacturers.

2.8.1.6. The hydraulic systems are to be submitted to a test pressure equal to 1.5 times the design pressure.

However, if a hydraulic test of the piping and its accessories has been performed prior to fitting onboard as per [2.6.5.1], the whole of the hydraulic system may be tested after fitting onboard at a pressure equal to:

- 1.25 times the design pressure when welded joints have been executed onboard

- at the set pressure of the safety valves or other protecting devices against over pressures if no welded joint has been executed onboard or if all the welded joints executed onboard have been subjected to nondestructive tests to the satisfaction of the Surveyor of the Society.

2.8.1.7. As a rule, the no-load tests and preliminary checking as per [2.9.2] are carried out within the scope of the survey of the fitting onboard

2.9. Overall testing prior to putting into service

2.9 1. General

2.9.1.1. All the lifting appliances concerned in this Rule must be tested prior to their putting into operation in the presence of a Surveyor of the Society.

2.9.1.2. A detailed test programme taking into account the requirements of this section is to be drawn up and submitted to the Surveyor.

For intricate cases, the Surveyor may require submitting of the test programme to the approval of the Society to take into account the most critical loading cases as determined by calculation.

2.9.1.3. Before testing, the test programme is to be agreed by the captain or the person responsible for the ship (or for the support of the lifting appliance) by the shipbuilder and by the Surveyor of the Society.

2.9.1.4. Prior to any load test, the captain or the person responsible for the ship must confirm that ship stability will not be impaired by testing and that strength of the structures intended to support the proof loads is sufficient.

If special ballast conditions or special devices (for example, support legs or removable stays) are provided either to limit the list of the support or to ensure stability of the lifting appliance, the person responsible for the ship is to ascertained that these conditions are complied with and that these devices are fitted before and during the load tests.

If ballast conditions are to be modified depending on the outreach of the proof load, working of the ballast system are to be tested prior to carrying out load tests.

2.9.1.5. During the overload tests and the load movement tests, the person responsible for the ship is to check that the list and trim conditions remain within the limits taken into account for stability calculation .refer Ch-3, Sec-2, [2.2.2].

If ballast capabilities do not allow compliance with these limits, as a rule, the tests are to be stopped and another study is to be submitted for approval with modified trim and list conditions.

In few cases, carrying out of load tests in the maximum trim and list conditions taken into account in the study may be required. If the person responsible for the ship is against placing the ship in these conditions since he considers that there is a risk of instability, the maximum list and trim angles finally authorized are to be reduced to the values deemed acceptable by the aforesaid person.

2.9.1.6. The load tests are to be carried out by applying certified weights the value of which are to be justified to the Surveyor’s satisfaction with an accuracy of ±2%.

2.9.1.7. The tests include:

- preliminary no-load tests (if these tests have not been carried out within the scope of survey of fitting onboard)
- overload test intended to test the strength of the appliance and its support
- maneuvering tests of the appliance at maximum capacity in conditions as near as possible to actual working conditions.

2.9.1.8. When a lifting appliance is designed to handle loads in several different conditions, the overload test and the maneuvering tests at maximum service capacity are to be carried out for each of these conditions.

However, if the overload test corresponding to a special working condition does not result in submitting appliance, its connections, its support and any of its constituents (except for the loose gear which have been tested separately) to stresses higher than those supported during other tests, the overload test may possibly be omitted for this special working condition, subject to agreement of the Surveyor or of the Society. The maneuvering test at maximum working capacity corresponding to this condition are however to be carried out.

2.9 2. No-load testing and preliminary checking

2.9.2.1. The whole lifting appliance is to be tested under no-load in order to check that every motion may be carried out within the contemplated working area.

2.9.2.2. During this test, correct operation of the driving and control devices of the motors, winches and brakes is to be checked.

2.9.2.3. It is to be ascertained that the ropes do not rub on metal parts and that there is no risk of them coming out of the block grooves.

It is also to be checked that the lengths of the ropes are sufficient and comply with the requirements of Ch-2, Sec-2, [2.1.2.2].

2.9.2.4. The end limit switches are properly set.

2.9 3. Overload testing

2.9.3.1. The proof load is specified in Table 4.2.2 according to factor SWL of the lifting appliance, describing maximum capacity of the appliance.

Table 4.2.2: Proof loads of the lifting appliances

SWL of the lifting appliance, in t	**Proof load, in t**
SWL ≤ 20 20 < SWL < 50 SWL ≥ 50	1.25 SWL SWL + 5 1.1 SWL

For offshore crane, the SWL referred in Table 4.2.2is to be taken as the greater of:

- 0.75 α_{CZ} SWL
- SWL.

α_{CZ} is defined in Ch-3, Sec-2.

2.9.3.2. When the SWL of the lifting appliances is constant over their whole working area they must be tested at their maximum radius i.e. at the minimum topping angle taken into account in the load and strength calculations.

2.9.3.3. The lifting appliances the SWL of which varies continuously over their working area must be tested at maximum and minimum topping angles. A test in an intermediate position to be determined in agreement with the Surveyor or the Society may be required.

If the SWL does not vary continuously over the working area but remains constant between two different values of the topping angle, the test are to be carried out at the maximum radius corresponding to each different SWL.

