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RULES FOR CARGO HANDLING APPLIANCES

Chapter 1 GENERAL

1.1 General

1.1.1 Application

1 The Rules for Cargo Handling Appliances (hereinafter referred to as "the Rules") apply to the power operated cargo handling appliances which are installed on the ships classed with NIPPON KAIJI KYOKAI (hereinafter referred to as "the Society"), and which are intended to be registered under **Chapter 3 of the Regulations for the Classification and Registry of Ships**.

2 The relevant requirements in **the Rules for the Survey and Construction of Steel Ships** apply to the materials, equipment, installation and workmanship of the cargo handling appliances, unless otherwise specified in the Rules.

3 Cranes used for personnel transfers are to comply with the requirements specified in the **Annex 1.1.1-3 "Additional Requirements for Cranes Used for Personnel Transfers"**, in addition to the requirements specified in the Rules.

4 For mobile offshore drilling units, the requirements specified in this Rule are to be complied with, and in addition, the requirements specified in 12.1 to 12.4, the "*2009 MODU Code*" defined in **1.2.36**, **Part P of the Rules for the Survey and Construction of Steel Ships** are to be complied with.

1.1.2 Equivalency*

1 Cargo gear, cargo ramps and loose gear which do not comply with the requirements of the Rules may be accepted, provided that they are considered by the Society to have the effectiveness equivalent to those complying with the Rules.

2 Any existing cargo gear, cargo ramps and loose gear designed and manufactured not under the requirements of the Rules may be deemed by the Society to comply with the Rules, provided that they comply with any rules or standards recognized by the Society to be appropriate and have passed the tests and inspection required by the Society.

1.1.3 Precautions in Application*

1 As for the cargo gear, cargo ramps and loose gear, precautions are to be taken to any manners of their treatment different from the requirements of the Rules in the flag state of the ship or state of call.

2 The Society may carry out inspection and issue necessary certificates for the cargo handling appliances according to the designated rules in the capacity of the government of the state concerned or other organization under the authorization by such state or organization.

1.2 Definitions

1.2.1 Terminology*

For the purpose of the Rules, the terms are defined as given in **(1)** through **(18)** below unless otherwise defined:

(1) Cargo handling appliances are lifting appliances and loose gear.

(2) Lifting appliances are cargo gears and cargo ramps include their installations of driving systems and cargo fittings.

(3) Cargo gears are derrick systems, cranes, cargo lifts and other machinery used for the loading and unloading of cargo and other articles except cargo ramps, and include their installations of driving systems and cargo fittings.

(4) Structural members are those of cargo handling appliances carrying the safe working load, including cargo fittings and cargo blocks permanently incorporated in the cargo gear and the cargo ramps.

(5) Cargo fittings are goose neck brackets, topping brackets, fittings at the derrick boom head, derrick heel lugs, guy cleats, eye fittings, etc. which are permanently fitted to the structural members or the hull structure for the purpose of cargo handling.

(6) Loose gears are blocks, ropes, chains, rings, hooks, shackles, swivels, clamps, grabs, lifting magnets, spreaders, etc. which are removable parts used for transmitting the loads of cargo to the structural members.

(7) Safe working load is the maximum allowable mass of cargoes specified by the Rules with which the cargo gear and the cargo ramp can be safely operated. It is abbreviated to "*SWL*" and expressed in *tons* (*t*).

(8) Allowable minimum angle is the angle to horizontal of a derrick boom at which the derrick system is permitted to operate under the safe working load, and expressed in *degrees* (°).

(9) Maximum slewing radius is the radius at which a jib crane is permitted to operate under the safe working load, and expressed in *meters* (*m*).

(10) Safe working load, etc. are safe working load, allowable minimum angle and other restrictive conditions in case of the derrick systems, safe working load, maximum slewing radius and other restrictive conditions in case of the jib cranes, safe working load and other restrictive conditions deemed necessary by the Society in case of other machinery used for the loading and unloading of cargo, and safe working load and other restrictive conditions deemed necessary by the Society in case of the cargo ramps.

(11) Safe working load of a loose gear is the maximum allowable mass of cargoes specified by the Rules with which the loose gear can be used safely. It is abbreviated to "*SWL*" and expressed in *tons* (*t*). For cargo blocks, the safe working load is defined according to **(a)** or **(b)** below:

(a) The safe working load of a single sheave block is the maximum mass of cargoes that can be safely lifted by that block when it is suspended by its head fitting and the mass is secured to a wire rope passing round its sheave.

(b) The safe working load of a multiple sheave block is the maximum mass of cargoes that may be applied to its head fitting of the block.

(12) Derrick systems are installations for handling cargo by suspending the cargo from the top of the derrick boom fitted to derrick post or mast, including those specified in **(a)**, **(b)** and **(c)** below:

(a) The end of topping lift being fixed, two guy ropes fitted at the top of the derrick boom are wound by independent winches respectively to swing the boom horizontally (hereinafter referred to as "*swinging derrick system*").

(b) Two derrick booms, on port and starboard sides, in pair are fixed at predetermined positions. The cargo falls of two derricks are connected to load or unload the cargo (hereinafter referred to as "*union-purchase derrick system*").

(c) The cargo fall can be paid out or heaved in and luffing and slewing of derrick boom can be carried out singly or simultaneously while the cargo is suspended (hereinafter referred to as "*derrick crane system*").

(13) Cranes cover jib cranes, gantry cranes, overhead cranes and hoists, cargo davits, etc. and are capable of performing the works of cargo loading and unloading, slewing and/or horizontal movement simultaneously or separately.

(14) Cargo lifts are the installations designed to contain the cargo in their structure to loading and unloading the cargo.

(15) Cargo ramps are the installation mounted on the shell or provided in the ship, and arranged to permit passage of vehicles as cargo or vehicles loaded with cargo on themselves and having mechanism enabling its opening and closing or turning.

(16) *JIS* is an acronym for Japanese Industrial Standards.

(17) Lifting load is the sum of the safe working load defined as the maximum mass of cargoes themselves to be suspended and the mass of accessories such as hooks, cargo blocks, grabs, buckets, lifting beams, spreaders, etc. Unless otherwise deemed necessary by the Society, the mass of wire ropes used as cargo falls need not be taken into account except when the installation is designed for a lift of 50 *m* or more.

(18) The acceleration of gravity is to be equal to 9.81 m/sec^2.

1.3 Arrangement, Construction, Materials and Welding

1.3.1 Arrangement

1 The arrangement and dimensions of the cargo gear and the cargo ramps are to be determined with due consideration given to avoid interference with manoeuvring lights, navigation lights and other functions of the ship.

2 When same parts of the cargo gear are utilized commonly for other functions, such as ventilators, or important systems or equipment designed for other purposes, or further, when some systems or equipment for other purposes are mounted on them, due considerations are to be given to avoid undue interference with each other in relation to their functions and strength.

3 When any parts of the cargo gear and the cargo ramps project beyond the ship's side under the working condition, it is recommended that such parts are to be of retractable, foldable or removable type designed for stowing within the line of ship's side

when not in use.

4 The cargo gear and the cargo ramps are to be provided with equipments for securing the movable parts when not in use.

1.3.2 General Construction*

1 The cargo gear and the cargo ramps other than those used ordinary trim and heel in calm weather and sea states, are to comply with, in addition to the requirements in the Rules, such additional requirements as considered appropriate by the Society for the actual working condition.

2 The requirements in **Chapter 3**, **4** and **8** assume the use of hull structural rolled steels specified in **3.1, Part K of the Rules for the Survey and Construction of Steel Ships**. High tensile steels used in the structural members, if any, are to comply with requirements specially made up by the Society. The construction and dimensions of the structural members containing or made of materials other than those steel specified herebefore are to be specially considered by the Society.

3 The structural members are to be designed to avoid structural discontinuities and abrupt change of sections as far as practicable. The welded joints are to be arranged to avoid the parts where concentration of stress is expected.

4 Corners of openings in the structural members are to be appropriately rounded off.

5 Openings causing dimensional anisotropy in the structural members are to be so arranged as their long sides or long axes may assume parallel to the direction of principal stresses.

6 Where two members having remarkably different stiffness are directly connected with each other, proper reinforcement is to be made by means of brackets, etc. to maintain the continuity of stiffness. Special consideration is to be given to the connection to the hull structures.

7 The cargo blocks of the structural members are to comply with the requirements in **6.2**.

1.3.3 Direct Calculation of Strength

The dimensions of the structural members are to be determined by the method of direct calculation of strength approved by the Society using the design loads and allowable stresses specified in respective Chapters concerned, with the exception of those members for which calculation formulae are given in **Chapter 3**.

1.3.4 Materials*

1 The hull structural rolled steel used in the structural members are to be as given in **Table 1.1** depending on their thickness, except in cases considered appropriate by the Society.

2 For the cargo gear and the cargo ramps always used in especially cold zones or refrigerated hold chambers and for any other cases considered to be necessary by the Society, the Society may require the use of steel materials of higher notch toughness notwithstanding the requirement specified in **-1**.

3 Steel casting and steel forgings used in the structural members are, as a rule, to comply with the requirements in **5.1** and **6.1, Part K of the Rules for the Survey and Construction of Steel Ships** respectively or of equivalent qualities.

4 The materials of bolts and nuts used for connection of components of the structural members are to be considered appropriate by the Society.

5 Wire ropes used as components of the structural members are to be those specified in **Part L of the Rules for the Survey and Construction of Steel Ships** for use as standing riggings or of an equivalent quality.

6 The materials used in the main parts of the installations of driving systems are to comply with the standard in **Part K of the Rules for the Survey and Construction of Steel Ships** or any standards recognized by the Society to be of equivalent qualities.

Table 1.1 Thickness and Grades of Steels

Thickness t (mm)	$t \leq 20$	$20 < t \leq 25$	$25 < t \leq 40$	$40 < t$
Grade	*A*/*AH*	*B*/*AH*	*D*/*DH*	*E*/*EH*

Note: *A*, *B*, *D*, *E*, *AH*, *DH*, and *EH* in the Table correspond to the following material grades.

A:*KA*
B:*KB*
D:*KD*
E:*KE*
AH:*KA*32, *KA*36 and *KA*40
DH:*KD*32, *KD*36 and *KD*40
EH:*KE*32, *KE*36 and *KE*40

1.3.5 Welding*

1 The Welding of the structural members is to comply with the requirements in **Part M of the Rules for the Survey and Construction of Steel Ships** and the additional requirements considered necessary by the Society according to the types of construction.

2 The arrangement of welded joints in the structural members is to be specially considered to avoid remarkable difficulties in welding work.

1.3.6 Prevention of Corrosion

1 The structural members are to be protected against corrosion with coating of a good quality or using other proper means.

2 Any parts liable to the accumulation of rainwater or dew condensation are to be provided with proper draining means.

Chapter 2 SURVEYS

2.1 General

2.1.1 Application*

1 The requirements in this Chapter apply to the tests and surveys for the cargo handling appliances.

2 Where the structural members of the cargo handling appliances are permanently fitted to the hull structure or where they form an integral part thereof, the tests and surveys for these parts are to comply with the requirements in this Chapter and, in addition they are to comply with the relevant requirements of the **Rules for the Survey and Construction of Steel Ships**.

3 At the Periodical Surveys, the Society's Surveyor (hereinafter referred to as "Surveyor") may require other than those specified in **2.2** through **2.5** in this Chapter where deemed necessary.

4 With respect to Annual Thorough Surveys in cases where considered appropriate by the Society, the Surveyor may modify the extent and contents of the tests and surveys specified in **2.2** through **2.5** in this Chapter, where deemed appropriate, based on the purpose, construction, age, history, results of the previous surveys and the current condition of the cargo handling appliances.

2.1.2 Preparation for Surveys and Others*

1 All such preparations as required for the survey to be carried out as well as those which may be required by the Surveyor as necessary in accordance with the requirements in the Rules are to be made by the applicant of the survey. The preparations are to include provisions of an easy and safe access, necessary facilities and necessary records for the execution of the survey. Inspection, measuring and test equipment, which Surveyors rely on to make decisions affecting classification are to be individually identified and calibrated to a standard deemed appropriate by the Society. However, the Surveyor may accept simple measuring equipment (*e.g.* rulers, measuring tapes, weld gauges, micrometers) without individual identification or confirmation of calibration, provided they are of standard commercial design, properly maintained and periodically compared with other similar equipment or test pieces. The Surveyor may also accept equipment fitted on board a ship and used in examination of shipboard equipment (*e.g.* pressure, temperature or rpm gauges and meters) based either on calibration records or comparison of readings with multiple instruments.

2 The applicant for the survey is to arrange a supervisor who is well conversant with the survey items intended for the preparation of the survey to provide the necessary assistance to the Surveyor according to his requests during the survey.

3 The survey may be suspended where necessary preparations have not been made, any appropriate attendant mentioned in the previous **-2** is not present, or the Surveyor considers that the safety for execution of the survey is not ensured.

4 Where repairs are deemed necessary as a result of the survey, the Surveyor will notify his recommendations to the applicant of the survey. Upon this notification, the repair is to be made to the satisfaction of the Surveyor.

5 In cases where it is necessary to replace any fittings, equipment or parts, etc. used onboard, replacements are to comply with the regulations to be applied during ship construction. However, in cases where new requirements are specified or where deemed necessary by the Society, the Society may require that such replacements comply with any new requirements in effect at the time the relevant replacement work is carried out. In addition, replacements are not to use any materials which contain asbestos.

2.1.3 Presentation of Certificates

All of the certificates for cargo handling appliances issued by the Society are to be presented to the Surveyor when requested at the tests and surveys.

2.1.4 Records of the Surveys

The "Register of Ship's Cargo handling Machinery and Gear" is to be made necessary entries on it and endorsed by the Surveyor at the completion of the Surveys.

2.1.5 Notification of Survey Results

1 The Surveyor is to notify the results of the Survey to the applicant in a form of Survey Report.

2 In case where repairing is requested by the attending Surveyor, the repairs are to be made to his satisfaction.

3 The Survey Report in **-1** is to be kept in the specified file and presented to the Surveyor at the subsequent Survey.

2.1.6 Re-Survey

In case where the applicant has any complaints in the Survey carried out in accordance with the Rules, he may request execution

of re-survey in writing to the Society.

2.2 Surveys of Cargo Handling Appliances

2.2.1 Kinds of Surveys

The kinds of Surveys for cargo handling appliances are as follows:

(1) Surveys for registration (hereinafter referred to as "Registration Survey")
  (a) Registration Surveys during Construction
  (b) Registration Surveys of Cargo Handling Appliances not built under Survey

(2) Periodical Surveys for maintaining registration
  (a) Annual Thorough Surveys (Periodical Survey)
  (b) Load Tests (Periodical Survey)
  (c) Occasional Surveys
  (d) Unscheduled Surveys

2.2.2 Timing of Surveys*

The timing of the Surveys of cargo handling appliances are to be in accordance with the followings:

(1) A Registration Survey is to be carried out when the safety working load, etc. are assigned for the first time.

(2) Annual Thorough Surveys are to be carried out at the dates not exceeding 12 *months* from the date of completion of the Registration Survey or the previous Annual Thorough Survey.

(3) Load Tests are to be carried out when the cargo handling appliances fall under any of the following.
  (a) At the Registration Survey
  (b) At the dates not exceeding 5 *years* from the date of completion of the Registration Survey or the previous Load Test
  (c) At the Occasional Survey when deemed necessary by the Society

(4) An Occasional Survey is to be carried out when the cargo handling appliances fall under any of the following conditions at the time other than Periodical Surveys. To implement the survey, in lieu of the traditional ordinary surveys where a surveyor is in attendance, the Society may approve survey methods which it considers to be appropriate.
  (a) When serious damage is caused on the structural members and the repair or conversion is made
  (b) When major conversion is made in the cargo handling procedures, rigging arrangements, operation and control methods
  (c) When the assignment and marking of safe working load, etc. is altered
  (d) Other cases when considered necessary by the Society

(5) The classed ships may be subject to Unscheduled Surveys when the confirmation of the status of appliances by survey is deemed necessary in cases where the Society considers the appliances to be subject to **1.4-3** of the **Conditions of Service for Classification of Ships and Registration of Installations**. At Unscheduled Surveys, investigations, examinations or tests are to be made to the satisfaction of the Surveyor with respect to the matters concerned.

2.2.3 Periodical Surveys Carried Out in Advance

Periodical Surveys may be carried out in advance of the due date of each Survey upon application by the owner.

2.2.4 Postponement of Periodical Surveys*

Periodical Surveys may be postponed subject to approval by the Society. The period of such postponement is not to exceed 3 *months* from the date specified in **2.2.2**.

2.2.5 Laid-up Ships

1 Laid-up ships are not subject to Registration Maintenance Surveys. However, Occasional Surveys may be carried out at the request of owners.

2 When laid-up ships are about to be re-entering service, the following surveys and surveys for specific matters which have been postponed due to being laid-up, if any, are to be carried out.

(1) If the due dates for Registration Maintenance Surveys have not transpired while the ship was laid-up, then an equivalent to the Annual Thorough Surveys specified in **2.4** is to be carried out.

(2) If the due dates for the Annual Thorough Surveys specified in **2.4** have transpired while the ship was laid-up, such Annual Thorough Surveys are to be carried out.

(3) If the due dates for the Load Tests specified in 2.5 have transpired while the ship was laid-up, such Load Tests are to be carried out.

2.3 Registration Surveys

2.3.1 Drawings and Other Documents to be Submitted*

1 At a Registration Survey, it is to be ascertained that the strength and construction of the cargo handling appliances comply with the Rules based on the drawings and documents submitted to the Society. In this case, the applicant is to submit application form (**CG-APP**), in addition to the relevant drawings and documents out of listed in -2, -3 and -4.

2 The drawings and documents listed in the following **(1)** through **(11)** are to be submitted for approval for cargo handling appliances to be newly constructed:

(1) General arrangement of cargo gears and cargo ramps

(2) Construction drawings of cargo gears and cargo ramps (including the dimensions of structural members, specifications of materials and joint details)

(3) Drawings of cargo fittings (including the dimensions, specifications of materials and the fixing methods of these fittings with structural members or hull structure)

(4) Arrangement of loose gears (including rigging arrangement)

(5) List of loose gears (showing the construction, dimensions, materials and locations. For those in compliance with the well-known code or standard, the type symbol may be used in place of dimensions and materials)

(6) Construction drawings of driving gears

(7) Power system diagram

(8) Drawings of operation and control mechanism

(9) Drawings of safety devices

(10) Drawings of protective devices

(11) Other drawings and documents as deemed necessary by the Society

3 The drawings and documents listed in the following **(1)** through **(7)** are to be submitted for reference for cargo handling appliances to be newly constructed:

(1) Specifications for cargo gears and cargo ramps

(2) Calculation sheets or check sheets relevant to drawings and documents for approval specified in -2

(3) Operation manual for cargo gears and cargo ramps

(4) Procedures of non-destructive testing

(5) Procedures of Load tests

(6) Asbestos-free declarations and supporting documents

(7) Other drawings and documents as deemed necessary by the Society

4 At a Registration Survey of cargo handling appliances not built under Survey, the drawings and data to be submitted for the cargo handling appliances are to be same as specified in -2 and -3. However, some of these drawings and documents may be omitted instead of submitting the past survey records and certificates with respect to them subject to approval by the Society.