2.9.3.4. The various motions allowed by the lifting appliance are to be carried out at low speed with the proof load.

a) Lifting motion: the proof load is to be lifted at low speed, the crane jib being located in the longitudinal plane of the ship. It is unnecessary to lift the proof load up to the maximum possible height, however, as a minimum, the cargo winch drum are to be entirely rotated.
b) Luffing motion: the crane jibs must be raised to their maximum luffing angle then lowered to their minimum luffing angle.
c) Translation: the various translating motions of the over-head travelling cranes, underhung trolleys, travelling gantries and travelling cranes are to be performed all along their tracks.

2.9.3.5. Stationary position of the proof load in case of failure of the power-source feeding the winches is to be demonstrated.

2.9 4. Operational testing

2.9.4.1. Maneuvering tests at maximum working capacity (α_{CZ} SWL) are to be carried out over the whole working area of the lifting appliance concerned.

In particular, the load is to be handled over the whole out- line of the working area.

2.9.4.2. These tests are to be carried out at the maximum working speed at which the lifting appliance may be used for each possible motion. When several motions may be carried out at the same time, the maneuvering tests are also to be carried out under these conditions.

2.9.4.3. Correct operation of the rigging, of the machinery and of the control devices are to be checked during testing.

In particular, efficiency of all the brakes inclusive of those of emergency stopping devices are to be proved.

2.9.4.4. Correct winding of ropes on winch drums are to be checked under load, especially when the maximum length of ropes is wound on drum.

2.9.4.5. Safety devices such as end limit-switches, load and moment indicators are to be set definitively and their good operation proved.

2.9.4.6. It is to be proved that the load can be held stationary and can be lowered at low speed in case of failure of the power source.

2.9.4.7. Under the responsibility of the responsible person aboard the ship and with the consent of the shipbuilders, the maneuvering tests under load may be performed with the proof load as per [2.9.3.1] under the conditions stated in [2.9.4].

2.9 5. Inspections after testing

2.9.5.1. After testing, fixed or movable parts of the lifting appliance and of its support are to be inspected by manufacturer under the attendance of the surveyor.

2.9.5.2. The thorough examination aims at verifying that the components of the lifting appliance and its supporting structures have not been damaged or permanently deformed during testing and that no defect likely to impede reliability of the lifting appliance is apparent.

2.9.5.3. The thorough examination consists in a visual inspection complemented by other means, such as dismantling's or various non-destructive controls which may possibly be required by the Surveyor.

Special attention are to be paid to the connections of the lilting appliance with its support and to the places where the structures are discontinuous in shape.
The Society may require carrying out of special tests or examinations at some places after testing.

2.9.5.4. Repairs can be contemplated only after agreement with the Surveyor of the Society who may possibly apply to the Society. If repairs are done on concern load carrying elements, the overload test and possibly the maneuvering tests are to be repeated under conditions and accepted by the Surveyor and, possibly, by the Society.

2.9.5.5. When the result of the inspections after testing is satisfactory, the Surveyor marks the lifting appliance in accordance with the provisions of Sec-1 of this chapter and then issues a certificate as per Ch-1, Sec-2, [2.2].

2.9 6. Procedure for load testing of a lifting appliance

2.9.6.1. Before load testing, the surveyor shall confirm the following:
— support of the lifting appliance is acceptable
— for a ship or other vessel, necessary pre-cautions with respect to stability, ballasting or similar conditions have been taken
— for a mobile crane, the crane has a sufficient margin of stability against overturning
— required test certificates for blocks and loose gear are available and acceptable
— for a new installation, design approval and survey during fabrication of the lifting appliance are documented.

2.9.6.2. A written test programme acceptable to the surveyor should preferably be available.

2.9.6.3. The test weights shall be lifted by the lifting machinery used for the regular handling of loads. Testing a lifting appliance driven by electrical motor(s) the regular electrical supply shall be used. For ships, electrical shore connection is acceptable when the power is distributed through the ship's main switchboard and distribution panels.

2.9.6.4. For cranes, the test load is to be hoisted, slewed and luffed at slow speed. Gantry and travelling cranes together with their trolleys, where appropriate, shall be traversed and travelled over the full length of their track.

2.9.6.5. For variable load-radius cranes, the tests are generally to be carried out with the appropriate test load at maximum, minimum and at an intermediate radius.

SECTION 3 MAINTENANCE

Contents

3.1. General provisions

3.1.1. Application

3.1.1.1. This Section is applicable to lifting appliances used at port or on open sea.

3.1.1.2. Unless otherwise specified, the term ship means a ship, an offshore unit or a fixed or mobile offshore platform.

3.1.2. Survey requirements for the fixed part of the lifting appliances in scope of ship classification

In order to maintain the class of the ship, the fixed parts of the lifting appliances . refer Ch-1, Sec-2, [2.1.3.2] are submitted to the survey requirements of those provided for in the Rules for Offshore units.

3.1.3. Validity of International Register of Shipping Cargo Gear Register and Maintenance of additional class notations for lifting appliances

3.1.3.1. In order to validate INTLREG Cargo Gear Register and/or to maintain additional class notation for the lifting appliances, the lifting appliances and their accessories must be submitted to:

- an annual thorough examination for lifting appliances used at harbor or offshore conditions ,as defined in Ch-1, Sec-2, [2.1.1.1], in particular when one of the additional class notation CG(H) or CG(H1) has been granted, especially when the lifting appliances are used to load and unload ship at port within the application of the Conventions of the l.LO. refer Ch-1, Sec-2, [2.1.3.3].

- a six-monthly thorough examination when:
  - one of the additional class notations CG(H) or CG(H1),has been granted
  - the lifting appliances concerned are used at sea, especially for the appliances referred to in as amended MODU Code as amended or in the l.LO. Code of practice concerning construction of fixed offshore installations, refer Ch-1, Sec-2, [2.1] and for appliances used for handling diving units
- a quinquennial thorough examination including re-testing of the lifting appliances.

3.1.3.2. Thorough examination means a detailed visual examination attended by a surveyor of the Society and supplemented, if the Surveyor of the Society deems it necessary, by other suitable means such as non-destructive tests carried out as carefully as the conditions permit in order to arrive at a reliable conclusion as to the safety of the inspected lifting appliance or accessory and the safety of the elements used to fix the lifting appliance or accessory.

For this purpose, the component parts of the appliance or accessory are to be dismantled if the Surveyor deems it necessary.

3.1.3.3. Two types of thorough examinations are considered:

- annual or six-monthly thorough examinations
- quinquennial thorough examinations including, in addition to a thorough annual examination, systematic checkings and compulsory re-testing of the lifting appliances. These thorough examinations may be quinquenal upon owner’s request.

The typical procedure of a thorough annual or six-monthly thorough examination is detailed in [3.2] of this section.

The typical procedure of a quinquennial thorough examination is detailed in [3.3]of this section.

These typical procedures are given for guidance only. They may be either reinforced or relaxed by the Surveyor depending on the general maintenance conditions or on any other element he would be acquainted with likely to affect his final decision.

3.1.3.4. A thorough examination of the lifting appliances and their accessories shall be carried out simultaneously with a survey as required in [3.1.2].In such a case, the thorough examination includes and replaces the aforesaid survey.

But anyhow a survey as mentioned in [3.1.2] can neither replace a thorough examination nor ensure maintenance of classification of the lifting appliances and/or maintenance of validity of the Cargo Gear Register.

3.1.3.5. In the case of discontinuance or suspension of the additional class notation of the lifting appliances and/or of expiration of the validity of the Cargo Gear Register, the surveys as per [3.1.2] are again compulsory to maintain the classification of the ship or offshore unit.

3.1.3.6. Any noticeable incident or accident occurring in the working of the lifting appliances must be notified to the Society in due time.

Any project concerning repair or alteration of the existing arrangements which would affect its strength or reliability must be submitted to the agreement of the Society.

The lifting appliances must be operated as originally designed and especially as mentioned in the Cargo Gear Register and in the Certificate of the lifting appliances.

If these requirements are not complied with, the additional class notations shall be suspended or withdrawn.

3.1.3.7. The carrying out of periodical thorough examinations does not relieve the person responsible onboard from having regular inspections performed by a designated member of his staff and from ensuring normal maintenance of the lifting appliances and their accessories.

3.1.4. Postponements of surveys or examinations

3.1.4.1. Upon Owner’s request, the surveys as per [3.1.2] may be postponed on INTLREG’s acceptance on case by case basis.

3.1.4.2. Upon Owner’s request, the thorough examinations as per [3.1.3.1] may be postponed under the conditions and within the limits as follows:

- a survey is carried out by a Surveyor of the Society who ascertains by visual examination that the whole of the lifting appliances is in condition satisfactory enough to postpone the thorough examination, If not so, the Surveyor may require dismantling, forbid the use of the lifting appliance until the next thorough examination or reject postponement. Further to this survey, an attestation is issued by the Surveyor

- the Owner has obtained the agreement of the National Authorities of the flag country of the ship or of the off- shore unit and informed the Society accordingly
- the thorough examination is postponed:
  - by 3 months at the most to be counted from the anniversary of the end of the original overall tests (or the last thorough quinquennial examination) to maintain the additional class notations CG(H) and CG(H1)
  - by 1 month at the most to maintain the additional class notations CG(O),CG(O1)
- the postponement granted shall not delay the subsequent thorough examinations to be carried out at the dates originally scheduled
- the postponement granted does not prejudge the position which could be adopted by the Authorities who have jurisdiction over the working site (Port Authorities or Coastal State Authorities).

3.1.4.3. Upon Owner's request, a twelve-monthly postponement shall be granted by the Society for the carrying out of a thorough quinquennial examination provided that an annual (or six-monthly) thorough examination takes place either at the scheduled date or at the date postponed as per [3.1.4.2].

Note 1: No postponement shall be granted for re-testing due to repairs, changes in elements or conversions ([3.4.5], [3.5.1.8] and [3.5.2.5]).

3.1.5. Practice concerning the construction of fixed offshore installations shall have enacted more severe regulations than the requirements of this chapter.

3.1.5.1. These National Authorities shall be those of the ship flag or of the offshore unit and/or those who have jurisdiction over the working site (Port Authorities or Coastal State Authorities).

It is the responsibility of the Owners or Operators to check that the requirements of this Section especially those concerning periodicity of surveys, examinations or postponements are admissible by the Authorities concerned.