5 The plans and documents specified in -2 and -3 above are to be submitted the Society in accordance with **(1)** to **(3)** below.

(1) Where the submission of plans and documents by paper, 2 sets for the Society and necessary sets for returning to the applicant are to be submitted.

(2) Where the submission of plans and documents electrically, the plans and documents are to be submitted using the systems prepared by the Society.

(3) Where the submission of plans and documents by means other than **(1)** and **(2)** above, the plans and documents are to be submitted by the means deemed appropriate by the Society.

2.3.2 Survey*

1 Workmanship of cargo handling appliances is to be examined and ascertained to be in good order when any of the following **(1)** through **(5)** is relevant:

(1) When, in process of manufacturing and assembling of structural members, requested by the Society

(2) When structural members are installed on board the ship

(3) For driving gears, at the times when the finishing work on major parts is completed and when the Surveyor considers necessary during the process of manufacture

(4) When the subcontracted materials, parts or equipment are incorporated to the cargo handling appliances

(5) Other cases when considered necessary by the Society

2 Cargo handling appliances are to be examined and ascertained to be in good order by the following tests and surveys:

(1) Testing as specified in **Part K of the Rules for the Survey and Construction of Steel Ships** where the materials need to be in compliance with the requirements in **Part K**

(2) Testing as specified in **Part M of the Rules for the Survey and Construction of Steel Ships** where the welding works need to be in compliance with the requirements in **Part M**

(3) Non-destructive testing where requested by the Surveyor

(4) Shop trial of the driving gears

(5) Operation tests of the cargo handling appliances

(6) Operation tests of the safety devices and protective devices (including braking tests and electric power source cut-off tests with a testing weight equal to the safe working load applied (Hereinafter same in **2.4.1-1(2)(c)**, **2.4.2(2)(d)**, **2.4.3(2)(d)** and **2.4.4-1(2)(c)**))

(7) Other tests considered necessary by the Society

3 To implement the tests and the surveys specified in **-1** and **-2** (hereinafter referred to as survey in this sub-paragraph), in lieu of traditional ordinary surveys where the Surveyor is in attendance, the Society may approve other survey methods which it considers to be appropriate.

2.4 Annual Thorough Surveys*

2.4.1 Derrick Systems

1 At Annual Thorough Surveys, the following items in **(1)** are to be visually examined for derrick systems and ascertained to be in good order. Where considered necessary by the Surveyor, the items in **(2)** are to be examined.

(1) Items to be examined

(a) Structural members

(b) Connection between the structural members and hull structure

(c) Driving systems

(d) Safety devices and protective devices

(e) Markings of the safe working load, etc., and the effectiveness of the relevant certificates

(f) Preservation of the instruction manual on board the ship

(2) Items to be examined where considered necessary by the Surveyor

(a) Checking of plate thickness of the structural members, non-destructive testing and open-up examinations of the topping brackets, goose neck brackets and derrick heel lugs

(b) Open-up examination of the driving systems

(c) Operation tests of the safety devices and protective devices

2 Open-up examinations of the topping brackets, goose neck brackets and derrick heel lugs are to be carried out during Annual Thorough Surveys at intervals not exceeding five years from the date of completion of the Registration Survey or the previous open-up examination.

2.4.2 Cranes

At Annual Thorough Surveys, the following items in **(1)** are to be visually examined for cranes and ascertained to be in good order. Where considered necessary by the Surveyor, the items in **(2)** are to be examined.

(1) Items to be examined

(a) Structural members

(b) For stationary cranes, the connection between the structural members and hull structure

(c) For track-mounted cranes, rails, buffers and the connection between those members and hull structure

(d) Installations of driving system
(e) Safety devices and protective devices
(f) Markings of the safe working load, etc., and the effectiveness of the relevant certificates
(g) Preservation of instruction manual on board the ship

(2) Items to be examined where considered necessary by the Surveyor
(a) Checking of plate thickness of the structural members, non-destructive testing and open-up examinations of the bearings
(b) Inside of the posts, their legs and stiffeners of cranes
(c) Open-up examinations of the driving gears
(d) Operation tests of the safety devices and protective devices

2.4.3 Cargo Ramps

At Annual Thorough surveys, the items in **(1)** are to be visually examined for cargo ramps in detail and ascertained to be in good order. Where considered necessary by the Surveyor, the items in **(2)** are to be examined.

(1) Items to be examined
(a) Structural members
(b) Connection between the structural members and hull structure
(c) Connection between the stoppers and hull structure
(d) Water-tight or weather-tight arrangements of cargo ramps that are used as water-tight or weather-tight doors when closed
(e) The driving gears
(f) Safety devices and protective devices
(g) Markings of the safe working load and the effectiveness of the relevant certificates
(h) Preservation of the instruction manuals on board the ship

(2) Items to be examined where considered necessary by the Surveyor
(a) Plate thickness measurements, open-up-inspection of lifting pins, nondestructive tests, etc.
(b) Hose testing or airtight testing for cargo ramps that are used as water-tight or weather-tight doors when closed
(c) Open-up examinations of the driving gears
(d) Operation tests of safety devices and protective devices

2.4.4 Cargo Lifts, etc.

1 At Annual Thorough surveys, the items in **(1)** are to be visually examined for cargo lifts in detail and ascertained to be in good order. Where considered necessary by the Surveyor, the items in **(2)** are to be examined.

(1) Items to be examined
(a) Structural members
(b) Connection between the holding parts of cargo lifts and hull structure
(c) Connection between the lifting/lowering devices of cargo lifts and hull structure
(d) Driving gears
(e) Safety devices and protective devices
(f) Markings of the safe working load and the effectiveness of the relevant certificates
(g) Preservation of the instruction manuals on board the ship

(2) Items to be examined where considered necessary by the Surveyor
(a) Plate thickness measurements, open-up-inspection of lifting pins, nondestructive tests, etc.
(b) Open-up examinations of the driving gears
(c) Operation tests of the safety devices and protective devices

2 At Annual Thorough Surveys for other cargo handling appliances used for loading and unloading of cargoes and other articles, they are to be visually examined and ascertained to be in good order. When considered necessary by the Surveyor, a further examination may be carried out.

2.4.5 Loose Gears

1 At Annual Thorough Surveys, the following items in **(1)** through **(3)** of loose gears are to be visually examined and ascertained to be in good order. However, where considered necessary by the Surveyor, the items in **(2)** are to be opened up and examined.

(1) Wire ropes for their full length

(2) Cargo blocks, chains, rings, hooks, shackles, swivels, lifting beams, cramps, rigging screw, grabs, lifting magnets, spreaders, etc.

(3) Markings of the safe working load and identification symbols, and the effectiveness of the relevant certificates

2 In case where some of loose gears need to be repaired or renewed at times other than at the Periodical Surveys, the Society may accept an autonomous inspection carried out by ship's master or his representative. In this case, the personnel who carried out an autonomous inspection is to record the following **(1)** through **(6)** for the loose gears renewed in the Inspection Record Book of Loose Gear (Part II), and show this Inspection Record Book and the certificates of the loose gears concerned to the Surveyor for his approval at the next Periodical Survey or Occasional Survey.

(1) Names and identification symbols

(2) Locations in service

(3) Safe working loads

(4) Testing loads

(5) Dates of renewal or repairs and dates of commencement of use

(6) Reasons for renewal or repairs

2.5 Load Tests

2.5.1 Load Tests*

1 At Load Tests, cargo handling appliances are to be examined by applying movable weights or loads at least equal to the test loads as specified in **-2** and in the manners specified in **-3** or **-4** depending on the types of cargo handling appliances and ascertained that they are in good order. However, Load Tests of loose gears may be replaced with tests conducted by manufacturers provided that the certificates with testing records of them are submitted.

2 The test loads used for Load Tests are to comply with the requirements of the following **(1)** through **(3)** depending on the types of cargo handling appliances:

(1) The test loads for cargo gears and cargo ramps are to be as given in **Table 2.1** according to the safe working loads;

(2) The test loads for loose gears except for ropes are to be as given in **Table 2.2** according to the safe working loads;

(3) The test loads for ropes are to satisfy the following formula:

$$T \geq W \cdot f$$

where,

T: Test loads for ropes (t)

W: Safe working loads of ropes (t)

f: Safety factors specified in **6.3.1 (5)** or **6.3.2 (3)**

Table 2.1 Test Load for Cargo Gear and Cargo Ramps

Safe working load SWL (t)	Test load (t)
$SWL < 20$	$1.25 \times SWL$
$20 \leq SWL < 50$	$SWL+5$
$50 \leq SWL < 100$	$1.1 \times SWL$
$100 \leq SWL$	Load as considered appropriate by the Society

Table 2.2 Test Loads for Loose Gears

Article of Gear		Safe Working Load (*SWL*) (*t*)	Test Load (*t*)
Pulley blocks	Single-sheave block without becket	—	4×*SWL*
	Single-sheave block with becket	—	6×*SWL*
	Multi-sheave block	*SWL*≤25	2×*SWL*
		25 < *SWL*≤160	(0.933×*SWL*)+27
		160 < *SWL*	1.1×*SWL*
Chain hook, shackle, ring, link, swivel, clamp and similar gear		*SWL*≤25	2×*SWL*
		25 < *SWL*	(1.22×*SWL*)+20
Lifting beam, Lifting magnet, spreader and similar gear		*SWL*≤10	2×*SWL*
		10 < *SWL*≤160	(1.04×*SWL*)+9.6
		160 < *SWL*	1.1×*SWL*

3 For cargo handling appliances of which the safe working loads, etc. are assigned for the first time, the methods of load tests are to comply with the following requirements in **(1)** through **(5)**:

(1) Derrick systems

(a) In case of a swinging derrick system, the test weight is to be slewed throughout the working range at the allowable minimum angle and then lifted/lowered at some position of the working range.

(b) In case of a derrick crane, in addition to **(a)**, the derrick boom is to be luffed with suspending the test weight at the position of outreach and ship's centre line.

(c) In case of a union-purchase derrick system, the test weight is to be manoeuvered throughout the working range within the allowable lifting height or the maximum angle between two cargo falls specified in 9.2.3.

(2) Cranes

(a) In case of a jib crane, the test weight is to be slewed throughout the working range at the maximum slewing radius and then lifted/lowered at some position of the working range. Further, jib is to be luffed at some position of the working range.

(b) In case of a track-mounted cranes, the crane with the test weight suspended is to be transveresed throughout the working range and test weight is to be lifted/lowered at some position.

(c) In case of a track-mounted hoisting gear, the hoisting gear with suspending the test weight is to be traversed from one end of the bridge span to the other and the test weight is to be lifted/lowered at some position.

(3) Cargo lifts

In case of a cargo lift, the test weight is to be so spaced that the most severe working condition is available taking into account one side loading, and the cargo lift is to be moved between each stop position, and to be lifted or lowered within the entire stroke of motion.

(4) Cargo ramps

In case of a cargo ramp, the test weight is to be placed on the severest position of loading in the designed loading conditions, and the deflection is to be measured. As far as practicable, a vehicle with the mass corresponding to the safe working load is to run on the cargo ramp.

(5) In case of loose gear, the test load is to be loaded in the method considered as appropriate by the Society.

4 For the cargo handling appliances other than described in -3, the methods of load tests are to comply with the following requirements in **(1)** or **(2)**.

(1) The load test specified in -3(1), **(2)**, **(3)**, or **(4)** is to be carried out.

(2) The load test may be carried out using a spring or hydraulic weighing machine anchored suitably and safely in accordance with the method considered appropriate by the Society.

Chapter 3 DERRICK SYSTEMS

3.1 General

3.1.1 Application

The requirements in this Chapter apply to the structural members of derrick systems.

3.2 Design Loads

3.2.1 Load Considerations*

The loads to be taken into the calculations of dimensions of the structural members are to be as specified in **(1)** through **(7)** below:

(1) Safe working load of the derrick systems

(2) Self-weight of derrick boom and cargo fittings attached thereto

(3) Self-weight of loose gear

(4) Friction of cargo blocks

(5) Loads due to ship inclination

(6) Wind loading

(7) Other loads considered to be necessary by the Society

3.2.2 Friction of Cargo Blocks

In calculating the load at the rope end, the following friction load coefficients are to be taken into account depending on the types of bearing:

Bush bearing: 0.05

Roller bearing: 0.02

3.2.3 Load due to Ship Inclination*

The angles of inclination used for the calculation of the loads due to ship inclination are to be the angles expected to occur in service condition, but they are not to be taken as less than 5° in angle of heel and 2° in angle of trim. If date on the angles of inclination of the ship concerned are submitted and recognized as appropriate by the Society, however, these angles may be used in the calculations.

3.2.4 Wind Loading

Wind loading is to be calculated according to **4.2.5**; however, the lower limit of the design wind velocity in the stowage condition is to be taken as "50 *m/sec*" instead of "55 *m/sec*".

3.2.5 Load Combinations

1 The load to be used in the strength analysis of the structural members is to be such a combined load that these members may be put in the most severe load condition considering the loads specified in **3.2.1**.

2 The union-purchase derrick system is to be analyzed as a swinging derrick system and a union-purchase derrick system respectively using the combined load according to the requirement in **-1**.

3.3 Strength and Construction of Derrick Posts, Masts, Derrick Booms and Stays

3.3.1 Strength Analysis

1 The strength of derrick posts, masts (hereinafter referred to as "posts"), derrick booms and stays are to be analyzed for the combined load specified in **3.2.5** to determine the dimensions of their members in accordance with the requirement in **3.3.2**, **3.3.3**, **3.3.5**, **3.3.6** and **3.3.7**.

2 The Young's modulus of the wire ropes to be used in the analysis of strength of stayed posts is to be 30.4 kN/mm^2 and 45.1 kN/mm^2 for the case of determining the dimensions of posts and stays respectively.

3.3.2 Allowable Stress for Combined Loads

1 The combined stress of derrick posts and derrick booms calculated by the following formula on the basis of the compressive stress due to bending moment, the compressive stress due to axial compression and the shearing stress due to twisting of the member is not to exceed the allowable stress σ_a given in either **Table 3.1** or **Table 3.2**.

$\sqrt{(\sigma_b + \sigma_c)^2 + 3\tau^2}$ (N/mm^2)

where

σ_b : Compressive stress due to bending moment (N/mm^2)

σ_c : Compressive stress due to axial compression (N/mm^2)

τ : Shearing stress due to twisting of member (N/mm^2)

Table 3.1 Allowable Stress σ_a (for derrick posts)

Safe working load W (t)	Allowable stress σ_a (N/mm^2)
W<10	$0.50\sigma_y$
10≤W<15	$(0.016W+0.34)\ \sigma_y$
15≤W<50	$0.58\sigma_y$
50≤W<60	$(0.005W+0.33)\ \sigma_y$
60≤W	$0.63\sigma_y$

Note:

σ_y : The yield point or proof stress of material $(N/mm2)$

Table 3.2 Allowable Stress σ_a (for derrick booms)

Safe working load W (t)	Allowable stress σ_a (N/mm^2)
W<10	$0.34\sigma_y$
10≤W<15	$(0.018W+0.16)\ \sigma_y$
15≤W	$0.43\sigma_y$

Note:

σ_y : The yield point or proof stress of material $(N/mm2)$

2 The tension of the wire ropes used for stay is not to exceed the value obtained by dividing the value of breaking strength specified in **Table L4.3, Part L of the Rules for the Survey and Construction of Steel Ships** by the safety factor specified in **6.3.1(5)**.

3.3.3 Minimum Plate Thickness of Posts

The plate thickness of posts is not to be less than 6 mm.

3.3.4 Construction of Posts

1 The lower part of the post is to be effectively connected to hull structures by any of the following methods **(1)**, **(2)** or **(3)**, or any other method approved as appropriate by the Society:

(1) To be supported by two or more superposed decks

(2) To be supported by deckhouse of an enough strength

(3) To be supported by bulkhead for an ample depth beneath the deck

2 The post well below the base to well above the goose neck bracket is to be of the dimensions equivalent to that at the base as far as practicable.

3 The post is to be locally reinforced by the use of thicker plating, doubling plates, additional reinforcing members, etc. in the connection of post body and portal beam, the parts where the goose neck brackets and topping brackets are fitted, etc. and the parts where stress concentration expected.

4 At the ends of the upper portal, its depth and plate thickness are to be properly increased. When opening hole at the end of the upper portal is unavoidably provided, properly reinforcement is to be provided around the opening hole.

3.3.5 Buckling Strength

For member subjected to compression, the value obtained from the following formula is not to exceed the allowable stress σ_a given in either **Table 3.1** or **Table 3.2**.

$1.15\omega\sigma_a$ (N/mm^2)

where

σ_c : Axial compressive stress (N/mm^2)

ω : Coefficient calculated by the formula in **Table 3.3(a)** for the slenderness ratio and type of the member concerned

Table 3.3(a) Formulae for ω

Relation of λ and λ_0	Type of member	Formulae for ω
$\lambda \geq \lambda_0$	All members	$2.9\left(\frac{\lambda}{\lambda_0}\right)^2$
$\lambda < \lambda_0$	Plate members	$\frac{1+0.45(\lambda/\lambda_0)}{1-0.5(\lambda/\lambda_0)^2}$
	Cylindrical members	$\frac{0.87+0.46(\lambda/\lambda_0)+0.12(\lambda/\lambda_0)^2}{1-0.5(\lambda/\lambda_0)^2}$

Notes:

1. λ is the slenderness ratio of the member subjected to compression to be obtained from the following formula:

$$l_e\sqrt{\frac{A}{I}}$$

where

A : Sectional area of the member (m^2)

I : Moment of inertia of section of member (m^4)

l_e : Effective length of the member to be determined as the product of the actual length of the member and coefficient K obtained from the following **Table 3.3(b)** for respective end conditions (m)

2. λ_0 is the value obtained from the following formula:

$$\sqrt{\frac{2\pi^2 E}{\sigma_y}}$$

where

π : The circular constant

E : Young's modulus (N/mm^2)

σ_y : Specified yield stress of material (N/mm^2)

Table 3.3(b) Values of K

Another end	One end			
	R: con. D: con.	R: con. D: free	R: free D: con.	R: free D: free
R: con. D: con.	0.5	1.0	0.7	2.0
R: con. D: free	1.0	-	2.0	-
R: free D: con.	0.7	2.0	1.0	-
R: free D: free	2.0	-	-	-

Note:

R : Rotation D : Displacement con.: constrained

3.3.6 Combined Compressive Stress

The compressive stress due to combination of the compressive stress due to axial compression and that due to bending moment is to meet the following formula:

$$\frac{\sigma_c}{\sigma_{ca}} + \frac{\sigma_b}{\sigma_a} \leq 1.0$$

where

σ_a : Allowable bending stress corresponding to the safe working load W given in either **Table 3.1** or **Table 3.2** (N/mm^2)

σ_{ca} : Allowable compressive stress to be taken as a quotient of σ_a divided 1.15 (N/mm^2)

σ_b : Compressive stress due to bending moment (N/mm^2)

σ_c : Compressive stress due to axial compression (N/mm^2)

3.3.7 Minimum Plate Thickness of Derrick Booms

The plate thickness used for the body of derrick booms is not to be less than 2% of the outside diameter at middle of the effective length or the boom or 6 mm, whichever is the greater.

3.3.8 Reinforcement of Derrick Booms

1 The plating at the head of the derrick booms to which fittings are attached is to be provided with doubling plates or reinforced by other suitable means.

2 Where cargo fittings for whipped rigging are attached to the boom, proper reinforcement is to be made by doubling plates or other suitable means.

3.3.9 Derrick Boom Stopper for Dropping out

Derrick booms are to be supported by a goose neck bracket and to be safeguarded against dropping out of their sockets or supports.

3.3.10 Effective Slenderness Ratio

The slenderness ratios of derrick posts, masts, derrick booms or other members subject to compression are to be not more than 150.

3.3.11 Ensuring stiffness

The stiffness of the main structural parts of a derrick is to be ensured to prevent any deformation that may interfere with the use of the derrick.

3.4 Simplified Calculation Method for Post and Stays of Swinging Derrick Systems

3.4.1 Application

Notwithstanding the provisions in **3.3.1**, **3.3.2**, **3.3.3**, **3.3.5** and **3.3.6**, the dimensions of posts and stays of swinging derrick systems may be determined according to the requirements in **3.4**.

3.4.2 Diameter of Post at the Base

The outside diameter of post at the base is not to be less than the value obtained from the following formula. For elliptic or oval section, its minor diameter is to be regarded as the outside diameter, while the short side is to be regarded as the outside diameter for rectangular cross section.

$$5h \ (cm)$$

where

h : Vertical distance from the base of post to the topping bracket (m)

3.4.3 Section Modulus of Post at the Base

1 The section modulus of unstayed posts at the base is not to be less than the value obtained according to **(1)** through **(3)** below depending upon the arrangement of derrick booms.

(1) When a derrick boom is fitted on either of forward or aftward side of the post, the section modulus is to be the value obtained from the following formula:

$$C_1 C_2 \rho W \ (cm^3)$$

where

W : Safe working load (t)

ρ : Slewing radius at the allowable minimum angle (m)

C_1 and C_2 : Coefficients obtained from **Table 3.4** For intermediate values of W, the coefficients C_1 and C_2 are to be obtained by interpolation.

(2) The section modulus about the axis parallel to the longitudinal direction of the ship is to be the value obtained from **(1)** or the value obtained from the following formula, whichever is the greater, when two derrick booms are fitted on both the forward and aftward the post.

$\sum C_2 W u \ (cm^3)$

where

$\sum C_2 W$: Sum of $C_2 W$ for derrick booms situated forward and aftward the post respectively Where C_2 and W are those obtained from **(1)**

u : Distance from the center of the post to the side of the ship, plus the outreach (m)

(3) Where derrick booms are supported by an independent structure other than the post, the section modulus is not to be less than obtained from the formula in **(1)** and **(2)**, multiplied by the value obtained from the following formula. In this case, the coefficient C_1 in the formula specified in **(1)** is to be taken as 1.0.

$\frac{h}{h-h'}$

where

h' : Vertical distance from the base of the post to the center of horizontal pin of the goose neck bracket

h : As specified in **3.4.2**

Table 3.4 Values of C_1 and C_2

W (t)	2 or less	3	4	5	6	7	8	9	10
C_1	1.35	1.25	1.20	1.17	1.15	1.14	1.13	1.12	1.10
C_2	125	120	117	115	114	113	112	111	110

2 The section modulus of stayed posts at the base may be the value specified in reduced by the value obtained from the following formula:

$10\frac{h^3}{d_m}\sum R \ (cm^3)$

where

h : As specified in **3.4.2**

d_m : Outside diameter of the post at the base in the direction in which R assumes minimum in the slewing range for the formula in **-1(1)**, or in the axis parallel to the athwartship direction of the ship for the formula in **-1(2)** (cm)

$\sum R$: Sum of the values obtained from the following formula for each effective stay:

$\frac{{d_s}^2 a^2}{l_0 {l_s}^2}$

where

d_s : Diameter of the wire rope for stays (mm)

l_s : Length of stays between the upper and lower ends (m)

l_0 : Length equal to l_s reduced by the value obtained from the following formula:

$0.045 d_s + 0.26$ (m)

a : Length of horizontal projection of the stays measured in the same direction as the measurement of d_m (m)

3 Where the derrick booms are supported by a king post with a portal having uniform cross section, the section modulus of the post at the base is not to be less than the values obtained from **(1)**, **(2)** and **(3)** below:

(1) The section modulus about the axis parallel to the athwartship direction of the ship is to be the value obtained by the formula in **-1(1)** multiplied by the following coefficient C_p :

0.7 for $r \geq 0.6$

$1 - 0.5r$ for $r < 0.6$

where

r : Ratio of the breadth of the cross section of the portal to the diameter of the post at the base in the longitudinal of the ship

(2) The section modulus about the axis parallel to the longitudinal direction of the ship is to be the values obtained from **-1(1)** or **(2)**, whichever is the greater, multiplied by the following coefficient:

0.35 for $r' \geq 0.3$

$0.5 - 1.67r'^2$ for $r' < 0.3$

where

r' : Ratio of the depth of the cross section of the portal to the diameter of the post at the base in the athwarship direction

(3) Where the distance between posts on the port and starboard sides exceed 2/3 of the height of the post, the coefficients specified in **(1)** and **(2)** are to be suitably increased.

where

4 The section modulus of the stayed king post at the base is not to be less than the values obtained from **(1)** and **(2)** below:

(1) The section modulus about the axis parallel to the athwartship direction of the ship is to be the value obtained from the following formula:

$$C_p\left(C_1C_2\rho W - 10\frac{h^3}{d_m}\sum R\right) \ (cm^3)$$

where

C_p : As specified in **-3(1)**

C_1, C_2 and ρ : As specified in **-1(1)**

$10\frac{h^3}{d_m}\sum R$: Values obtained according to **-2**, provided that stays on one side only are to be taken into account

(2) The section modulus about the axis parallel to the longitudinal direction of the ship is to be the value given in **-3(2)** above.

5 The section modulus of the short side post at the base supporting the derrick boom is not to be less than the value obtained according to **(1)** or **(2)** below:

(1) When a derrick boom is fitted on either of the forward or aftward side post, the section modulus is to be the value obtained from the following formula:

$$85\frac{h'}{h-h'}\rho W \ (cm^3)$$

where

W and ρ :As specified in **-1(1)**

h' : As specified in **-1(3)**

h : As specified in **3.4.2**

(2) Where derrick booms are fitted on the forward and aftward the side post, the section modulus of the side post about the parallel to the longitudinal direction of the ship is to be the greater of the value obtained from **(1)** or the value obtained from the formula in **(1)** using, in place of ρW, the product of the sum of W values for the forward and aftward booms and the value u given in **-1(2)**, provided that u is to be measured from the center of the side post.

3.4.4 Dimensions of Post other than at the Base

1 The post from well below the base to well above the goose neck bracket is to be of the dimensions equivalent to that at the base as far as practicable.

2 The diameter and thickness of the post above the position specified in **-1** may be gradually reduced according to the following **(1)** and **(2)**.

(1) The outside diameter where the outrigger or the topping bracket are fitted may be 85% of the diameter at the base.

(2) The plate thickness at any arbitrary position of the post is not to be less than obtained from the following formula.

$0.1d_m + 2.5 \ (mm)$

where

d_m : Minimum outside diameter of the post at each position (cm)

3.4.5 Outriggers

Outriggers are to be properly constructed and of sufficient strength.

3.4.6 Portals

1 The section modulus of the portal of uniform section fitted to the king post is not to be less than the values obtained from **(1)** to **(3)** below:

(1) The section modulus about the vertical axis is to the value obtained from the formula given in **3.4.3-1(1)** multiplied by the coefficient obtained from the following formula. Where this coefficient exceeds 0.2, it may be taken as 0.2.

$$0.1 + 0.235\frac{r}{c}$$

where

r : As specified in **3.4.3-3(1)**

c : Ratio of the actual section modulus (cm^3) of the post at the base about the axis parallel to the athwarship direction of the ship to that obtained from the formula in **3.4.3-1(1)**

(2) Notwithstanding the requirements in **(1)**, the section modulus of the portal about the vertical axis may be reduced to a half of the value in **(1)** where a derrick boom is fitted on either of forward or aftward side of the post.

(3) The section modulus about the horizontal axis is to be the value obtained from the formula in **3.4.3-1(2)** multiplied by the coefficient obtained from the following formula. Where this coefficient exceeds 0.2, it may be taken as 0.2.

$$0.25\frac{r'}{c'}$$

where

r' : As specified in **3.4.3-3(2)**

c' : Ration of the actual section modulus (cm^3) of the post at the base about the axis parallel to the longitudinal direction of the ship to that obtained from the formula in **3.4.3-1(2)**

2 The portal is to be properly stiffened so as to prevent deformation due to bending.

3.4.7 Stays

The tension in wire ropes used for stays is to be less than the value obtained from the following formula.

$$18\frac{d_s^2 a}{l_0 l_s}\delta \quad (kN)$$

where

a, d_s, l_0 and l_s : As specified in **3.4.3-2**. In this case, a is to be measured in the same direction as in the calculation of the value of δ.

δ : Value obtained from the following formula:

$$C_s\frac{h}{h-h'}\cdot\frac{\rho W}{\frac{I}{h^2}+7.32h\sum R}$$

where

I : Moment of inertia of section (cm^4) of the post at the base about the axis parallel to the athwarship direction of the ship. For the king posts, however, the value of I divided by the coefficient C_p given in **3.4.3-3(1)** is to be used in place of I.

h : As specified in **3.4.2**

h', W and ρ : As specified in **3.4.3-1(1)** and **(3)**

$\sum R$: As specified in **3.4.3-2**, In this case, a is to be measured in all directions in the slewing range of the derrick boom in calculating $\sum R$.

C_s : Value given in **Table 3.5**. For intermediate values of W, the coefficient C_s is to be obtained by interpolation.

Table 3.5 Values of C_s

W (t)	2 or less	3	4	5	6	7	8	9	10	15 and above
C_s	2.64	2.52	2.46	2.41	2.38	2.35	2.33	2.31	2.29	2.22

3.5 Simplified Calculation Methods for Derrick Booms

3.5.1 General

Notwithstanding the requirements in 3.3.1, 3.3.2, 3.3.5, 3.3.6 and 3.3.7, the dimensions of derrick booms may be determined in accordance with requirements in this 3.5.

3.5.2 Derrick Booms without Whipped Rigging

1 The dimensions of derrick booms of derrick system without whipped rigging are not to be less than obtained according to **(1)**, **(2)** and **(3)** below:

(1) The moment of inertia of derrick boom at the middle post is not to be less than obtained from the following formula:

$C_B P l^2$ (cm^4)

where

C_B : Value obtained from Table 3.6

l : Effective length of derrick boom (m) (*See* Fig. 3.2)

P : Axial compression of derrick boom to be determined according to **(a)** or **(b)** depending on the type of the derrick systems. When the self-weight of derrick boom and its fitting are accurately estimated, the value obtained from the force diagram may be used as P.

(a) Swinging Derrick Systems

$$P = \left(\alpha_1 \frac{l}{h-h'} + f\right) Wg \quad (kN)$$

where

W and h' : As specified in 3.4.3-1(1) and **(3)**

h : As specified in 3.4.2

α_1 : Value obtained from Table 3.7. For intermediate values of W, α_1 is to be obtained by interpolation.

f : Coefficient obtained from Table 3.8 depending on the number of cargo block for cargo fall. Where the cargo fall is carried to the top of the post through the sheave fixed to the top of the boom, f may be taken as zero.

(2) In derrick booms with tapered end parts, the parallel part in the midlength is, as a standard, to be of a length equal to 1/3 of the effective length, and the diameter at the ends is not to be less than 60% of the diameter of the parallel midlength part.

(3) The thickness of steel plate used for the body of derrick booms is not to be less than the value obtained from the following formula or 2% of the outside diameter at the middle part whichever is the greater.

6 (mm) for $P<75.5$ (kN)

5+0.0133 P (mm) for $P \geq 75.5$ (kN)

Table 3.6 Values of C_B

Safe working load W (t)	C_B
$W \leq 10$	0.28
$10 < W < 15$	$0.40-0.012W$
$15 \leq W \leq 50$	0.22
$50 < W$	Value as considered appropriate by the Society

Table 3.7 Values of α_1

W (t)	2 or less	3	4	5	6	7	8	9	10	10 and above
α_1	1.28	1.23	1.20	1.18	1.16	1.15	1.14	1.13	1.13	Value as considered appropriate by the Society

Table 3.8 Values of f

n	1	2	3	4	5	6	7	8
f	1.102	0.570	0.392	0.304	0.251	0.216	0.192	0.172

Note:

n : The sum of sheaves of cargo block for cargo fall.

(b) Derrick systems other than swinging derrick systems

$$P = \left(\alpha_1 \frac{l}{h-h'} + f\right) Wg + \frac{K n_1 \alpha_1 \alpha_2}{n_2 \sqrt{b^2+l^2}} lWg \quad (kN)$$

where

α_1, l, h, h', f and W : As specified in **(a)**

α_2 : As specified 5.2.2

b : Horizontal distance from the goose neck bracket to guy post (m)

n_1 : Number of guy ropes

n_2 : Number of topping ropes

K : Values given in Table 3.9 depending on the type of rigging

Table 3.9 Values of K

Rigging system	K
Type *A*	0
Type *B*	1.2
Type *C*	2.0

Notes:

1. Type *A* is rigging system having two guy tackles on port and starboard sides of the top of the post so that these guy tackles may also serve as topping lifts.
2. Type *B* is a rigging system having a deltaplate connecting the end of topping lift and ends of port and starboard side guy ropes so that the tension of topping lift may absorb the slackening of guy ropes.
3. Type *C* is a rigging systems having a connecting block connecting the end of guy rope(s) of both sides (or of one side) and the topping lift led along the derrick post so that the slackening of guy rope(s) may be absorbed by the topping lift.

2 The shape and dimensions of the derrick boom of swinging derrick system may be in accordance with *JIS F* 2201 or any other standards recognized by the Society to be equivalent.

3.5.3 Derrick Booms with Whipped Rigging

The dimensions of derrick booms of derrick system with whipped rigging are not to be less than obtained according to **(1)** and **(2)**.

(1) The moment of inertia of section at an arbitrary position at a distance of x (m) from the center of eye fitting at derrick heel is not to be less than obtained from the following formula. Where a doubling plate is fitted for a sufficient length, 70% of the doubling plate may be added to D (x) and A (x) in the formula.

$$I(x) = C_B P l^2 \left\{1 - 3.136 \left(\frac{x}{l} - 0.5\right)^2\right\} + \frac{D(x) l_1 x}{2\left(\sigma_0 - \frac{P}{A(x)} \times 10\right) l} \cdot \frac{Wg}{N} cos\theta \times 10^3$$

where

$I(x)$: Required moment of inertia of section at a distance of x (m) from the derrick heel (cm^4)

C_B : As specified in 3.5.2

P : Axial compression of boom specified in 3.5.2-1(1) (kN)

l : Effective length of boom (m)

W : Safe working load as specified in 3.4.3-1(1) (t)

N : Sum of sheaves of cargo block for cargo fall (except cargo block for cargo relief)

θ : Allowable minimum angle of boom (*degree*)

l_1 : Distance between the eye fittings for whipped rigging (m)(*See* **Fig. 3.2**)

$D(x)$: Outside diameter of derrick boom at a distance of x (m) from the boom heel minus plate thickness (cm)

$A(x)$: Sectional area of derrick boom at a distance of x (m) from the boom heel (cm^2)

σ_0 : Value given in **Table 3.10** (N/mm^2)

(2) The length of parallel part at the middle, the diameter at ends and the plate thickness of the boom body are to be as specified in **3.5.2-1(2)** and **(3)**.

Fig. 3.2 Derrick Boom with Whipped Rigging

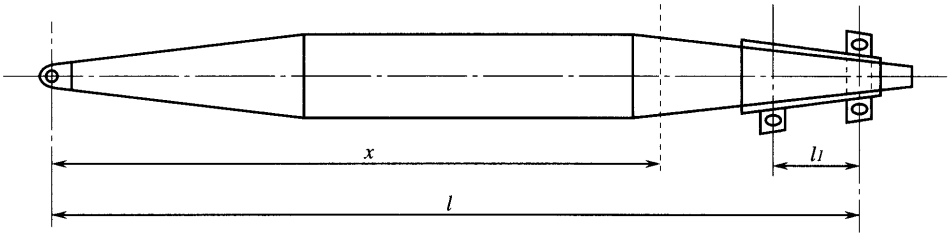


Table 3.10 Values of σ_0

Safe working load W (t)	σ_0
$W \leqq 10$	80.4
$10 < W < 15$	$4.04W+40.0$
$15 \leqq W \leqq 50$	100.6
$50 < W$	Value as considered appropriate by the Society

Chapter 4 CRANES

4.1 General

4.1.1 Application

The requirements in this Chapter apply to the structural members of cranes.

4.2 Design Loads

4.2.1 Load Considerations

The loads to be taken into the calculation of dimensions of structural members are to be those related to the crane concerned among the items enumerated from **(1)** to **(11)** below:

(1) Safe working load of the cranes
(2) Impact loads
(3) Self-weight of crane system and cargo fittings attached thereto
(4) Self-weight of loose gear
(5) Friction of cargo blocks
(6) Horizontal forces
(7) Wind loading
(8) Buffer forces
(9) Loads due to ship inclination
(10) Loads due to ship motion
(11) Other loads considered necessary by the Society

4.2.2 Impact Loads

1 The impact load is to be the product of the hoisting load and the impact load coefficient given in **Table 4.1** depending on the types of cranes or the impact load coefficient deemed appropriate by the Society. When the stress due to hoisting of cargo and the stress due to the self weight have different signs in a member, 50% of impact load is to be taken into account in addition to the self-weight, considering the shock due to unloading.

2 Notwithstanding the requirements specified in **-1**, impact load coefficient based on actual measurements taking into account the hoisting speed, deflections of girders, length of ropes, etc. may be used in place of the values given in **Table 4.1**.

Table 4.1 Impact Load Coefficient

Types of cranes	Impact load coefficient
Provision handling crane, Machinery handling crane, Maintenance crane and Hose handling crane	1.10
Jib crane and gantry crane for cargo handling	1.25
Jib crane and gantry crane occasionally used with hydraulically operated of rope-operated bucket, etc. for cargo handling	1.40
Jib crane and gantry crane always using grab, lifting magnet, etc. for cargo handling and Offshore jib crane	1.60

4.2.3 Friction of Cargo Blocks

The friction of cargo blocks is to be as specified in **3.2.2**

4.2.4 Horizontal Forces

1 In track-mounted cranes, the transverse forces due to travel motion is to be taken into consideration as a factor of horizontal force in addition to the inertial force and centrifugal force.

2 The inertial force is to be obtained by multiplying the sum of the mass of the moving parts and the hoisting load (in slewing motion, the load is assumed to be at the top of jib) by the following coefficient depending on the condition of motion. In the case of travelling by driven wheels, however, this inertial force need not exceed 15% of the driving wheel load.