3.1.5.2. When a Cargo Gear Register has been issued in compliance with special national regulations, the validity of this Register shall be maintained in accordance with these regulations; however when the requirements of this Section are not inconsistent with the previsions of the national regulations, they may be applied wholly or partly.

3.1.5.3. It is to be noted that the Society is empowered only by some governments to carry out statutory surveys and to deliver certificates or attestations within the scope of their own regulations. Admissibility of the relevant requests for such interventions shall examined by the Society.

3.2. Six-monthly or annual thorough examinations

3.2.1. General

3.2.1.1. The Cargo Gear Register and its attached documents must be shown to the Surveyor who will ascertain that they are brought up to date and especially that no alteration has been made to the equipment since the last thorough examination.

3.2.1.2. The responsible person of the ship or of the offshore unit is to take all the necessary steps to allow the Surveyor to carry out thorough examinations under satisfactory conditions of safety.

3.2.1.3. As far as possible, the elements to be examined are to be brought down to deck. In particular, the derrick booms and the crane jibs are to be lowered to facilitate their inspection.

Close up survey of hinges, bearings and supporting structure. If accessible, bearing clearances are to be measured in accordance with manufacturer's Operation and Maintenance manual.

3.2.1.4. The ladders, gangways or other means of access used for inspection are to be in sound condition. If not so, repairs may be required before the Surveyor carrying out the examination.

3.2.1.5. The Surveyor may require the provision of a safety harness and fitting of guard rails or other protecting devices for his own safety.

3.2.1.6. The elements for which the Surveyor considers dismantling is necessary are to be dismantled and re-assembled by skilled personnel under the responsibility of a member of the ship's staff. They are to be properly cleaned and degreased before examination.

3.2.1.7. The Surveyor may require removal of the protective coatings (planking, flooring, sheathing, painting, etc.) particularly for crack and/or corrosion detection, or thickness checking.

3.2.1.8. The methods for repairs, the criteria for replacement and the re-testing due to repairs or replacements are defined in [3.4] of this section.

3.2.2. Fixed parts and connections with hull

3.2.2.1. The fixed structures of the lifting appliances must be checked to ascertain that there is no corrosion, deformation and other damages likely to hinder their reliability.

Special attention is to be paid to their connections especially with the hull, where risks of corrosion are the most important.

3.2.2.2. The structure adjacent to the places where lifting appliances are fixed to the structure of the ship or of the platform is to be examined above and under deck.

The mounting rings for cranes and rails for gantry-cranes are to be carefully examined.

3.2.3. Removable structures and fittings

3.2.3.1. The joints of moving or hinged structures (forks, pivots, goosenecks, jib heel pins, span trunnions, etc.) are to be examined to ascertain that there is no crack or deformation and that they are in good maintained condition and suitably greased.

It is recalled that the Surveyor is always authorized to ask for dismantling if necessary, in particular if abnormal clearances are noticed.

3.2.3.2. The crane jibs are to be examined to check that they are not distorted, buckled or corroded and that there is no trace of impacts or abnormal wear especially on the surfaces in contact with stowage cradles. The built-in sheaves are to be examined as per [3.2.4.3].

3.2.3.3. The connections of braces and struts of lattice structures are to be carefully inspected to detect possible cracks or corrosion.

3.2.3.4. The fittings intended for fixing the rigging accessories are to be examined as per [3.2.2.1].

3.2.3.5. The crane slewing rings and their fixing elements are carefully examined to detect possible cracks at random, by hammer tests or any other suitable means, and to ascertain that abnormal clearances have not developed. It is recommended to carry out this inspection in the presence of a representative from the crane manufacturer and to take into account his recommendations (within permissible limits) and those given in the operating manual of the crane.

3.2.3.6. The requirement [3.2.3.5] applies to bogies of gantry cranes or travelling cranes.

3.2.3.7. When fixing bolts have been removed to check their good condition they must be retightened to the torque stipulated by the manufacturer or, failing that, to the torque given in Ch-3, Sec-4, [4.2.3.4] according to steel bolt quality. It is however recommended to replace the removed bolts by new bolts ,refer [3.4.2.6].

3.2.4. Loose gear

3.2.4.1. Every item of loose gear is to be examined to check that it is not distorted or cracked and that wear or corrosion is within acceptable limits.

3.2.4.2. It shall be checked that locking devices of pins, nuts or swivels are not damaged or missing.

3.2.4.3. Blocks are examined to check that sheaves rotate freely around their axis and that grooves are not abnormally or excessively worn.

Three cases of abnormal wear of a block groove are shown on Fig 4.3.1.

a) symmetrical wear on both sides of groove: in general means that the groove radius is not sufficient but may also means that the fleet angle of the rope ,refer Ch-2, Sec-2, [2.1.2.4] is too great

b) symmetrical wear very much localized at the bottom of groove: usually means that the radius of block groove is too great

c) dissymmetrical wear on one side: usually occurs on blocks the head fitting of which is not free enough, the block is not freely positioned in the plane formed by both directions of the rope (no swivel for instance). In such a case, the block head fitting is to be carefully examined.