Level luffing motions : $0.01\sqrt{V}$

Traversing or travelling motions : $0.008\sqrt{V}$

Slewing motions : $0.006\sqrt{V}$

where

V : Velocity of motion concerned to be determined by the designer (m/min)

3 Notwithstanding the requirements in **-2** the values of the actual acceleration deceleration characteristics, the actual braking time, etc. for the mode of motion concerned may be used as the inertial forces, if such values are known.

4 The centrifugal force is to be considered for slewing motions and is to be determined from following formula.

$\frac{Wv^2}{R}$ (kN)

where

W : Safe working load (t)

R : Slewing radius (m)

v : Circular speed (m/sec)

5 The transverse force due to travel motions is to be calculated from the following formula:

λD (kN)

where

D : Wheel load (kN)

λ : Transverse force coefficient to be determined from the following formula depending on the value of l/a. However, λ need not exceed 0.15:

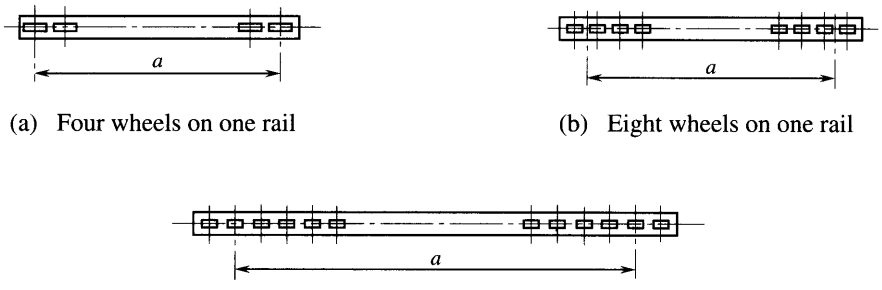
0.05 for $\frac{l}{a} \leq 2$

$\frac{1}{60}\left(\frac{l}{a}+1\right)$ for $\frac{l}{a} > 2$

l : Span of rails (m)

a : Effective wheel base to be determined according to **Fig. 4.1** (m)

Fig. 4.1 Measurement of Effective Wheel Base



(a) Four wheels on one rail

(b) Eight wheels on one rail

(c) More than eight wheels on one rail

4.2.5 Wind Loading

1 The wind loading is to be calculated by the following formula:

$F=PA\times10^{-3}$ (kN)

where

F : Wind loading (kN)

A : Sum of structural members and cargo under wind pressure in projection in respective wind direction, corresponding to respective conditions of the cargo gear (m^2). When a girder is wholly or party protected from wind by another girder, the areas of the superposed portions may be multiplied by the reduction factor (η) obtained from **Fig. 4.2**. The distance b between girders is to be as given in **Fig. 4.3**.

P : Wind pressure calculated by the following formula (Pa).

$$\frac{1}{16}C_hC_sgV^2 \ (Pa)$$

where

V : Wind velocity according to **(1)** and **(2)** below (m/sec):

(1) The velocity of wind giving effect on the structural members and cargo in the service conditions is to be the design wind velocity specified by the applicant, but not be less than 16 *m/sec*.

(2) The velocity of wind giving effect on the structural members in the stowage conditions is to be the design wind velocity specified by the applicant. In no case is the design wind velocity to be less than 55 *m/sec*. In ships with restricted navigation areas, however, the design wind velocity may be decreased according to the degree of restriction as approved by the Society in the range down to 27.5 *m/sec*.

C_h : "Height factor" to be determined according to **Table 4.2** depending on the height of the position is question from the lightweight waterline.

C_s : "Shape factor" to be determined according to **Table 4.3** depending on the shapes of various parts of the cargo gear and the cargo.

2 Notwithstanding the requirements in **-1**, the data on wind loading obtained by wind tunnel tests for the structural members and cargo may be used for calculations.

Fig. 4.2 Repleteness Ratio, ϕ versus Reduction Factor, η

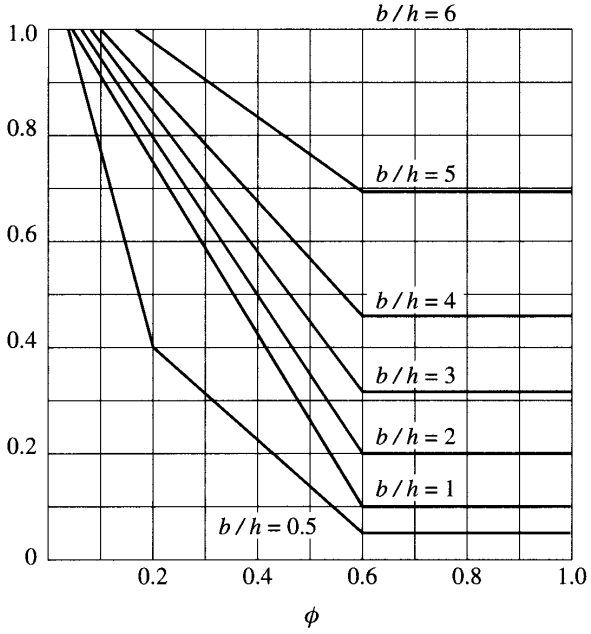


Fig. 4.3 Distance between two Neighbouring Girders, *b*

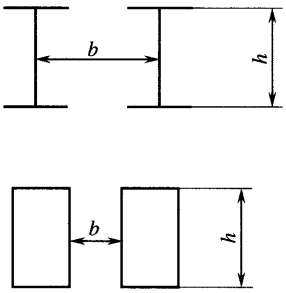
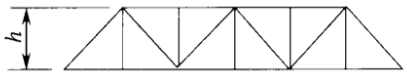
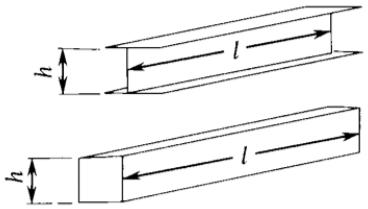
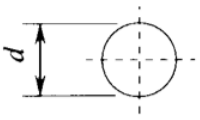


Table 4.2 Height Factor C_h

Vertical height h (m)	C_h
h<15.3	1.00
15.3≤h<30.5	1.10
30.5≤h<46.0	1.20
46.0≤h<61.0	1.30
61.0≤h<76.0	1.37
76.0≤h	Value as considered appropriate by the Society

Table 4.3 Shape Factor C_s

Type of area under wind pressure		ϕ or size ratio		C_S
Truss of angle		ϕ	$\phi < 0.1$	2.0
			$0.1 \leq \phi < 0.3$	1.8
			$0.3 \leq \phi < 0.9$	1.6
			$0.9 \leq \phi$	2.0
Plate girder or Box girder		l/h	$\phi < 5$	1.2
			$5 \leq \phi < 10$	1.3
			$10 \leq \phi < 15$	1.4
			$15 \leq \phi < 25$	1.6
			$25 \leq \phi < 50$	1.7
			$50 \leq \phi < 100$	1.8
			$100 \leq \phi$	1.9
Cylinder member or Truss of cylindrical member		$d\sqrt{q}$	$d\sqrt{q} < 1.0$	1.2
			$1.0 \leq d\sqrt{q}$	0.7

Notes:

ϕ : Repleteness ratio equal to the ratio of projected area under wind pressure to the projected area surrounded by the outer contour of the area under wind pressure

l : Length of plate girder or box girder (m)

h : Height of plate girder or box girder looked at from windward (m)

d : Outer diameter of cylindrical member (m)

q : Value calculated by the following formula:

$\frac{1}{16} C_h \cdot gV^2 \times 10^{-3}$ (kPa)

4.2.6 Buffer Forces

1 The buffer forces are assumed to be the loads in the crane system originating from collision with buffer at a speed equal to 70% of the rated speed when no cargo is suspended from the crane. In a crane system having a rigid guide, etc. to limit the swinging of suspended cargo due to collision, the influence of the cargo weight is also to be taken into consideration.

2 Notwithstanding the requirement in **-1**, in a crane system designed to be automatically decelerated before colliding the buffer, the speed after deceleration may be regarded as the rated speed in the requirement in **-1**.

4.2.7 Loads due to Ship Inclination*

The angles of inclination used for the calculation of loads due to ship inclination are not to be less than the values specified below:

In service conditions: 5 degrees in angle of heel and 2 degrees in angle of trim occurring simultaneously

In stowage conditions: 30 degrees in angle of heel

4.2.8 Loads due to Ship Motion

The accelerations used for the calculation of loads due to ship motion are the severest of the combinations **(1)** or **(2)** below for

the stowage condition, and values recognized by the Society to be appropriate for the service condition. If data on the ship's motions are submitted and recognized by the Society to be appropriate, the values in such data may be used in the calculations.

(1) ±1.0 *g* in the direction normal to the deck and ±0.5 *g* in the longitudinal direction parallel to the deck

(2) ±1.0 *g* in the direction normal to the deck and ±0.5 *g* in the transverse direction parallel to the deck

4.2.9 Load Combinations*

1 The load to be used in the strength analysis of structural members is to be such a combined load that these members may be put in the severest loading condition considering the loads specified in **-2** through **-5** below.

2 When the wind loading is not taken into account in service condition, the sum of loads from **(1)** to **(9)** below multiplied by a work coefficient given in **Table 4.4** according to the type of crane concerned or a work coefficient deemed appropriate by the Society is to be considered.

(1) Safe working load of the cranes

(2) Impact loads

(3) Self-weights of crane system and loose gear attached thereto

(4) Self-weights of loose gear

(5) Friction of cargo blocks

(6) Horizontal loads

(7) Loads due to ship inclination

(8) Loads due to ship motion (except those intended to cargo handling in harbours only)

(9) Other loads considered necessary by the Society

3 When the wind loading are to be taken into consideration in the service conditions, the wind loading is to be added to the design load as specified in **-2**.

4 The buffer forces as given in **4.2.6** are to be taken into consideration for the track-mounted cranes.

5 In stowage condition, the loads from **(1)** to **(5)** below are to be considered

(1) Self-weights of crane system and loose gear attached thereto

(2) Wind loading in the stowage conditions

(3) Loads due to ship inclination in the stowage conditions

(4) Loads due to ship motion stowage conditions

(5) Other loads considered necessary by the Society

Table 4.4 Work Coefficient of Crane Systems

Type of crane	Work coefficient
Provision handling crane, Machinery handling crane, Maintenance crane and Hose handling crane	1.00
Jib crane and gantry crane for cargo handling	1.05
Jib crane and gantry crane occasionally used with hydraulically operated or rope-operated bucket, etc. for cargo handling	1.10
Jib crane and gantry crane always using grab, lifting magnet, etc. for cargo handling and Offshore jib crane	1.20

4.3 Strength and Construction

4.3.1 General*

1 The strength of structural members is to be analyzed on the load conditions specified in **4.2.9** to determine their dimensions according to requirements in **4.3.2** through **4.3.10**.

2 For structures connected by bolts and nuts, proper considerations are to be given to the decrease of effective sectional areas.

3 When considered necessary the Society may require the confirmation of the appropriateness of strength analyses by examination of models or the things in question.

4.3.2 Allowable Stress for Loads

1 The allowable stress given in **Table 4.5** is not to be exceeded depending on the type of stress.

2 Strength for fixed posts is to be in accordance with the requirements in **3.3.2**.

4.3.3 Buckling Strength

For members subjected to compression, the values obtained from the following formula is not to exceed the allowable compressive stress given in **Table 4.5**.

$\omega\sigma_c$ (N/mm^2)

where

ω and σ_c : As specified in **3.3.5**

4.3.4 Combined Compressive Stress

When the compressive stress of a member is determined as a combination of compressive stress due to axial compression and that due to bending moment such a compressive stress is to comply with the following formula:

$$\frac{\sigma_c}{\sigma_{ca}} + \frac{\sigma_b}{\sigma_a} \leq 1.0$$

where

σ_b : Compressive stress due to bending moment (N/mm^2)

σ_c : Compressive stress due to axial compression (N/mm^2)

σ_a : Allowable bending stress given in **Table 4.5** (N/mm^2). For fixed posts at the base, however, the allowable stress σ_a in **Table 3.1** is to be used.

σ_{ca} : Allowable compressive stress given in **Table 4.5** (N/mm^2). For fixed post at the base, however, the allowable stress (N/mm^2) is to be taken equal to the allowable stress in **Table 3.1** divided by 1.15.

Table 4.5 Allowable Stress σ_a

Load Condition	Kind of stress						
	Tension	Bending		Shear	Compression	Bearing	Combined stress
		Tension side	Compression side				
Condition specified in **4.2.9-2**	σ_d	σ_d	$0.87\sigma_d$	$0.58\sigma_d$	$0.87\sigma_d$	$1.41\sigma_d$	$1.15\sigma_d$
Condition specified in **4.2.9-3**	$1.15\sigma_d$	$1.15\sigma_d$	σ_d	$0.67\sigma_d$	σ_d	$1.63\sigma_d$	$1.33\sigma_d$
Condition specified in **4.2.9-4** and **-5**	$1.3\sigma_d$	$1.3\sigma_d$	$1.13\sigma_d$	$0.75\sigma_d$	$1.14\sigma_d$	$1.84\sigma_d$	$1.5\sigma_d$

Notes:

1. σ_d: Following values for steel material, whichever is the smaller
   (1) The value obtained by dividing the yield point or the proof stress of material by 1.5 (N/mm^2)
   (2) The value obtained by dividing the tensile strength by 1.8 (N/mm^2)
2. The combined stress is to be the value obtained from the following formula:
   $\sqrt{\sigma_x^2 + \sigma_y^2 - \sigma_x\sigma_y + 3\tau_{xy}^2}$ (N/mm^2)

   where

   σ_x : Applied stress in x-direction at the middle of plate thickness (N/mm^2)

   σ_y : Applied stress in y-direction at the middle of plate thickness (N/mm^2)

   τ_{xy} : Applied shear stress in the x-y plane (N/mm^2)

4.3.5 Fatigue Strength

Where the influence of repeated stress cannot be neglected, the member is to have an ample strength against fatigue with due consideration for the magnitude and frequency of repeated stress, the form of the member in question, etc.

4.3.6 Ensuring stiffness

The stiffness of the main structural parts of cranes is to be ensured to prevent bucking and significant deformation.

4.3.7 Minimum Thickness

The thickness of structural members is not to be less than 6 *mm*.

4.3.8 Strength of Bolts, Nuts and Pins

Bolts, nuts and pins are to have sufficient strength for the magnitudes and directions of the loads they are subjected to.

4.3.9 Fixed Posts*

1 The fixed posts are to be effectively connected to the hull structure in accordance with the requirements in **3.3.4-1**.

2 The upper part of fixed post where the flange is attached is to be sufficiently reinforced by increasing the plate thickness or by providing of brackets.

4.3.10 Slewing-ring Fixing Bolts

1 Any material having a tensile strength exceeding 1.18 kN/mm^2 and yield stress exceeding 1.06 kN/mm^2 is not to be used for the bolts fixing the slewing-rings except when special considerations have given to the strength characteristics of the bolts.

2 Special considerations are to be given to the tightening force of fixing bolts.

3 The stress generated in fixing bolts is not to exceed the allowable stress given in **Table 4.6** according to the load conditions specified in **4.2.9**. In this case, the stress in bolts is taken as the value of the axial compression determined by the following formula divided by the minimum sectional area of fixing bolts.

$$\frac{4M}{D \cdot N} - \frac{W}{N} \ (N)$$

where

M : Upsetting moment $(N \cdot mm)$

D : Pitch circle diameter of fixing bolts (mm)

N : Number of fixing bolts

W : Axial compression on the slewing-ring (N)

Table 4.6 Allowable Stress of Fixing Bolts σ_a

Load condition	σ_a
Condition specified in **4.2.9-2** and **-3**	$0.4\sigma_y$
Condition specified in **4.2.9-5**	$0.54\sigma_y$

Note:

σ_y : The yield point or proof stress of the material (N/mm^2)

4.4 Special Requirements for Track-mounted Cranes

4.4.1 Stability*

The track-mounted cranes are to have a suffocate stability under the load conditions specified in **4.2.9**.

4.4.2 Prevention of Upsetting

The track-mounted crane are to be designed with sufficient considerations for the stability to prevent upsetting or detaching even if the wheel shafts or wheels are damaged.

4.4.3 Deflection Criteria

When suspending the safe working load, deflection of the traveling girder of the track-mounted cranes is not to exceed 1/800 of the span between the supporting points.

4.4.4 Travel Gear

The travel gear is to be securely fixed to the main body of the track-mounted cranes by bolts, welding or pins. The inclinations of hull in service condition and stowage condition are to be taken into consideration.

4.4.5 Buffers

The track-mounted cranes are to be provided with buffers in accordance with **(1)** and **(2)** below, except when automatic system for prevention of collision is provided.

(1) At both ends of tracks or any other equivalent positions. These buffers may be replaced by stops of a height not less than 1/2 of the diameter of wheels.

(2) Where more than two track-mounted cranes are provided on one track, between these track-mounted cranes.

Chapter 5 CARGO FITTINGS

5.1 General

5.1.1 Application

The requirements in this Chapter apply to the cargo fittings.

5.2 Cargo Fittings

5.2.1 Goose Neck Brackets and Derrick Heel Lugs

1 The sizes of goose neck pin, cross bolt and derrick heel lug shown in **Fig. 5.1** are to be not less than the following values. The sizes of other parts are to be as deemed appropriate by the Society.

$$b = e_1\sqrt{\frac{P}{g}}\ (mm)$$

$$c = 0.55e_1\sqrt{\frac{P}{g}}\ (mm)$$

$$d = e_1\sqrt{\frac{P}{g}}\ (mm)$$

where

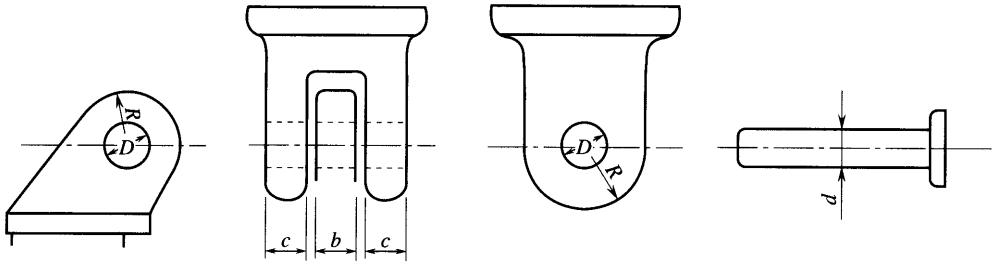
P: Design axial compressive force acting on derrick boom (kN)

e_1: 15.6. However, in the swinging derrick system, the values given in **Table 5.1** may be used according to the safe working load.

2 It is recommended that clearance at parts where the cross bolt penetrates through the derrick heel lug and the gooseneck pin of gooseneck bracket is to be less than 2 mm in diameter. The size of the outer parts of bolt holes for the gooseneck pin and derrick heel lug is to be of the same size at the cross bolt radius, as a standard.

3 Notwithstanding the requirements in **-1**, the sizes of gooseneck bracket and derrick heel lug may be in accordance with *JIS F* 2201, *F* 2203 or any other standards recognized by the Society. However, for the fittings used for other than the swinging derrick systems, consideration to the effect of increasing load caused by the guy ropes is to be given.