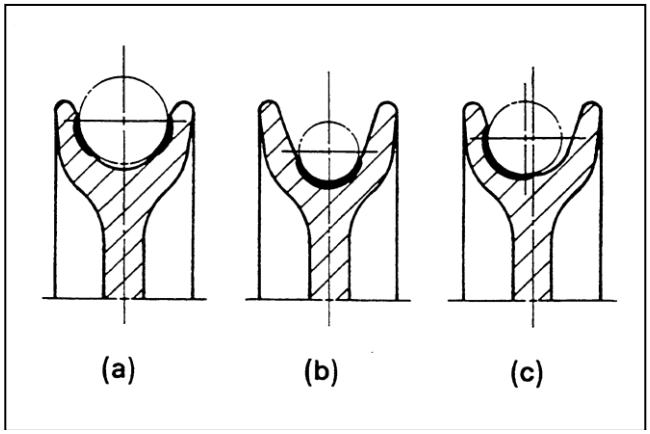


Figure 4.3.1: A normal wear of block groove

3.2.4.4. The existing items of loose gear in wrought iron are to be replaced as soon as possible by accessories made of steel or other materials not subject to metallurgic ageing and which do not require to be heat-treated at regular intervals.

Until they are replaced, the items of loose gear in wrought iron (chains, rings, hooks, shackles, swivels) are to be annealed at regular intervals.

The periodicity for annealing is 6 months for the elements with a diameter lower than or equal to 12.5 mm and one year for the others. If however the above mentioned elements are part of hand-operated tackles or apparatus, the above periodicity may be doubled.

Annealing is to be carried out in a suitable furnace and not in an open fire.

3.2.5. Wire and fiber ropes

3.2.5.1. Wire and fiber ropes are to be inspected to check or to detect:

- corrosions or chemical attacks
- wear condition, especially on curved portions
- broken wires or strands
- deformation or straining of wires and strands (wire extrusions, kinks, protusions of core, bends, flattened portions, etc.)
- local increase or decrease in rope diameter
- condition of rope terminations inclusive of winch end fastenings.

The construction of the wire rope is to comply with a recognized standard such as API Spec 9A, EN 12385 or ISO 2408.

3.2.5.2. Absence of internal corrosion or damage is to be checked at random preferably choosing places where the rope is especially exposed and where variations in diameter are noticed.

Generally, the internal examination at random of non-rotating ropes is necessary to ascertain that breaking of wires or strands not normally visible has not occurred.

3.2.5.3. The terminations of shrouds and pendants are to be carefully examined to detect corrosion due to infiltration into the rope sockets.

3.2.5.4. Temporary shrouds (removable stays) and slings in store are also to be examined.

3.2.5.5. After examination, the wire ropes must be suitably lubricated.

3.2.5.6. Wire Rope Test

All wire ropes are to have a certificate of test, furnished by the manufacturer or the certificating authority, showing the breaking test load of a sample. The certificate is to show also standard of construction, size of rope, number of strands, number of wires per strand, lay, core, quality of wires, date of test, and is to be submitted for inclusion in the Register of Lifting Appliances. .

3.2.5.7. Subsea lifting

When performing subsea lifting, the wires are to be lubricated every 6 months unless they are renewed every 2 years.

3.2.6. Winches

3.2.6.1. Winches and their reduction gears are to be examined to check their general maintenance conditions: absence of corrosion, suitable lubrication of the gear, condition of the attachments and foundations.

3.2.6.2. The locking devices (pawls, ratchet-wheels) are checked to detect possible cracks.

3.2.6.3. The connections of the end flanges with the drum are to be examined to detect corrosion and possible cracks.

3.2.6.4. Good condition of the rope end fastenings is to be checked.
It must be ascertained that three safety turns remain on the drum in operating condition and two safety turns when the lifting appliance is in stowed condition.

3.2.6.5. Wear condition of the brake linings is to be checked.

3.2.7. Operation and safety devices

3.2.7.1. Good operation of the machinery, of its control devices and of the brakes is to be checked in carrying out no load movements in the presence of the Surveyor.

3.2.7.2. The visible parts of the electric, hydraulic or air circuits are to be examined to ascertain that they have not suffered damage likely to hamper their reliability.

3.2.7.3. It must be checked that the various safety devices (safety valves, fuses, guards, limit switches, load indicators, emergency stops, etc.) are fitted and in good operating conditions.

3.3. Quinquennial thorough examinations

3.3.1. General

3.3.1.1. The procedure described in [3.2] of this section for annual or six-monthly thorough examinations is applicable to the quinquennial thorough examinations which is to be, as a rule, completed by dismantling, thickness measurements, systematic checking and by compulsory retesting of the lifting appliances.

3.3.1.2. The typical procedure of the quinquennial thorough examination normally includes:

- checking for compliance of the existing arrangements with the rigging drawings and the certificates attached to the Cargo Gear Register
- thickness measurements at random of the structural elements
- thorough examination of the dismantled elements
- re-testing of the lifting appliances after re-assembling
- thorough examination after testing.

3.3.1.3. Attention is drawn to the requirement [3.1.3.3] of this section especially to the last paragraph which gives the Surveyor full discretion to strengthen or to reduce the typical procedure except for re-performing of the tests which is compulsory.