Fig. 5.1 Gooseneck Pin, Derrick Heel Lug and Cross Bolt



Gooseneck pin Derrick heel lug Cross bolt

Table 5.1 Values of e_1

Safe working load W (t)	e_1
$W \leq 10$	15.6
$10 < W < 15$	$18.8\text{-}0.32W$
$15 \leq W \leq 50$	14.0
$50 < W$	Value as considered appropriate by the Society

5.2.2 Fittings Attached to Head of Derrick Booms

1 The sizes of fittings attached to the head of derrick booms are not to be less than the values given in the following **(1)** and **(3)**

according to the respective purpose and shapes of the fittings:

(1) Where the shape of cargo fittings attached to the head of derrick boom are as given in **Fig.5.2**, the sizes of them are not to be less than the following values. The sizes of other parts are to be as deemed appropriate by the Society.

$$d = e_2\sqrt{\frac{T}{g}} \ (mm)$$

$$t = e_2\sqrt{\frac{T}{g}} \ (mm)$$

where

e_2: Value as given in **Table 5.2**

T: Maximum tension applied to cargo fitting at the head of derrick boom (kN). However, in the swinging derrick system, the following value may be used:

$\alpha_1\alpha_2\ Wg$ for topping lift

$\lambda\ Wg$ for cargo fall

where

W : Safe working load (t)

α_1 : As specified in **3.5.2**

α_2 : As given in **Table 5.3** depending on the value of $l/(h-h')$. However, for intermediate values of α_2, it is to be obtained by interpolation.

λ : Value given in **Table 5.4** depending on the number of sheaves of blocks for cargo fall. However, the value of λ may be taken as 1.0 where the cargo fall is led to the top of derrick post through the sheave incorporated in the head of the derrick boom.

(2) Where the shape of cargo fitting attached to the head of cargo derrick boom is as shown in **Fig. 5.3**, the sizes of them are not to be less than the following values. The sizes of other parts are to be as deemed appropriate by the Society.

$R \geq D$

$$t = e_1\sqrt{\frac{T}{g}} \ (mm)$$

However, where the value of R is larger than $1.15D$, the value obtained from the following formula may be taken:

$$t = \frac{e_3}{\left(R-\frac{D}{2}\right)} \cdot \frac{T}{g} \ (mm)$$

where

e_1: As specified in **5.2.1-1**

T: As specified in **(1)**

e_3: As given in **Table 5.5**.

(3) The sizes of guy fittings attached the head of derrick boom are to be enough against the design load.

Fig. 5.2 Cargo Fitting Attached at Head of Derrick Boom

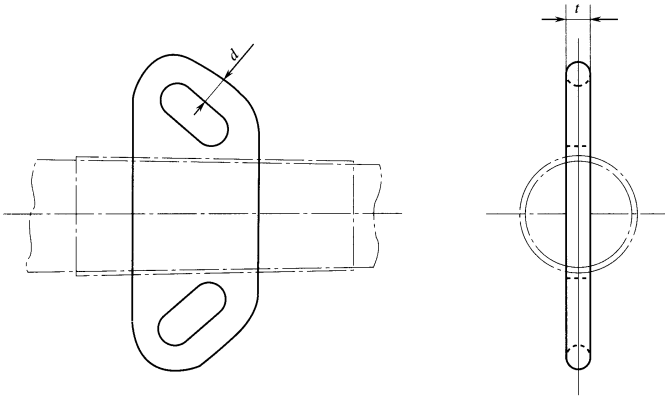


Table 5.2 Values of e_2

Safe working load W (t)	e_2
$W \leq 10$	12.5
$10 < W < 15$	$15.1-0.26W$
$15 \leq W \leq 50$	11.2
$50 < W$	Value as considered appropriate by the Society

Table 5.3 Values of α_2

$l/(h-h')$		2.0	1.9	1.8	1.7	1.6	1.5	1.4	1.3	1.2
α_2	W<10	1.99	1.90	1.81	1.73	1.65	1.57	1.49	1.42	1.35
	15≤W<50	1.82	1.73	1.65	1.57	1.49	1.41	1.33	1.26	1.19

Note:

l, h and h':As specified in 3.5.2

Table 5.4 Values of λ

Sum of the number of sheaves of blocks for cargo fall	1	2	3	4	5	6	7	8
λ	2.10	1.58	1.40	1.31	1.26	1.23	1.20	1.18

2 Notwithstanding the requirements in -1, the sizes of cargo fittings attached at the head of derrick boom may be in accordance with *JIS F* 2201 or any other standards recognized by the Society to be equivalent. However, for the fittings used for other than the swinging derrick systems, consideration to the effect of increasing load caused by the guy ropes is to be given.

5.2.3 Other Cargo Fittings

The sizes of the other cargo fittings such as topping bracket, guy cleat, eye and so on, may be in accordance with *JIS F* 2202. However, for the topping bracket used for other than the swinging derrick systems, consideration to the effect of increasing load caused by the guy ropes is to be given.

Fig. 5.3 Fitting Attached at Head of Derrick Boom

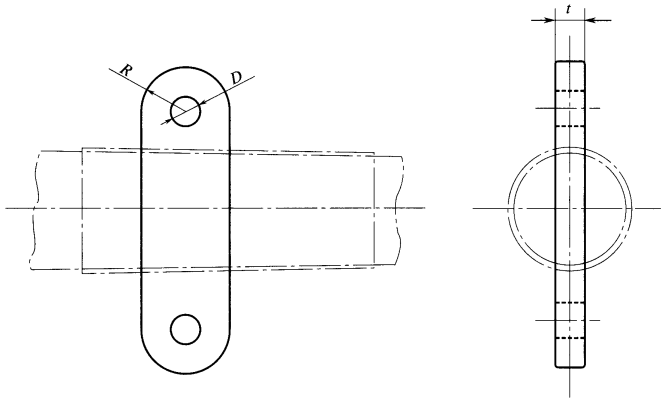


Table 5.5 Values of e_3

Safe working load W (t)	e_3
$W \leq 10$	122
$10 < W < 15$	$170-4.8W$
$15 \leq W \leq 50$	98
$50 < W$	Value as considered appropriate by the Society

Chapter 6 LOOSE GEAR

6.1 General

6.1.1 Application

The requirements in this Chapter apply to the loose gear.

6.1.2 General Requirements

When the safe working load is applied to the cargo gear and cargo ramps, the load created in the important part of those loose gears and ropes is not to be exceed the respective specified safe working load.

6.2 Cargo Blocks

6.2.1 Cargo Blocks for Wire Ropes*

The cargo blocks for wire ropes are to comply with the following requirements **(1)** through **(4)**. However, in sheaves for equalizer sheaves or those for overload sensors, they are to be as deemed appropriate by the Society. (*See* **Fig. 6.1**)

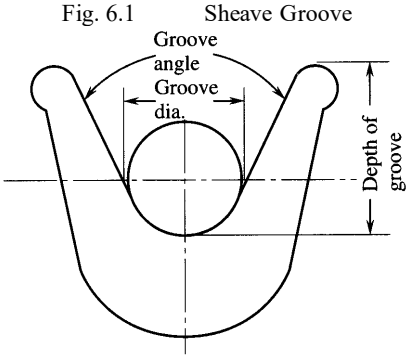
(1) The diameter of the sheave at the bottom of the rope groove is not to be less than 14 times the wire rope diameter.

(2) The depth of the groove of the sheave is not to be less than the wire rope diameter.

(3) The bottom of the groove of the sheave is to have a circular contour over a segment sustained by angle of not less than 120 *degrees*.

(4) The groove diameter of the sheave is to be 1.1 times the wire rope diameter, as a standard.

Fig. 6.1 Sheave Groove



6.2.2 Cargo Blocks for Fibre Ropes

The cargo blocks for fibre ropes are to comply with the following requirements **(1)** through **(3)**:

(1) The diameter of the bottom of the rope groove is not to be less than 5.5 times the fibre rope diameter.

(2) The depth of the groove of the sheave is not to be less than the fibre rope diameter.

(3) The groove diameter of the sheave is to be the fibre rope diameter plus 2 *mm*, as a standard.

6.3 Ropes

6.3.1 Wire Ropes*

The wire ropes are to comply with the following requirements **(1)** through **(5)**:

(1) The wire ropes are to be subjected to suitable corrosion prevention treatment.

(2) The wire ropes are to be suitable for the purpose of application, and in addition are to attach a certificate stating that they conform to the requirements of **Part L of the Rules for the Survey and Construction of Steel Ships** or the requirements of the standards as deemed appropriate by the Society.

(3) No splicing of the wire ropes is permitted.

(4) Terminal connection of wire ropes is to be made in a method approved by the Society to have sufficient strength.

(5) The safety factor of the wire ropes is not to be less than the following value according to their purpose and their safe working load. However, the safety factor of the wire ropes for running rigging may not exceed 5, and those for standing rigging, 4.

$\frac{10^4}{8.85W+1910}$ for $W \leq 160$

3 for $W > 160$

where

W: Safe working load (t)

6.3.2 Fibre Ropes

Fibre ropes are to comply with the following requirements **(1)** through **(3)**:

(1) The fibre ropes are to comply with the recognized standards and to be provided with the certificate deemed appropriate by the Society.

(2) The diameter of the fibre ropes is not to be less than 12 *mm*.

(3) The safety factor of fibre ropes is not to be less than the value given in **Table 6.1** depending on the rope diameter.

6.4 Other Loose Gears

6.4.1 General

The design loads of loose gears such as chain, rings, hooks, shackles, swivels, clamps, grabs, lifting beams, lifting magnets, spreader, etc. are not to be more than the value obtained by dividing the breaking strength of each gears by the safety factor of 5.

6.5 Equivalent Requirements

6.5.1 General*

Notwithstanding the requirements in **6.2** through **6.4**, the constructions of loose gear may be in accordance with any other standards recognized by the Society.

Table 6.1 Safety Factor or Fibre Ropes

Rope diameter D (*mm*)	Safety Factor
$12 \leq D < 14$	12
$14 \leq D < 18$	10
$18 \leq D < 24$	8
$24 \leq D < 40$	7
$40 \leq D$	6

Chapter 7 MACHINERY, ELECTRICAL INSTALLATIONS AND CONTROL ENGINEERING SYSTEMS

7.1 General

7.1.1 Application*

The requirements in this Chapter apply to the machinery, electrical installations and control engineering systems used in the cargo handling appliances. However, in applying the requirements in this Chapter to winches used for cargo ramps, they may be suitably modified.

7.2 Machinery

7.2.1 General

The driving systems of the cargo handling appliances are to be steadily operated in the rated speed under the safe working load.

7.2.2 Hoisting and Luffing Winch*

1 The construction of the winch is to comply with the following requirements **(1)** through **(6)**:

(1) The drum end flange diameter is to have an allowance corresponding to not less than 2.5 times the rope diameter as measured from the outer rim of the outermost layer of ropes in service condition. However, where rope disengagement prevention system is provided or in case of single layer winding on the drum, this requirement may be dispensed with.

(2) The pitch circle diameter of winch drum is to be not less than 18 times the rope diameter.

(3) Winches are to be installed on the winch foundation with foundation bolts having sufficient proof strength against the drum load (the maximum rope tension applied on the drum when the rope is wound under the single winding at a nominal rope hoisting speed) created when the safe working load is applied to the cargo handling appliances.

(4) Braking system complying with the following requirements **(a)** through **(c)** is to be provided:

(a) The braking system is to be able to exert a breaking torque 50% in excess of the torque required when the safe working load is applied to the cargo handling appliances.

(b) The power operated braking system is to operate automatically when the manoeuvring is returned to its neutral position.

(c) The power operated braking system is to operate automatically when there is any failure in the power supply. In this case, emergency retrieval for cargo lowering is to be provided.

(5) Clutchable drums are to be provided with effective locking system capable of restricting rotation of the drum. The locking system is be, as a rule, capable of resisting the torque not less than 1.5 times the torque required when the safe working load is applied to the cargo handling appliances.

(6) Rope guards or suitable other means of protection are to be provided.

2 The winding of the wire rope into the winch drum is to comply with the following **(1)** and **(2)** except in cases where the winch drum is equipped with the over-winding prevention device.

(1) For grooved drums such as a hoisting winch, etc., the angle between the direction in which the wire rope is caught in the groove of the drum and the direction of the wire rope when it is caught in the groove (i.e. the fleet angle) is to be 4° or less.

(2) For drums other than grooved drums, the fleet angle is to be 2° or less.

3 The rope at its end is to be secured to the drum in such a manner that will not damage any part of the rope and to have such a length that not less than 3 complete turns in case of an ungrooved drum, or 2 complete turns in case of a grooved drum are remaining on the drum when the complete working length of rope has been paid out.

7.3 Power Supply

7.3.1 General*

1 The equipment, piping and cables consisting of the electric, hydraulic, pneumatic or steam power supply system and their arrangements are, as a rule, to comply with the relevant requirements of **the Rules for the Survey and Construction of Steel Ships**.

2 The construction, strength, materials, etc. of internal combustion engine used as the prime mover are to comply with the requirements in **Part D of the Rules for the Survey and Construction of Steel Ships**.

7.4 Control Engineering Systems

7.4.1 General

1 The electric, hydraulic or pneumatic equipments used for the control, alarm and safety systems are, as a rule, to comply with the relevant requirements of **the Rules for the Survey and Construction of Steel Ships**.

2 The control, alarm and safety systems are to be designed on the basis of the principle of fail-safe.

7.4.2 Control System

1 Control systems are to be so arranged as not interfere with the operator or qualified other personnel giving signals for operation.

2 Control systems are, as a rule, to be of such design that controls automatically return to the neutral position when control operation by the operator is interrupted.

3 For electric winches, local power disconnecting switch is to be provided at the position in the proximity of the place of operation.

4 Cranes and cargo lifts are to be provided with emergency switch capable of stopping all the motions at the position readily accessible for the operator.

5 Cargo lifts are to be provided with a suitable automatic speed control system that reduces the starting acceleration and stopping deceleration as far as practicable.

6 Cargo lifts are to be provided with a suitable control system that stops the lift at the specified deck position.

7 Where cargo lifts are secured by locking latches, suitable means is to be provided so as to prevent the impact load to be induced on the lift in case of withdrawal of the latches.

8 Control systems for the track-mounted cranes (including their trolleys) are to be provided with braking devices to control travelling except for the human-powered travelling cranes.

7.4.3 Safety System*

1 The cargo handling appliances are, as a rule, to be provided with an overload protection system.

2 In general, the cargo handling appliances are to be provided with suitable safety systems capable of preventing the abnormalities given in the following **(1)** through **(6)** according to kind of appliances and their motion:

(1) Over hoisting

(2) Over slewing

(3) Over luffing

(4) Excessive travelling speed

(5) Over run on the track

(6) Other items of abnormality recognized by the Society

3 In cranes where the safe working load varies according to the operating radius, rating chart showing the relationship between the operating radius and safe working load are to be provided in the control cab and in addition, equipment satisfying the following **(1)** and **(2)** or **(3)** is, as a rule, to be provided:

(1) Operating radius indicator

(2) Hoisting load indicator

(3) Overload preventor with respect to the safe working load according to the operating radius

7.4.4 Protection System

1 For the rotating parts of the driving machinery, electrical installations and steam pipes, necessary means to protect the operator are to be provided.

2 Steam winches are to be arranged not to interfere with the operator's field of vision by the steam.

3 Cargo lifts are to be provided with the protection systems given in the following **(1)** through **(4)**:

(1) Protective barriers of a height of not less than 1 *m* above deck level around the deck opening provided for lift platform.

(2) Interlocking system so that cargo lifts cannot be moved unless the barriers are all closed.

(3) Interlocking system that prevents opening of protective barriers unless cargo lifts are at the opening position of the barriers.

(4) Warning lights or suitable other warning signs at the boarding place of cargo lifts.

Chapter 8 CARGO LIFTS AND CARGO RAMPS

8.1 General

8.1.1 Application

The provisions in this Chapter apply to the structural members of cargo lifts and cargo ramps.

8.2 Design Loads

8.2.1 Load Considerations

Consideration is to be given to the utilization and duty of the particular type of cargo lifts and cargo ramp in the "in service" and stowage conditions with respect to the following loads listed from **(1)** to **(7)**.

(1) Safe working load

(2) Self-weight of the installation

(3) Wind loading

(4) Wave loading

(5) Loads due to ship inclination

(6) Loads due to ship motion

(7) Other loads considered necessary by the Society

8.2.2 Wind Loading

The wind loading is to be calculated according to **4.2.5**.

8.2.3 Wave Loading

For the structural members forming parts of shell plating and subjected to the wave load, the head of water is not to be less than that obtained from the following formula:

$$\{d - 0.125D + 0.05L' + \Delta H_w(x)\}\frac{gD}{D+2h_s} \ (kPa)$$

where

x: Distance from the forward face of stem on the designed maximum load line defined in **2.1.11(2), Part A of the Rules for the Survey and Construction of Steel Ships** (m)

d: Designed maximum load draught defined in **2.1.12(2), Part A of the Rules for the Survey and Construction of Steel Ships** (m)

D: Depth of ship defined in **2.1.6, Part A of the Rules for the Survey and Construction of Steel Ships** (m)

L': Length of ship defined in **2.1.2, Part A of the Rules for the Survey and Construction of Steel Ships** (m). L' is to be taken as 230 m when the length exceeds 230 m.

$\Delta H_w(x)$:Value obtained from the following formula for respective value of x

$(38 - 45C_b')\left(1 - \frac{x}{0.3L}\right)^2$ for $x \leq 0.3L$

0 for $x > 0.3L$

C_b': Block coefficient defined in **2.1.14, Part A of the Rules for the Survey and Construction of Steel Ships**. C_b': is to be taken as 0.85 when the block coefficient exceeds 0.85.

L: Length of ship defined in **2.1.2, Part A of the Rules for the Survey and Construction of Steel Ships** (m)

h_s: Value shown in **Table 8.1** depending on the length of ship

8.2.4 Loads due to Ship Inclination*

The loads due to ship inclination are to be as recognized by the Society to be appropriate.

Table 8.1 Values of h_s

Length of ship L (m)	h_s
$L \leq 90$	1.95
$90 < L < 125$	$0.01L + 1.05$
$125 \leq L$	2.30

8.2.5 Loads due to Ship Motion

The loads due to ship motion are to be as specified in 4.2.8.

8.2.6 Load Combinations

1 The load combinations to be used in strength analysis of structural members is to be those causing the more severe loading condition of the structural members resulting from the load combinations specified in -2 to -5 below.

2 The load combination of the following loads **(1)** to **(5)** are to be taken into consideration "in service" conditions:

(1) Safe working load

(2) Self-weight of slewing or moving parts of the cargo lifts and cargo ramps

(3) Self-weight of the fixed parts of the cargo lifts and cargo ramps

(4) Loads due to ship inclination

(5) Other loads considered necessary by the Society

3 The loads -2(1) and **(2)** are to be multiplied by 1.2 for the installations designed to slew or move with cargo loaded thereon/therein and by 1.1 for the cargo ramps designed not to slew or move with cargo loaded thereon.