3.3.2. Systematic checking of the location and marking of loose gear

3.3.2.1. The Surveyor checks that the rigging list is up-to-date and corresponds actually to the existing arrangements onboard.

3.3.2.2. It is to be ascertained that relevant test certificates of the existing loose gear are onboard.

3.3.3. Thickness measurements

3.3.3.1. The number of thickness measurements is determined by the Surveyor depending on the general maintenance conditions and on the results of the first measurements made.

3.3.3.2. When the thickness of an element cannot be measured directly, it is to be measured preferably by means of a suitably calibrated ultrasonic device or failing that by means of drillings (not to be carried out in highly stressed areas).

3.3.3.3. As a rule, from the third quinquennial thorough examination the thickness measurements are to be systematically made.

The check points and the resulting values are to be noted on a sketch to be kept together with the documents attached to the Cargo Gear Register.

3.3.4. Systematic dismantling

3.3.4.1. As a rule, every hinged connection is to be stripped down to allow checking of the state of pins and bearings. In particular, this is true for:

- jib heel pins
- joints of rigid stays.

3.3.4.2. The blocks and their pins inclusive of the built-in sheaves are to be dismantled. The side plates of the blocks are to be carefully examined to detect possible cracks and corrosion.

3.3.4.3. Several fixing bolts of the mounting and slewing rings of the cranes must be removed to check their condition.

Systematic replacement of the fixing bolts (screws, nuts and washers) is recommended particularly on cranes operated extensively on the open sea ,refer [3.4.2.6] of this section.

The mounting and slewing rings of the cranes must be especially examined to detect possible cracks by nondestructive tests (dye penetrant tests, ultrasonic or magnetic crack detection).

3.3.4.4. The ropes must be examined externally over their whole length and internally in several places selected by the Surveyor.

3.3.4.5. All the dismantled elements must be suitably greased before being re-assembled.

3.3.5. Re-testing

3.3.5.1. All the lifting appliances must be tested upon each quinquennial thorough examination.

3.3.5.2. The requirements of Sec-2, [2.9] of this chapter are applicable to re-testing, however, the tests may be less complete than those required prior to putting into service of the lifting appliance provided the Surveyor agrees on it. However, they must include at least:

- an overload test under the proof load specified in Sec-2, Table 4.2.2.
- maneuvering tests which may be carried out with no load or under a load lower than the SWL of the lifting appliance.

3.3.5.3. The overload test may be carried out by means of a spring or hydraulic dynamometer when gauged loads are unavailable. This procedure is however to be exceptional and reserved to low capacity lifting appliances.

The guaranteed accuracy of the dynamometer must be within ± 2.5% and calibration is to be checked biennially by a recognized and competent organization. The relevant calibration certificates are to be made available to the Surveyor.

The test force must be applied long enough to keep in position the pointer of the dynamometer for at least 5 min.

The fixing points of the dynamometer are to be suitably reinforced to withstand the test force.

3.3.5.4. The maneuvering tests aim at checking proper and sound operations of the lifting appliances, of their mechanisms and of their control systems. Special attention is to be paid to soundness operation of the locking and braking devices.

3.4. Repairs and criteria to replace equipment or accessories

3.4.1. General

3.4.1.1. The elements which are excessively deformed, cracked, worn or corroded must be either repaired or replaced in agreement with the Surveyor.

3.4.1.2. The rusted elements or those the paint of which has been removed for examination must be repainted with a suitable anti-corrosive paint.

3.4.1.3. When an element or accessory is in such a condition that it is necessary either to repair it or to replace it shortly but not at once, the Surveyor may allow a certain period of time to do so; this period is not to end after the due date of the next thorough examination.

The contemplated repair or replacement and the period of time allowed are to be mentioned on the Cargo Gear Register.

3.4.1.4. The Surveyor may exceptionally accept temporary repair to permit continued service of the lifting appliance.

The fact that repair is temporary and the period of time allowed until final repair (duration which shall not exceed the one as per [3.4.1.3]) are to be duly noted on the Cargo Gear Register.

3.4.1.5. In some cases, the Surveyor may require and mention on the Cargo Gear Register that a special attention is to be paid to the satisfactory behaviour in service of repair or replacement.

3.4.1.6. In the cases as per [3.4.1.3], [3.4.1.4] and [3.4.1.5], it is the responsibility of the responsible person onboard the ship or offshore unit to have the concerned elements frequently inspected, by a designated member of the staff, for satisfactory behavior.

3.4.1.7. The final decision concerning repair or replacement of parts is to be made by the Surveyor of the Society.

3.4.2. Wear limits and criteria for replacement

3.4.2.1. The maximum allowable wear by friction or corrosion is estimated by the Surveyor depending on the element concerned, on its working conditions and on the possible effects of its failure on the reliability of the lifting appliance.

3.4.2.2. The maximum wear limits are given hereafter for guidance, however repair or replacement of the element concerned may be required by the Surveyor before these limits are reached ,refer [3.4.1.3]):

- plate thickness of load carrying members:
  - 10% reduction in thickness at any point
  - 20% for very localized wear or corrosion which concerns only a small portion of the cross-section of a structure
- sections:
  - 10% reduction in cross sectional area for any primary element in case of wear or corrosion evenly distributed over the considered cross-section
  - 20% locally when the section concerned is a secondary element only
- elements of circular cross-sectional area:
  - 3% reduction in diameter at any point on the same cross-section (with 1 mm at least)
  - 5% locally in a particular direction (with 1 mm at least).

3.4.2.3. When the plates, sections and elements of circular cross-section have reached the maximum wear limit indicated above, they are to be replaced.

In agreement with the Surveyor, very localized corroded areas may be built up by welding.

3.4.2.4. The pins which have reached the wear limit must be replaced.

It is necessary to check that the apparent wear of a pin is not actually a deformation due to shear which requires immediate replacement whatever the magnitude of the deformation noticed (refer Fig 4.3.2).

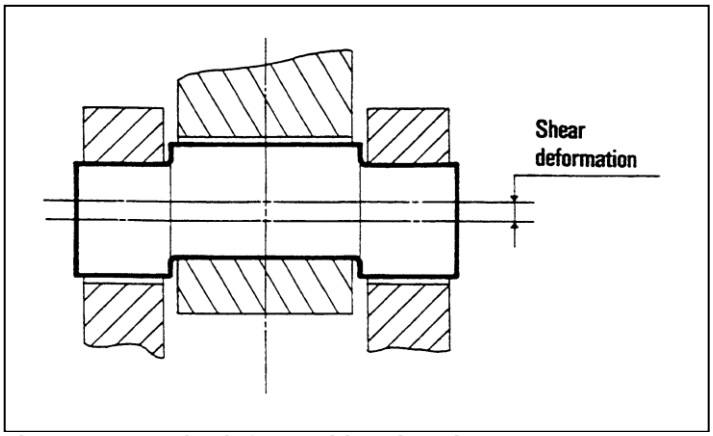


Figure 4.3.2: Pin deformed by shearing

3.4.2.5. It is to be remembered (refer [3.2.4.4]) that the existing items of loose gear in wrought iron must be replaced as soon as possible by items made of steel or other materials which do not require to be periodically heat-treated.

No new item of loose gear or other accessory in wrought iron will be accepted.

3.4.2.6. When pre-stressed high tensile steel bolts are removed (refer [3.2.3.7] and [3.3.4.3]),it is recommended to replace them by new ones.

The screws shall however be kept until the next dismantling if they are in excellent condition; the washers and nuts are to be replaced systematically upon each dismantling.

Replacement of fixing bolts shall be made before retesting the lifting appliance.

3.4.3. Rope discard criteria

3.4.3.1. The wire ropes must be discarded and replaced in the following cases:

- when damages such as wire extrusions, kinks, core protrusions, bends, flattened portions, increase or decrease in diameter, etc., are noticed
- when the sectional area of the outer wires is reduced by 40% due to wear or corrosion
- when internal corrosion is noticed
- when a strand is broken
- when the number of broken wires results in 5% reduction of the metal sectional area of the rope on a rope length equal to 10 times its diameter. For application of this criterium, wires highly corroded or deformed and those which have reached the wear limit of 40% mentioned above are to be considered as broken.

3.4.3.2. The above criteria are given for guidance. Reference can also be made to the standard ISO 4309-2004: “Wire rope for lifting appliances - Code of practice for examination and discard”, which gives detailed particulars in this respect.

Each time deemed necessary, the Surveyor may require replacement of a wire rope before the discard criteria are entirely met , refer [3.4.1.3].

3.4.4. Repairs

3.4.4.1. Repairs must be made in agreement with and under the survey of a Surveyor of the Society.

3.4.4.2. The materials used for repairs must be inspected in accordance with the requirements of Ch-2, Sec-2, [2.3]. The inspection certificates or attestations, as the case may be, must be shown to the Surveyor.

Reference is to be made to the original construction drawings in order to determine the quality of the materials to be used.

3.4.4.3. When repairs by welding are concerned it must be ascertained that the elements to be repaired are of weldable quality and that welding is not likely to impair their characteristics.

Usual precautions are to be taken to avoid residual welding stresses especially when an element with no free contraction after welding is carried out.

In some cases, heat-treatment may be required after welding.

3.4.4.4. When repairs after important or repeated damages are concerned, the Surveyor may require reinforcements in order to prevent their recurrence. When deemed necessary, the Surveyor may ask the Society for its opinion.

3.4.4.5. All cracks are to be entirely eliminated. Dye penetrant or magnetic crack detection tests must be carried out to ensure this.

3.4.4.6. Reconditioning of pins, rotating parts or bearings by means of re-machining can only be accepted by the Surveyor, if the reduction of the diameter of the pin or the increase of the bore does not exceed 2% of the diameter originally provided. Outside these limits, the opinion of the Society is to be requested prior to repairing.

3.4.4.7. The repairs of crane slewing rings and more generally of mechanisms must be carried out in specialized workshops and in accordance with the recommendations of the manufacturer and shipbuilder.

3.4.5. Tests after repairs or replacements

3.4.5.1. Items of loose gear repaired in such a way that their strength may be affected must individually be re-tested in accordance with the requirements of Sec 2, [2.7] of this chapter.

When an item of loose gear is replaced by a new one the latter must be tested separately as here above stated.

In both above mentioned cases, the lifting appliance need not be re-tested (except within the scope of quinquennial thorough examination). The test certificates of the new or re-tested items of loose gear must be attached to the Cargo Gear Register.