4 The following loads **(1)** to **(6)** are to be taken into consideration for cargo lifts in stowage conditions.

(1) Loads in stowage conditions

(2) Self-weight of the cargo lifts

(3) Wind loading

(4) Loads due to ship inclinations in navigation

(5) Loads due to ship motions in navigation

(6) Other loads considered necessary by the Society

5 The following loads **(1)** to **(5)** are to be taken into consideration for cargo ramps in stowage conditions.

(1) Self-weight of the cargo lifts

(2) Wind loading

(3) Loads due to ship inclinations in navigation

(4) Loads due to ship motions in navigation

(5) Other loads considered necessary by the Society

8.3 Strength and Construction

8.3.1 General

1 The strength of structural members is to be analyzed for the load conditions specified in 8.2.6 according to the requirements in 8.3.2 to 8.3.7.

2 For the installations loaded with vehicles, the concentrated loads from wheels corresponding to their loading or running conditions are to be taken into account.

3 The strength of structural members forming parts of shell plating is, in general, to be equivalent to that of the surrounding hull structure.

4 The structural members are to have proper stiffeners and, in addition, suitable lushing devices for preventing their vertical and horizontal movements when stowed in position.

8.3.2 Allowable Stress for Loads

The allowable stress prescribed in Table 8.2 is not to be exceeded depending on the type of stress.

Table 8.2 Allowable Stress σ_a

Load Condition	Kind of stress						
	Tension	Bending		Shear	Compression	Bearing	Combined stress
		Tension side	Compression side				
Condition given in 8.2.6-2	σ_d	σ_d	$0.87\sigma_d$	$0.58\sigma_d$	$0.87\sigma_d$	$1.41\sigma_d$	$1.15\sigma_d$
Condition given in 8.2.6-4 and -5	$1.15\sigma_d$	$1.15\sigma_d$	σ_d	$0.67\sigma_d$	σ_d	$1.63\sigma_d$	$1.33\sigma_d$

Notes:

1. σ_d: Following values for steel material, whichever is the smaller
   (1) The value obtained by dividing the yield point or the proof stress of material by 1.5 (N/mm^2)
   (2) The value obtained by dividing the tensile strength by 1.8 (N/mm^2)
2. The combined stress is to be the value obtained from the following formula:

$$\sqrt{\sigma_x^2 + \sigma_y^2 - \sigma_x\sigma_y + 3\tau_{xy}{}^2} \quad (N/mm^2)$$

where

σ_x:Applied stress in x-direction at the middle of plate thickness (N/mm^2)

σ_y: Applied stress in y-direction at the middle of plate thickness (N/mm^2)

τ_{xy}:Applied shear stress in the x-y plane (N/mm^2)

8.3.3 Lift Deck Plating and Ramp Plating Thickness

1 The thickness of the plating forming a part of shell plating is not to be less than the thickness of shell plating at the position concerned to be determined regarding the actual stiffener spacing as the frame spacing.

2 The plate thickness of the plating forming a part of bulkhead is not to be less than the thickness of bulkhead plating at the position concerned to be determined regarding the actual stiffener spacing as the bulkhead stiffener spacing.

3 For the installations loaded with vehicles the thickness of lift deck plating or ramp plating is not to be less than required for deck plating of the car deck.

8.3.4 Minimum Thickness

The thickness of structural members is not to be less than 6 *mm* in the parts exposed to weather and 5 *mm* in the parts not exposed to weather.

8.3.5 Deflection Criteria*

The deflection of the structural members due to the safe working load is to be limited, as a rule, to 1/400 of the span between supports in cargo lifts and 1/250 of the span between supports in cargo ramps.

8.3.6 Strength of Bolts, Nuts and Pins

Bolts, nuts and pins are to have ample strength for the magnitudes and directions of the loads they are subjected to.

8.3.7 Locking Devices of Cargo Ramps

1 Stowage locks are to be provided to resist the load resulting from consideration of loads specified in 8.2.6-5.

2 The hydraulic locking devices are to be designed to keep the ramp locked mechanically even in the event of failure of the hydraulic pressure.

3 For a cargo ramp utilized commonly as a means for closing openings, the closing devices may be utilized as locking devices, if the area of opening is larger than half of the projected area of the stowed ramp. The design load of the closing devices is to include also the loads specified in 8.2.6-5 in addition to the loads in 14.10.1.4, Part 1, Part C of the Rules for the Survey and Construction of Steel Ships.

Chapter 9 CERTIFICATION, MARKING AND DOCUMENTATION

9.1 General

9.1.1 Application

The requirements in this chapter apply to the certification, marking and documentation of the cargo handling appliances.

9.2 Assignment of Safe Working Load, etc.

9.2.1 General

The Society assigns the safe working load, etc., for the cargo handling appliances that have passed the inspection and load tests specified in Chapter 2.

9.2.2 Duplicated Assignment of Safe Working Load, etc.

The Society will assign, at the application of the shipowner, the following **(1)** to **(3)** in addition to the safe working load etc. in accordance with the requirements in 9.2.1:

(1) The maximum load corresponding to an angle smaller than the assigned allowable minimum angle in case of derrick systems

(2) The maximum load corresponding to a radius exceeding the assigned maximum slewing radius in case of jib cranes

(3) The maximum load for personnel transfers specified in 1.1.1-3 of the Rules in case of cranes

9.2.3 Assignment for Union-purchase Derrick Systems

1 The assignments of the safe working load, etc. for the union-purchase derrick systems are the safe working load and maximum angle between two cargo falls or the safe working load and allowable lifting height (the vertical distance between the highest position of the structure above the upper deck with hatch opening and the delta plate or ring attached to the cargo falls).

2 The maximum angle between two cargo falls specified in **-1** is not to be assigned to exceed 120°.

9.3 Marking of Safe Working Load, etc.

9.3.1 Marking for Cargo Gear and Cargo Ramps

1 On the cargo gear and cargo ramps assigned by the requirements specified in 9.2, the safe working load, allowable minimum angle, maximum slewing radius and other restrictive conditions are to be marked by using stamps in accordance with the following requirement in **(1)** through **(3)**:

(1) Derrick systems

At the conspicuous place of the base of derrick boom, the stamp mark of the Society, the safe working load, the allowable minimum angle of the boom and other restrictive conditions are to be marked.

(2) Jib cranes

At the conspicuous place of the base of jib or the similar position, the stamp mark of the Society, the safe working load, the maximum slewing radius and other restrictive conditions are to be marked.

(3) Other cargo gear and cargo ramps

At the conspicuous place which is hardly fouled, the stamp mark of the Society, the safe working load and other restrictive conditions are to be marked.

2 In the case of the duplicated assignment of safe working loads are assigned to derrick systems and jib cranes in accordance with the requirements of 9.2.2, the necessary markings for respective combinations are to be made correspondingly in according to the requirements of **-1**.

3 For the cargo gear which is used with grabs, lifting beams, lifting magnets, spreaders and similar other loose gear and assigned the maximum cargo load excluding the self-weight of such loose gear to safe working load, the notation in this connection to be marked as other restrictive conditions correspondingly according to **-1**.

4 The stamp marks are to be coated with anti-corrosive paint and framed with paint for easy recognition.

5 In addition to the stamp marks specified in **-1**, **-2** and **-3**, the same markings (except for the stamp mark of the Society) are to be made so as to be permanently and easily visible at conspicuous places using welded bead and paint or methods recognized by the Society to be equivalent.

6 The size of the letters used in the markings specified in **-5** above is not to be less than 77 *mm* in height.

9.3.2 Marking for Loose Gear

1 On the loose gear other than wire ropes and fibre ropes, the test load, the safe working load and the identification symbols are to be marked by using stamps at the conspicuous place and no adverse effects are to be caused for both their strength and service. On grabs, lifting beams, lifting magnets, spreaders and similar other loose gear, the self-weight of them are to be stamped additionally.

2 The stamp marks are to be coated with anti-corrosive paint and framed with paint for easy recognition.

3 In addition to the markings specified in **-1**, grabs, lifting beams, lifting magnets, spreaders and similar other loose gear are to be marked with the safe working load and the self-weight of them with paint, etc. In this case the size of letters should not be less than 77 *mm* in height.

4 Notwithstanding the requirements in **-1** and **-3**, where it is difficult to make direct stamp mark or marking with paint, other means may be taken when approved by the Society.

9.4 Documentation

9.4.1 Kinds of Documents

The kinds of the documents issued by the Society for cargo gears, cargo ramps and loose gear are to be as specified in the followings:

(1) Register of Ship's Lifting Appliances and Items of Loose Gear (*ILO Form 1*) (CG.1)

(2) Certificate of Test and Thorough Examination of Derricks, Winches and their Accessory Gear (*ILO Form 2*) (CG.2)

(3) Certificate of Test and Thorough Examination of Derricks, Winches and their Accessory Gear, for Operation in Union Purchase (*ILO Form 2 (U)*) (CG.2(U))

(4) Certificate of Test and Thorough Examination of Cranes or Hoists and their Accessory Gear (*ILO Form 2*) (CG.3)

(5) Certificate of Test and Thorough Examination of Cargo Lifts/Cargo Ramps and their Accessory Gear (CG.3LR)

(6) Certificate of Test and Thorough Examination of Loose Gear (*ILO Form 3*) (CG.4)

(7) Certificate of Test and Thorough Examination of Wire Rope (*ILO Form 4*) (CG.5)

9.4.2 Timing of Issuance of Documents

The timing of issuance of documents specified in **9.4.1** is to be as given in **Table 9.1** depending on the tests and survey.

9.4.3 Revocation of the Documents

1 The whole or part of the certificates specified in **9.4.1** will be revoked when either of the following **(1)** through **(9)** is relevant:

(1) When application is made by the shipowner for cancellation or alteration of the assignment of the safe working load, etc.

(2) When the construction, arrangement or rigging of the cargo handling appliances are altered

(3) When the cargo handling appliances are removed

(4) When the surveys specified in **Chapter 2** are not subjected to

(5) When the cargo handling appliances are considered to be unserviceable by the Surveyor

(6) When the contents is the certificates are intentionally altered

(7) When the contents in the certificates have become illegible due to foul or damage

(8) When the specified fee covering the survey is not paid

(9) In case where the Society has a doubt on the effectiveness of the certificates, etc.

2 The certificates which become invalid in accordance with the provisions in **-1** are to be returned to the Society without delay.

9.4.4 Reissuance and Corrections of Documents

In case where the certificates, etc. become invalid in accordance with the provisions of the preceding **9.4.3-1** or lost, the Society will reissue the certificates or make necessary corrections thereto depending on the circumstances involved.

9.5 Preservation of Documents

9.5.1 General

The Certificates issued depend on the requirements in 9.4 by the Society and the instruction manual for cargo handling appliances are to be preserved aboard the ship or by shipowner's responsible person in case of towing boat not manned.

9.5.2 Instruction Manual

The instruction manual mentioned in 9.5.1 is to note essential items necessary for operation and maintenance of the cargo handling appliances among those given in the following **(1)** through **(8)**:

(1) General arrangement of cargo gear and cargo ramps
(2) Arrangement drawing of loose gear (including rigging arrangement)
(3) List of loose gear
(4) Design conditions (including safe working load, wind speed, trim and heel of ship, etc.)
(5) List of materials
(6) Operation manual (including functions of safety systems and protective systems)
(7) Load testing procedure
(8) Maintenance and control procedures

Table 9.1 Timing of Issuance

Kind of Documents		Timing of Issuance
A	Document in 9.4.1(1)	When the application for assignment is made and the ship passes the Registration Survey for the first time
B	Document in 9.4.1(2)	(1) When the application for assignment is made and the ship passes the Registration Survey for the first time (2) When the cargo handling appliances that are installed additionally pass the Registration Survey (3) When the safe working load, etc. is altered (4) When the ship passes the load tests specified in 2.5.1-4
	Document in 9.4.1(3)	
	Document in 9.4.1(4)	
	Document in 9.4.1(5)	
C	Document in 9.4.1(6)	(1) When the application for assignment is made and the ship passes the Registration Survey for the first time (2) When the cargo handling appliances that are installed additionally pass the Registration Survey (3) When loose gear is replaced or repair at time of the Periodical Surveys and the Occasional Survey, and when the contents of autonomous inspection is recognized appropriate by the Society
	Document in 9.4.1(7)	

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GUIDANCE FOR CARGO HANDLING APPLIANCES

Chapter 1 GENERAL

1.1 General

1.1.2 Equivalency

1 "Rules and standards recognized by the Society to be appropriate" specified in **1.1.2-2 of the Rules** mean, as a rule, *JIS B* 8821 (Specification for the Design of Crane Structures) or other standards or rules equivalent thereto.

2 "Tests and inspection required by the Society" specified in **1.1.2-2 of the Rules** mean, as a rule, the Design Examination specified in **2.3.1 of the Rules** and the Work Examination specified in **2.3.2** thereof. However, the Society may dispense with part of the plan investigation and examination for the machinery and gear which passed the plan investigation and examination of the official or third-party organizations considered appropriate by the Society and were certified by them.

1.1.3 Precautions in Application

1 For ships flying Greek flags, the rules of Greek Government concerning the cargo gear are to be complied with in addition to the Rules. The rules of Greek Government are applied to all power driven cargo gear regardless of their safe working loads and services intended.

2 Attention is to be paid to the fact that some states of call require to hold certificates of special form specified by those in addition to the certificates specified in **9.4.1 of the Rules** and issued by the Society.

1.2 Definitions

1.2.1 Terminology

The derricks come under the requirements of the Rules include those illustrated in **Fig. 1.2.1-1**.

1.3 Arrangement, Construction, Materials and Welding

1.3.2 General Construction

1 The cargo gear which are to comply with the additional requirements considered appropriate by the Society in applying the Rules as specified in **1.3.2-1 of the Rules** include the following **(1)** through **(4)**:

(1) Cargo gear installed on mobile offshore units

(2) Cargo gear installed on workboats

(3) Hoisting and stowing equipment for submersibles and diving

(4) Other equipment to which the Society deems necessary to pay special attention

2 "Requirements specially made up by the Society" specified in **1.3.2-2 of the Rules** include the following requirements **(1)** through **(4)**:

(1) Where steel materials of various strengths are used in the structural members, due considerations are to be given to the stress caused in the material of lower strength adjoining that of higher strength.

(2) For the members in which high tensile steels are used, special attention is to be paid to the structural details so that significant stress concentration may not take place.

(3) Where high tensile steels are extensively used in the structural members, careful considerations are required. In such cases, a thorough study with regard to ensuring buckling strength and the results of the study are to be submitted to the Society.

(4) Dimensions of the members are to comply with the following requirements **(a)** through **(e)**:

(a) The minimum thickness of post specified in **3.3.3 of the Rules** may be obtained from the following formula:

$5.0K+1.0\ (mm)$

where:

$K = \sigma_{yM}/\sigma_{yH}$

σ_{yM} : Specified value of yield stress of mild steel

σ_{yH} : Specified value of yield stress of high tensile steel

(b) The minimum outside diameter of post at the base specified in **3.4.2 of the Rules** may be as obtained from the following formula:

$5hK\ (cm)$

where:

h : As specified in **3.4.2 of the Rules**

K : As specified in **(a)**

(c) The value of the coefficient C_2 specified in **Table 3.4** in **3.4.3-1(1) of the Rules** may be substituted by the value of C_2 multiplied by the coefficient K specified in **(a)**.

(d) The minimum thickness of the structural members specified in **4.3.7 of the Rules** may be substituted by the value obtained from the following formula:

$5.0K+1.0\ (mm)$

where:

K : As specified in **(a)**

(e) The minimum thickness of the structural members specified in **8.3.4 of the Rules** may be substituted by the value obtained from the following formulae:

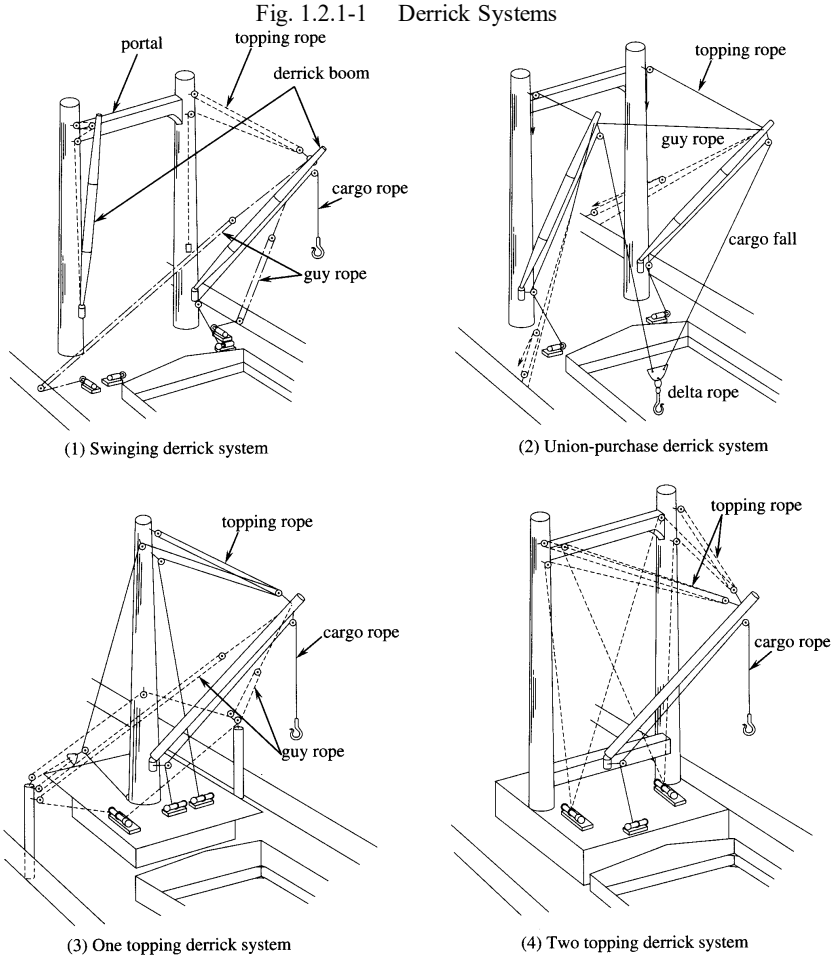
Weather part $5.0K + 1.0\ (mm)$

Enclosed part $5.0K\ (mm)$

where:

K : As specified in **(a)**

Fig. 1.2.1-1 Derrick Systems



1.3.4 Materials

1 "Cases considered appropriate by the Society" mentioned in **1.3.4-1 of the Rules** are the following cases **(1)** to **(3)**:

(1) Where *KB* of more than 25*mm* in thickness are used in the following members **(a)** to **(c)** of the structural members of cranes:

(a) Flange for mounting slewing ring (bearing) of jib crane

(b) Housing base of jib crane

(c) Members constituting movable parts of gantry crane, etc. with increased plate thickness to ensure stiffness. However, requirements specified in **Table 1.1 of the Rules** may be applied according to the magnitude of working stresses

(2) Where steel pipes conforming to the following requirements **(a)** through **(d)** are used to manufacture the structural members such as derrick booms, derrick posts, crane jibs, crane posts and other similar members:

(a) The steel pipes are to be of 20*mm* or less in thickness.

(b) The steel pipes are to be of Grade 1 or 2 of steel pipes for pressure piping specified in **Part K of the Rules for the Survey and Construction of Steel Ships**, or the equivalent thereto.

(c) Steel pipes for structural purposes specified in *JIS* may be used only when the material tests are carried out in the presence of the Society's Surveyor.

(d) Steel pipes to be welded are to be of 0.23% or less in carbon contents.

(3) Where rolled steel material and steel pipes, not exceeding 12.5*mm* thick, complying with *JIS* or the standards recognized to be appropriate by the Society are used in the main structural members of cargo gears which are not employed in cargo handling services excluding those used for cargo hoses. The materials of the members welded directly to the hull structure, however, are to comply with the requirements in **1.3.4-1 of the Rules** or **(2)(a)** to **(d)** above.

2 Classification of the steel materials used in the structural members, travelling girders, tracks, etc. of cargo gear used in areas with low air temperatures or refrigerated hold chambers are to comply with **Table 1.3.4-1** according to design temperatures.

3 Forged or cast steel parts used in the following structural members **(1)** through **(6)** may be of the materials conforming to *JIS* or standards considered equivalent thereto by the Society.

(1) Topping bracket of derrick system
(2) Gooseneck bracket and gooseneck pin of derrick system
(3) Derrick heel lugs and head fitting of derrick boom
(4) Heel bracket of jib crane
(5) Heel fitting of crane jib
(6) Bracket and pin for movable parts of gantry crane, cargo lift and cargo ramps

Table 1.3.4-1 Classification of Steel Materials Exposed to Low Temperature

Design temperature T (℃)	Material thickness t (mm)				
	$t \leq 10$	$10 < t \leq 20$	$20 < t \leq 25$	$25 < t \leq 40$	$40 < t$
$-10 \leq T$	*A/AH*		*B/AH*	*D/DH*	*E/EH*
$-20 \leq T < -10$	*B/AH*	*D/DH*	*E/EH*		
$-30 \leq T < -20$	*E/EH*			*KL24A*	*KL24B*
$-40 \leq T < -30$	*KL24A*		*KL24B*		*
$-50 \leq T < -40$	*KL24B*		*		

Notes:

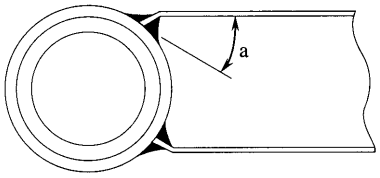
1. Steel grades for the construction capable of relieving thermal stress will be specially considered by the Society.
2. The Society may require materials having higher notch toughness according to the material thickness and construction if the design temperature is below -50℃ or working stress of the material exposed to low temperatures exceeds 60% of the yield point.
3. Steel grades for the members corresponding to classification asterisked * will be specially considered by the Society.
4. Symbols used in this Table are same as those in **Table 1.1 of the Rules**.

1.3.5 Welding

1 Welding of derrick posts is to comply with the following requirements **(1)** through **(8)**:

(1) Welding of post is to be both side welding as far as practicable.
(2) Welding of post to deck is to be of double grooved at the foot of post. If inside work of the post is difficult due to small diameter or any other reasons, penetration welding with the backing metal for single groove may be permitted.
(3) As for the welding of side plates to upper and lower plates constituting portal, the fillet size, at the portal ends and at the portions where topping brackets, eyes, etc. are fitted are to be of *F*1 weld specified in **Table 12.2.1-2, Part 1, Part C of the Rules for the Survey and Construction of Steel Ships**.
(4) Welding for portal and post are to be both side welding as far as practicable. If angle shown in **Fig. 1.3.5-1** is small, the ends of portal are to intersect orthogonally with the post surface by providing knuckle to carry out fillet welding as completely as practicable.
(5) Topping brackets and gooseneck brackets are to be fitted by penetrating the post or mounting the base. If the plate thickness of the post or the mounting base exceeds 12.5mm, the welding is to be penetration welding with grooves.
(6) The joint of derrick boom for circumferential is to be both side welding and back welding after removing defects of face run by back chipping. However, penetration welding with backing metal may be permitted limiting to such an unavoidable case as partial replacement for repair. In this case, the welded joint concerned is to be verified by suitable non-destructive inspection carried out along the whole length of weld line that it is free from injurious defects.
(7) The backing metal used for the joint derrick boom for longitudinal joint is to be jointless along the whole length with smooth surface.
(8) The requirements in **(2)**, **(5)** and **(6)** may be modified for the derricks not used in cargo handling service in consideration of the safe working load and the type of construction.

Fig. 1.3.5-1 Welding for Portal and Post



2 Welding for cranes is to comply with the following requirements **(1)** to **(4)**:

(1) In principle, the welded joints of the jib are to be both-side welding (including fillet weld). Where both-side welding is difficult, penetration bead welding or welding with backing strip is to be carried out.

(2) As for the welding of crane post, the requirements in **-1(1)** and **(2)** are to be applied.

(3) The following parts are, as a rule, to be fixed by full penetration welding.

(a) Fixing part of crane post and post flange for slewing ring

(b) Fixing part of bracket for sheave to jib top

(c) Fixing part of bracket for sheave to crane house

(d) Fixing part of base bracket of jib

(e) Fixing part of crane house well and turning table.

(4) The fillet weld applied to the primary structural members is, as a rule, to be *F*1 weld specified in **Table 12.2.1-1, Part 1, Part C of the Rules for the Survey and Construction of Steel Ships**, or equivalent thereto.

3 Welding for cargo lifts and cargo ramps is to comply with the following requirements **(1)** to **(3)**:

(1) The fillet weld applied to the primary structural members is to comply with the requirements in **-2(4)**.

(2) Welding for non-slip bar, etc. fitted directly to the primary structural members is to be carried out in such a way that it may not give any injurious effect on the members.

(3) If stoppers, their braces and similar fittings used in stowing the machinery and method of welding are to be selected or carried out in such a way that they do not give any adverse effect on the structural members or hull structures.

4 Welding for the structural members of cargo gear used in areas with low air temperatures or refrigerated hold chambers is to be carried out in such a way that it may not give any adverse effect on prevention of occurrence of low temperature brittle fracture in consideration of the structure, working stress, etc.

5 When cast steel or forged steel parts are connected to steel plates by butt welding or lap welding, the details of welded joints are to comply with the requirements specified in **12.2, Part 1, Part C of the Rules for the Survey and Construction of Steel Ships**.

6 Non-destructive inspection for welded joints of structural members of cargo gear and cargo ramps is to comply with the following requirements **(1)** to **(3)**:

(1) The following places **(a)** to **(c)** are to be subjected to radiographic test or ultrasonic test:

(a) Places specified in **-1(6)**

(b) For structural members of cranes, places specially considered by the Society according to their structure and method of construction as well as the places specified in **-2(1)**

(c) Places being suspicious in integrity of welded joints

(2) When the Society deems necessary, the following places corresponding to **(a)** to **(d)** are to be subjected to the magnetic particle test or dye penetrant test:

(a) Welded joint of rolled steel plate to cast or forged steel

(b) Trace of removing hanging pieces, jigs, etc. welded temporarily to the structural members

(c) Weld of cargo fitting

(d) Fillet welds of structural members being suspicious in integrity

(3) Method of non-destructive test specified in **(1)** and **(2)** and judging criteria of defects are to be in accordance with the discretion of the Society according to the construction of the places concerned.

Chapter 2 SURVEYS

2.1 General

2.1.1 Application

1 Posts for derricks and cranes and supports for cargo lifts/ramps fixed directly to the hull structure are to be subjected to the tests and examinations specified in **Part B of the Rules for the Survey and Construction of Steel Ships** in addition to this chapter.

2 Where cargo lifts and cargo ramps constitute part of the hull structure, they are to be subjected to the tests and examinations in compliance with the requirements in **Part B of the Rules for the Survey and Construction of Steel Ships**, according to the type and arrangement of hull structure.

3 "In cases where considered appropriate by the Society" specified in **2.1.1-4 of the Rules** means those cases where examinations are carried out in accordance with measures specially approved by the Society. However, this regulation is not to be applied to surveys required by international regulations or the requirements of flag states.

2.1.2 Preparation for Surveys and Others

1 "The Surveyor considers that the safety for execution of the tests and examinations is not ensured" means that the safety measure of prevention for downfall is not taken at high position survey, etc.

2 With respect to **2.1.2-5 of the Rules**, surveyors are to confirms at periodical surveys that asbestos-free declarations and supporting documents are provided for any replaced or newly installed fittings, equipment, parts, etc. The wording "materials containing asbestos" means that asbestos is present in the product/material above the threshold value stipulated in Appendix 1 of *IMO* resolution *MEPC*.379(80).

2.2 Surveys of Cargo Handling Appliances

2.2.2 Timing of Surveys

The wording "the Society may approve the survey methods which it considers to be appropriate." in **2.2.2(4) of the Rules** means survey methods which the Society considers to be able to obtain information equivalent to that obtained through traditional ordinary surveys where a surveyor is in attendance.

2.2.4 Postponement of Periodical Surveys

In order to obtain "approval by the Society" specified in **2.2.4 of the Rules**, the followings are to be complied with.

(1) The owner or its representative is to make the application for postponement before the due date in the same manner specified in **B1.1.5 of the Guidance for the Survey and Construction of Steel Ships**.

(2) There is no Society's Condition relevant to cargo handling appliances.

2.3 Registration Surveys

2.3.1 Submission of Plans and Documents

1 Submission of drawings of hydraulic motors, hydraulic pumps, steam cylinders, pneumatic motors or internal combustion engines for driving various winches and travelling machines used in cargo handling appliances are to be in accordance with the following requirements **(1)** to **(3)** according to the output:

(1) Where the output is less than 375*kW*:

Submission of drawings may be dispensed with. However, name of manufacturer, type and principal particulars are to be described in the approval drawings of winches or travelling machines employed.

(2) Where the output is 375*kW* or more:

Principal particulars, drawings of structural details and strength calculation sheet are to be submitted in one set for reference.

(3) Others:

Where the machinery is installed in ships under the classification of the Society for the first time, the requirements in **(2)** are to

be applied even when the output is less than 375*kW*.

2 General arrangement plan and structural drawings of derricks are to include at least the following items **(1)** and **(2)**:

(1) General arrangement plan

(a) Masts, posts, guy posts, shrouds, stays (including attached rigging screws), derrick booms, and arrangement of cargo fittings fitted to hull structure, etc.

(b) Breadth of ship and outreach

(c) Positions and name of cargo blocks and arrangement of running ropes (for lifting and slewing)

(d) Positions, types and capacities of winches

(e) Self-weight of lifting beams, grabs, lifting magnets, spreaders, etc.

(2) Structural drawings

(a) Construction, dimensions and materials of masts, posts, guy posts and derrick booms

(b) Dimensions and materials of shrouds and stays

(c) Dimensions and materials of gooseneck brackets, topping brackets, eye plates at upper and lower ends of preventer stays and other cargo fittings

2.3.2 Survey

1 Tests and examinations for driving machines, etc. for cargo gear and cargo ramps are to be in accordance with the following requirements **(1)** to **(4)**:

(1) Hydraulic motors and regulating valves attached thereto:

(a) Where the output is less than 375*kW*, shop tests may be replaced with the tests conducted by the manufacturer. In this case the Society may require submission of the test results, if it deems necessary.

(b) Where the output is 375*kW* or more, hydraulic test may be dealt with in a same way as **(a)**, but performance verification test and open-up examinations are to be carried out in the presence of the Surveyor. The hydraulic (water or oil) test is to be carried out at a pressure of 1.5 times the design pressure.

(c) Notwithstanding the requirements **(a)** and **(b)** where the driving machines are installed on the class ship of the Society for the first time, the hydraulic test, performance verification test, and open-up examination are all to be carried out in the presence of the Surveyor.

(2) Hydraulic pumps:

Hydraulic pumps are to be dealt with in similar ways to **(1)(a)** to **(c)** depending on the outputs of the driving motors.

(3) Steam cylinders, pneumatic motors and internal combustion engines:

These are to be dealt with in similar ways to **(1)(a)** to **(c)** depending on each output. The hydraulic tests for the steam cylinders are to be carried out at a pressure of 1.5 times the design steam pressure and those for the valves directly connected to the cylinder are to be carried out at a pressure of 2 times the design steam pressure.

(4) Driving motors for winches or hydraulic pumps and their control equipment:

These are to comply with the requirements specified in **Part H of the Rules for the Survey and Construction of Steel Ships** and to pass the tests and examinations specified in **Part H** thereof.

2 Winches which are used for the cargo gear and cargo ramps (except those specified in **-3**) are to be subjected to the tests and examinations mentioned in the following **(1)** and **(2)** at the shop tests after completion of assembly including installation of driving machines, etc. In this case, one winch selected from those of the same type manufactured at the same time and to be installed on the same ship is to be tested in the presence of the Surveyor, and, if the results are satisfactory, tests and examinations for other winches may be substituted by confirmation of the test results issued by the manufacturer.

(1) Electro-hydraulic winches

(a) Visual examinations and checking of the construction:

It is to be ascertained that no practically injurious defects exist in materials and workmanship and each movable part moves smoothly.

(b) No-load test:

The winch is to be operated with no load at the maximum speed for 30 *minutes* (15 *minutes* for each normal and reverse rotation) and be ascertained that the performance and each structural part is in good order.

(c) Load tests:

The winch is to hoist and lower the rated load for a period of 30 *minutes* continuously. (Pause of 20 *seconds* may be inserted between each hoisting and lowering operation, and effective lift is desirable to be 10*m* or more.) During this operation, the temperature rise of the bearings, the hoisting speeds, the lowering speeds and the input power are to be measured and ascertained that they are in good order.

(d) Braking tests:
During hoisting and lowering the rated load for the winch, return the control handle to the neutral position and check the slip of the load to be 1.5*m* or less. Manual releasing test of the brake is also to be carried out and ascertained to be in good order.

(e) Speed control tests

(f) Emergency assurance tests:
The emergency assurance devices provided in the winches is to be ascertained of the performance by cutting off power supply during lowering the rated load.

(g) Overload tests:
The winch is to hoist and lower a load weighing 125% of the rated load several times. The winch is to be stopped at least three times during lowering the load and ascertained to be in good order.

(h) Adjustment of the over-pressure preventive device:
The adjusted pressure is to be checked as necessary.

(i) Open-up examinations
The Society may require an open-up examination of the part where abnormality is found.

(j) Other tests deemed necessary by the Surveyor.

(2) The shop test for steam winches, electric winches and winches driven by internal combustion engines are also to be carried out in accordance with the requirement specified in **(1)** for electro-hydraulic winches (except **(h)**).

3 Winches that are used for cranes, special derricks, cargo lifts or cargo ramps and are integrated in their moving bodies are, as a rule, to be handled in accordance with the requirements in **-2**. However, in case where deemed impracticable by taking into account the construction or arrangement of the winch, part or whole of the tests and examinations specified in **-2** may be permitted to be carried out at the time of the Load Tests specified in **2.5 of the Rules**.

4 The wording "the Society may approve other survey methods which it considers to be appropriate" in **2.3.2-3 of the Rules** means survey methods which it considers to be able to obtain information equivalent to that obtained through traditional ordinary surveys where the Surveyor is in attendance.

2.4 Annual Thorough Surveys

At Annual Thorough Surveys, the structural members and loose gear in which corrosion, abrasion or other defects specified in the followings are found are, as a rule, to be repaired or renewed:

(1) Structural members (plate members and cargo fittings other than pin construction):
Structural members in which amount of wear and tear reaches 10% of the original dimensions. However, this may not be applied where steel plates having enough margin to the thickness required by the Rules is used.

(2) Cargo fittings of pin construction:
Structural members where clearance between pin or similar fitting and its mating hole increases up to 10% of the original diameter of the pin. However, for gooseneck pin the limit of clearance between the cross bolt and the bracket hole is to be 5% of the original diameter of the cross bolt.

(3) Loose gear (except wire ropes)
For loose gear except wire ropes, those corresponding to any of the followings:
(a) Those in which injurious deformation occurred
(b) Those in which crack occurred
(c) Those in which amount of abrasion or corrosion reaches 10% or more of the original dimensions
(d) Blocks whose sheaves do not rotate smoothly

(4) Wire ropes

Wire ropes corresponding to any of the followings:

(a) Those in which 5% or more of total number of independent wires (except filler wires) were broken within a length of 10 times the diameter of wire rope

(b) Those in which reduction in diameter of the wire rope reaches 7% or more of the diameter

(c) Those in which kink or other injurious deformation occurred

(d) Those in which significant corrosion occurred at the surface of independent wires or inside the wire rope

(e) In addition to wire ropes specified in the preceedings, those to which the discard criteria specified in *ISO 4309* "Wire Rope for Lifting Appliances Code of Practice for Examination and Discard" is applicable are recommended to be discarded.

2.5 Load Tests

2.5.1 Load Tests

1 Load Tests for cranes which are newly constructed, as a rule, are to be carried out after having been assembled at the shops, as well as after having been installed on board the ships. If the results of the shop tests are satisfactory for one crane selected from those of the same type manufactured at the same time and to be installed on the same ship, those for other cranes may be substituted by confirmation of the test results issued by the manufacturer. Where any special reason is admitted by the Surveyor, the Load Tests at the shop may be dispensed with.

2 For cargo gear exclusively using grabs, lifting beams, magnets, spreaders and other similar loose gear (hereinafter referred to as "cargo holding gear"), the test load and safe working load may be dealt with in either case of the following **(1)** or **(2)** in accordance with the application:

(1) Where the mass of loose gears is included in the safe working load:

Test load $=\alpha \times$ {(maximum cargo mass) + (mass of cargo holding gear)}

Safe working load = (maximum cargo mass) + (mass of cargo holding gear)

where:

α: a factor obtained from the test load specified in **Table 2.1 of the Rules** divided by the safe working load. However, for the safe working load not less than 20*t* but less than 50*t*, the test load is to be the safe working load plus 5*t*.

(2) Where the mass of loose gears is not included in the safe working load and the maximum cargo mass only is assigned as the safe working load, the cargo gear whose safe working load is assigned by this procedure is to satisfy the following conditions:

(a) The load tests are to be carried out employing the loose gears used in the cargo gear concerned or other loose gears having same construction and mass.

(b) The loose gears used on board the ship is to be the same gears as used in the load test or those having same construction and mass.

Test load $=\alpha \times$ (maximum cargo mass)

Safe working load = maximum cargo mass

where:

α: As specified in **(1)**

3 Load Tests for cargo gear which are used for solely conventional cargo handling by cargo hook are, as a rule, to be handled in accordance with the manners specified in **-2(2)**.

4 Details of Load Tests and operation tests for cargo gear and cargo ramps are to comply with the following requirements in **(1)** to **(4)**, in addition to those specified in the Rules.

(1) Derricks

(a) In cases where the assignment of the additional safe working loads specified in **9.2.2(1) of the Rules** is made, the Load Test for such loads may be dispensed with. In such cases, the relationship between the safe working load, etc. and any additional safe working load, etc. is to satisfy the following formula:

$$B = W\frac{\cos\alpha}{\cos\beta}$$

where:

W: Safe working load (*t*)

α: Allowable minimum angle (*degree*)

B: Additional safe working load (t)

β: Additional allowable angle (*degree*)

(b) Load Tests may be omitted provided that the cargo gear complies with either of the following conditions:

i) For heavy derrick systems: they are not frequently used and the Load Tests will be carried out before use.

ii) For union-purchase derrick systems: they passed the Load Tests as a swinging derrick system and the eye plates of the preventer stays are in good order.