3.4.5.2. When repairs or replacements concern a load carrying element of a structure or an accessory for which an individual test is not required, the lifting appliance is to be re-tested after repair.

The purpose of this re-testing is to submit the concerned element to a strength test and possibly the lifting appliance to a maneuvering test if repairs are liable to affect its good working conditions.

These tests must include at least a test with an overload in compliance with the requirements of Sec 2, [2.9] of this chapter carried out in such a way that the concerned element be submitted to the maximum forces it has to withstand in the most critical loading conditions.

These test conditions are to be determined in agreement with the Surveyor and specified on the relevant test certificate.

The tests thus carried out will not result in postponing the date of the next overall tests to be performed within the scope of a quinquennial thorough examination.

3.4.5.3. In spite of the requirements as per [3.4.5.2], in some cases (for example replacement of a pin) waiving of the tests of the lifting appliance as rigged may be accepted provided that the concerned element be submitted separately to a proof load determined as per the requirements of Sec 2, [2.7] of this chapter (see Note-1 below) and provided that the load conditions during testing be representative of the load conditions to which the element would have had to withstand during a test of the lifting appliance as rigged.

It is necessary however to ascertain that the element concerned may withstand the prescribed overload (see Note) without damage. In case of doubt, it is advisable to dispense with this special test procedure and to carry out the overall test.

Note 1: For the purpose of this requirement the proof loads to be determined as indicated in (d) of Table 4.2.1.

3.4.5.4. When a lifting appliance has been dismantled and then re-assembled, it has to be re-tested.

If only its fastening with the support has been dismantled, the tests may be limited to an overload test under the conditions corresponding to the maximum overturning moment. (Replacement of fixing bolts is to be regarded as dismantling).

If dismantling is complete, the tests must include manoeuvring tests to the Surveyor's satisfaction in addition to the overload test.

3.5. Occasional interventions after damage or conversion

3.5.1. Survey after damage

3.5.1.1. If a lifting appliance or the local structure supporting it is damaged the Owner or his Representative must apply to the Society as soon as possible to have the lifting appliance surveyed.

3.5.1.2. When the damage concerns elements within the scope of classification of the ship, i.e. parts of the lifting appliance definitively fixed to the ship and the local hull structure support, the aim of the survey is double:

a) maintaining of the class of the ship
b) maintaining of the additional class notations and of the validity of the Cargo Gear Register.

3.5.1.3. When the damage concerns elements outside the scope of classification of the ship, the survey is carried out to maintain additional class notation and validity of the Cargo Gear Register.

3.5.1.4. The circumstances and, where known, the probable origin of the damage are to be communicated to the Surveyor who have to mention them in his report in giving the origin of the gathered information.

3.5.1.5. The recommended repairs are to be accepted by the Surveyor and carried out under his survey in accordance with the applicable provisions of [3.4.3]. If re-building differs from the original construction, the relevant drawings are to be submitted to the Society for approval, within the limits fixed in Ch-1, Sec-2, [2.3].

3.5.1.6. The Society is entitled to require additional studies, reinforcements or fitting of additional safety devices to prevent recurrence of the damage.

3.5.1.7. The Surveyor may put on the Cargo Gear Register when the necessary repairs cannot be carried out at once and provided the damage does not affect the overall strength of the ship, that the use of the damaged lifting appliance is not allowed until it is repaired.

3.5.1.8. After repair, the lifting appliance is to be tested as per [3.4.5].

3.5.2. Conversion

3.5.2.1. Any project of conversion which aims at modifying the characteristics of the lifting appliance and affecting either its strength or its operation must be submitted to the Society for approval prior to starting the corresponding works.

3.5.2.2. When change in the main characteristics of a lifting appliance (for example increase in SWL of span or alteration of the operating service conditions) is contemplated, it is strongly recommended to entrust a specialized shipyard with the relevant study or, preferably, the original manufacturer of the lifting appliance; it is their responsibility to submit the study to the Society for approval.

3.5.2.3. In some cases however, the Society may accept the execution of a study at the request of the Owner, in order to inform him about feasibility of the conversion project. If an increase in SWL is considered, the study would consist:

- on the one hand, of analyzing the forces involved in order to determine whether the scantlings of the ropes are still acceptable and whether the individual SWL of the items of loose gear remains sufficient
- on the other hand, of verifying the scantlings of the structural elements of the lifting appliance and of its support in order to determine whether the existing scantlings are still acceptable or whether reinforcements are necessary.

Items of loose gear the SWL of which is not sufficient are to be either replaced by new ones to be tested and inspected as per Sec-2 of this section or re-tested as per Sec-2, [2.7] of this chapter when their strength is considered as sufficient. The drawings showing the alterations and final reinforcements are to be submitted to the Society for approval.

3.5.2.4. The materials used are to comply with the requirements of Ch-2, Sec-2, [2.3] and the alteration works are to be carried out under the survey of a Surveyor of the Society in accordance with the applicable provisions of [3.4.4] and of Sec 2.

3.5.2.5. After conversion, the lifting appliance is to be re-tested in compliance with the applicable requirements of [3.4.5] and of Sec-2, [2.9] of this chapter.