(2) Jib cranes

(a) Where assignment of additional safe working load specified in **9.2.2(2) of the Rules** is made, the Load Test for the additional safe working load must not be dispensed with.

(b) For cranes with constant safe working load regardless of slewing radius, slewing tests are to be carried out at the maximum radius with test load based on the safe working load suspended on it and luffing operation to the minimum radius or the smallest possible radius is to be carried out and slewing test at that radius is also to be carried out as far as practicable.

(c) For cranes whose safe working load changes depending on the slewing radius, slewing operations are to be carried out at both the maximum and minimum slewing radius after hoisting the test loads corresponding to each radius.

(d) For cranes capable of doing all three of hoisting, slewing and luffing operations or any two out of these three operations simultaneously, these combined operations prescribed in the design specifications are to be verified that they are in satisfactory condition with the test loads corresponding to the limited radius suspended on it.

(3) Gantry cranes and other track-mounted cranes

(a) The crane is to run on the track within the travelling limits with the test load based on the safe working load suspended on it. In this case, the hull structure supporting the travelling track is also to be confirmed that it is free from defects.

(b) Where travelling trolley is employed, it is to run the whole travelling range through with the test load based on the safe working load suspended on it.

(c) Where sponson girder of stowing type for travelling trolley is employed, stretching and stowing operations of the girder are to be ascertained that they are in good order.

(4) "The method considered appropriate by the Society" in **2.5.1-4(2) of the Rules** means the following requirements at least.

(a) Accuracy of the load weighing machine is to be within the range of $\pm$2.5%.

(b) Load applying position is to be selected in such a way that the stress generated in the structural members be the most severe within the approved operating range.

(c) The load is to be sustained for a period of 5 *minutes* or more being sufficient to ensure the load indicator remains constant.

Chapter 3 DERRICK SYSTEMS

3.2 Design Loads

3.2.1 Load Considerations

Where strength of derrick systems is to be calculated directly, external forces exerting on top of boom are to include tension in topping lifts, tension in guy ropes, tension in cargo falls (which is caused by the weight of cargo), tension in cargo relief, half of self-weight of boom, and additional loads including self-weight of cargo blocks, hooks, ropes, etc. However, the additional loads may be as given in **Table 3.2.1-1**.

3.2.3 Loads due to Ship Inclination

1 Where an angle of heel less than that specified in the Rules is used for the design of structural members, data concerning ship inclination in service condition in at least the following conditions **(1)** through **(3)** are to be submitted to the Society. Longitudinal strength of hull and stability in these conditions are to be separately examined.

(1) Ship light condition

(2) On going condition in service of cargo loading

(3) Immediately before fully loaded condition

2 In ships conducting ballast adjustment to keep angle of heel within that specified in **3.2.3 of the Rules** in working condition, data concerning the following **(1)** through **(3)** are to be submitted to the Society. All these date are to be entered in the Instruction Manual to Cargo Handling Machinery and Gear referred to in **9.5.2 of the Rules**.

(1) Specifications of equipment for ballast adjustment

(2) Method and procedure of ballast adjustment

(3) Trouble-shooting of equipment for ballast adjustment

Table 3.2.1-1 Additional Loads

Safe working load W (t)	Additional Loads (t)
$W \leq 2$	$0.283W$
$2 < W \leq 15$	$0.4\sqrt{W}$
$15 < W \leq 50$	$0.1W$
$50 < W$	As considered appropriate by the Society

Chapter 4 CRANES

4.2 Design Loads

4.2.2 Impact Loads

The "impact load coefficient deemed appropriate by the Society" mentioned in **4.2.2-1 of the Rules** is the coefficient calculated from the hoisting speed of cranes specified in following **(1)** or **(2)**.

(1) For jib cranes

$\varphi = 1 + 0.3V_h$

where

$1 + 0.3V_h < 1.1$: $\varphi = 1.1$

$1 + 0.3V_h > 1.3$: $\varphi = 1.3$

(2) For other than jib cranes

$\varphi = 1 + 0.6V_h$

where

$1 + 0.6V_h < 1.1$: $\varphi = 1.1$

$1 + 0.6V_h > 1.6$: $\varphi = 1.6$

φ : Impact load coefficient

V_h : Hoisting speeds (*m/sec*)

4.2.7 Loads due to Ship Inclination

In calculating loads due to ship inclination to be taken into consideration in the design of cranes, requirements in **3.2.3-1** and **-2** specified for derrick systems may be also applied to cranes.

4.2.9 Load Combinations

1 Wind loading need not be taken into account for cargo gear mentioned in the following **(1)** and **(2)**:

(1) Cargo gear used in cargo hold, engine room, and other enclosed spaces in ship

(2) Cargo gear installed on weather deck and used only for loading and unloading articles other than cargo. The Society may, however, require to take the wind loading into account considering the construction system, method of operation, and safe working load of the machinery and gear.

2 A "work coefficient deemed appropriate by the Society" mentioned in **4.2.9-2 of the Rules** is the coefficient obtained based on the ratio of the average lifting load to the safe working load and the cargo load cycles specified in **Table 4.2.9-1** in which the coefficient is to be applied upon the agreement between the manufacturer of the cargo handling appliances and the ordering parties.

Table 4.2.9-1 Work coefficient of cranes

Division (Ratio of the average lifting load to the safe working load *W(t)*)	Number of loads *N* (Cargo load cycles)						
	$N < 6.3 \times 10^4$	$6.3 \times 10^4 \leq N < 1.2 \times 10^5$	$1.2 \times 10^5 \leq N < 2.5 \times 10^5$	$2.5 \times 10^5 \leq N < 5.0 \times 10^5$	$5.0 \times 10^5 \leq N < 1.0 \times 10^6$	$1.0 \times 10^6 \leq N < 2.0 \times 10^6$	$2.0 \times 10^6 \leq N$
Less than 50 % *W*	1.00	1.02	1.05	1.08	1.11	1.14	1.17
50 % *W or more, but* less than 63 % *W*	1.02	1.05	1.08	1.11	1.14	1.17	1.20
63 % *W or more, but* less than 80 % *W*	1.05	1.08	1.11	1.14	1.17	1.20	1.20
80 % *W or more*	1.08	1.11	1.14	1.17	1.20	1.20	1.20

Note:

For the calculation of the number of uses, the service life of crane is to be the design life of the crane.

4.3 Strength and Construction

4.3.1 General

1 As for slewing ring of the crane, drawings and data given in the following **(1)** through **(5)** are to be submitted to the Society. However, for those having operational experiences aboard ships under the classification of the Society, the requirements may be reduced to only those specified in **(2)**.

(1) Those giving structural details and materials of slewing ring

(2) Allowable values of vertical load, radial load, and upsetting moment exerting on the slewing ring

(3) Installation criteria of slewing ring

(4) Strength calculation sheet

(5) Data on operating experience and quality control during period of manufacture.

2 In construction of jib crane house, such portions subjected to concentrated load as fixing parts of brackets for sheaves and wire rope stoppers are to be effectively reinforced.

4.3.8 Fixed Posts

1 Where the fixing flange of slewing ring of jib crane at the upper part of post is reinforced by brackets, the brackets are at least to be fitted at every two fixing bolts for the slewing ring.

2 The method of reinforcement specified in **-1** is to be applied also to gantry cranes and other special cranes having slewing ring.

4.4 Special Requirements for Track-mounted Cranes

4.4.1 Stability

Tracks for track-mounted cranes are to comply with the following requirements **(1)** through **(3)**:

(1) The tracks are to have proper cross section, to be properly laid considering expansion and construction due to hull deformation and thermal effect, to be rigid and horizontal, and to have sufficient strength and monolithic travel surface.

(2) Where intended to serve as anchor to stop the crane under strong wind condition, the tracks are to be properly designed for the purpose intended.

(3) Tracks for electric cranes are to be properly earthed.

Chapter 6 LOOSE GEAR

6.2 Cargo Blocks

6.2.1 Cargo Blocks for Wire Ropes

Diameters of equalizer sheaves and sheaves of overload sensing devices at the bottom of groove are to be not less than 10 times and 5 times the diameters of wire ropes to be used, respectively.

6.3 Ropes

6.3.1 Wire Ropes

Terminal connections of ropes are to comply with the following **(1)** through **(6)**, as a standard:

(1) A loop splice should have at least three tucks with a whole strand of rope, followed by two tucks with half the wires cut out of each strand.

(2) All tucks other than the first should be against the lay of the rope. If another form of splice is used, it should be as efficient as that described in **(1)**.

(3) A splice in which all the tucks are with the lay of the rope should not be used in the construction of a sling or in any part of a cargo handling appliance where the rope is apt to twist about its axis.

(4) If a loop is made or a thimble secured to a wire rope by means of a compressed metal ferrule, the ferrule should be made to a manufacturer's standard conforming to the following **(a)** through **(e)**:

(a) The material used for the manufacture of the ferrule should be suitable, particularly to withstand plastic deformation without any sign of cracking.

(b) The correct size (both in diameter and length) of ferrule should be used for the diameter of the rope.

(c) The end of the rope that looped back should pass completely through the ferrule.

(d) The correct dies should be used for the size of the ferrule.

(e) The correct closing or compression pressure should be applied to the dies.

(5) Where zinc or other alloy is cast in socket to hold the end of rope, work is to be done in accordance with the manufacturer's criteria conforming to the following requirements **(a)** through **(d)**:

(a) Rope length necessary to make alloy casting is to be ensured.

(b) Oil and dirt adhering to independent wires are to be completely removed and proper clean surfaces are to be ensured by treatment before casting work.

(c) Casting temperature suitable to the characteristics of the alloy is to be properly maintained.

(d) Socket is to be preheated before casting of alloy.

(6) The terminal fitting of any wire rope should be capable of withstanding the following loads **(a)** or **(b)**.

(a) Not less than 95% of the minimum breaking load of the rope in the case of a rope of a diameter of 50*mm* or less

(b) Not less than 90% of the minimum breaking load of the rope in the case of a rope of a diameter above 50*mm*

6.5 Equivalent Requirements

6.5.1 General

1 Construction and materials of cargo blocks and hooks are to comply with the following requirements in **(1)** through **(3)**.

(1) Steel blocks are to comply with *JIS F* 3421, *F* 3422, *F* 3428, *F* 3429 or other standards considered appropriate by the Society.

(2) Wooden blocks are to comply with standards considered appropriate by the Society.

(3) Hooks are to comply with *JIS F* 2105 or other standards considered appropriate by the Society.

2 Sheaves, main parts of which are fabricated by welding steel plates, are to be verified prior to application that they have sufficient structural strength by the tests and inspections specified in the following **(1)** through **(6)**:

(1) Welding procedure test (The test items are in accordance with the requirements specified in **Chapter 4, Part M of the Rules for the Survey and Construction of Steel Ships**. They are, however, increased or decreased according to the type of joint.)
(2) Structural strength test (Local and/or total strength)
(3) Fatigue test (Test is to be carried out by rotating the sheave at least 10^6 turns under the most severe load condition of the block.)
(4) Load Test
(5) Verifying test for special process of manufacture such as quenching
(6) Verification test for process of manufacture conforming to manufacturing standard (No occurrence of defects such as distortion is to be verified.)

Chapter 7 MACHINERY, ELECTRICAL INSTALLATIONS AND CONTROL ENGINEERING SYSTEMS

7.1 General

7.1.1 Application

"They may be suitably modified" specified in the requirement of winches used for cargo ramps means that the requirements specified in 7.2.2-1(1), 7.2.2-1(2), 7.2.2-1(5), 7.2.2-1(6), **7.4.2-3** and 7.4.3-1 of the Rules are not applied.

7.2 Machinery

7.2.2 Hoisting and Luffing Winch

1 Winches are to be so designed that the safety factor of the structural parts based on the ultimate tensile strength of the material is not less than the value given as follows according to the safe working load of cargo gear incorporating the winches concerned:

5 for safe working load is 10*t* or less

4 for safe working load exceeds 10*t*

2 Winches which may have to continue stalling condition for a given period with load applied to winch drums are to be provided with devices capable of preventing positively rotation of the drum by means of such mechanism as ratchet in addition to the braking devices specified in **7.2.2-1(4) of the Rules**. In general, winches having mechanism shown in the following **(1)** and **(2)** correspond to these winches:

(1) Topping drum (or guy drum) of a winch, which drives its cargo hoist drum and topping drum (or guy drum) by a same driving unit through clutch

(2) Drum of a topping winch or guy winch, which is used as the end stopper of wire rope holding the boom at its working position

3 The "fleet angle" mentioned in **7.2.2-2(1) and 7.2.2-2(2) of the Rules** is the angle α specified in **Fig. 7.2.2-1** and the angle θ specified in **Fig. 7.2.2-2** respectively.

Fig. 7.2.2-1 Fleet angle of grooved drum

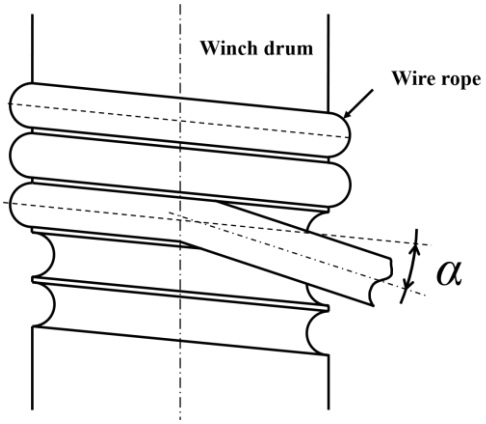
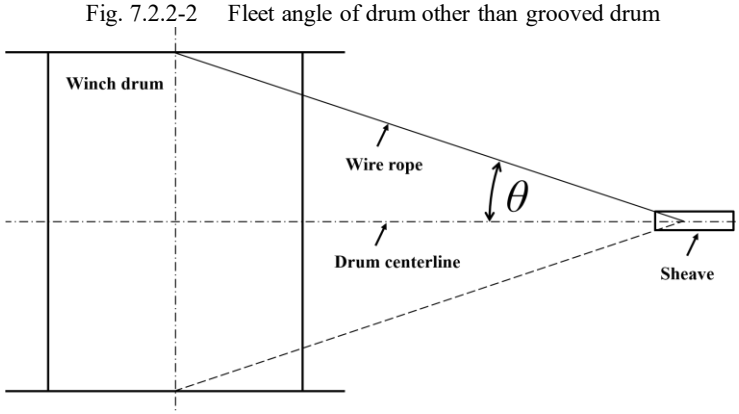


Fig. 7.2.2-2 Fleet angle of drum other than grooved drum



4 The wording "the rope at its end is to be secured to the drum" specified in **7.2.2-3 of the Rules** means a force to sustain a load being double the drum load on condition that the wire rope is wound on the drum by four full turns.

7.3 Power Supply

7.3.1 General

1 Among cables used in power circuit of 600*V* or less for electric equipment for movable cargo gear, rubber flexible cords used in portions requiring flexibility and bending strength are to be *EP* rubber insulated chloroprene cabtire cable of grade 2, 3 or 4 specified in *JIS C* 3327 or those conforming to other standards considered appropriate by the Society.

2 High pressure rubber hoses used in the hydraulic oil systems of cranes are to be approved in accordance with the requirements specified in **Chapter 12, Part D of the Rules for the Survey and Construction of Steel Ships**. However, such hoses are not required to be fire resistant when installed on exposed decks or when installed within cranes located on exposed decks.

7.4 Control Engineering Systems

7.4.3 Safety System

1 Derrick systems are to be provided with devices that indicate the degree of inclination angle of the boom at a position where easily visible to the operator. In addition, it is recommended that derrick systems be provided limit switches to prevent over winding up, slewing and over luffing.

2 Cranes are to be provided with safety devices specified in the following **(1)** through **(4)**:

(1) Overload preventive device and overload alarm. Cranes not serving cargo handling may dispense with these devices.

(2) Limit switches to prevent over winding up, over slewing over luffing except in cases where the cranes are operated by cylinders.

(3) Where trolley or crab travels on horizontal jib or luffing jib and safe working load varies depending on the load and radial position of trolley or crab, radial load indicator clearly visible to the operator indicating the following items **(a)** and **(b)**:

(a) Safe working load of crane corresponding to the radial position of hook or other hoisting gear fitted to the hoist rope

(b) Limit value for luffing motion of jib or longitudinal motion of trolley/crab. This, however, does not apply to the case where rated load diagram is posted in the operator cab.

(4) For cranes having travelling equipment on the body or hoisting device, overrun preventive device on the travelling tracks. In addition, it is recommended that overspeed preventive device be provided.

(5) For jib cranes that luff their jib, devices that indicate the degree of inclination angle of the jib are to be provided at a position easily visible to the operator.

3 Cargo lifts are to be provided with the safety devices given in the following **(1)** through **(3)** as far as practicable:

(1) Overload alarm

(2) Automatic cutout device for power supply to the driving equipment when hoisting rope or chain slacks

(3) Interlock device capable of functioning the following **(a)** and **(b)** where locking bars are used in stowing device of the lift

(a) Power is not to be supplied to the lift unless all locking bars are pulled out.

(b) For hydraulic lifts, locking bars can not be pulled out until oil pressure reaches a pressure sufficient to sustain the lift.

4 The emergency stopping device specified in **7.4.2-4 of the Rules** is to operate independently of other control devices.

5 Cargo ramps are to be provided with the safety devices specified in the following **(1)** and **(2)**:

(1) An alarm device generating alarm before inclination of the ship reaches the value determined in accordance with the requirements in **8.2.4-1**

(2) For ramps slewing or travelling with cargo loaded, safety devices determined by the requirements in **-1** to **-3** depending on the operating system

Chapter 8 CARGO LIFTS AND CARGO RAMPS

8.2 Design Loads

8.2.4 Loads due to Ship Inclination

1 The load due to ship inclination is, as a rule, to comply with the requirements in **4.2.7 of the Rules**. The Society, however, may permit to apply value of ship inclination offered, if the data on ship inclination in service conditions are submitted to and deemed appropriate by the Society.

2 Cargo ramps are not, as a rule, to be designed to be capable of operating at a slope of exceeding 1/10.

8.3 Strength and Construction

8.3.5 Deflection Criteria

Concerning deflections of the cargo lifts and cargo ramps, the Society may permit application of values larger than those specified in **8.3.5 of the Rules** if it considers no obstruction exists in strength and operation of the equipment judging from the operating experience, results of model tests, etc.

Annex 1.1.1-3ADDITIONAL REQUIREMENTS FOR CRANES USED FOR PERSONNEL TRANSFERS

Chapter 1 GENERAL

1.1 General

1.1.1 Application

1 Cranes registered under the **Rules for Cargo Handling Appliances** (hereinafter referred to as "the Rules") in cases where they are used to transfer personnel are to comply with the requirements in this Annex in addition to the requirements of the Rules.

2 The means of embarkation and disembarkation required by the **Rules for the Survey and Construction of Steel Ships** are not to be substituted by such cranes.

Chapter 2 SURVEYS

2.1 Registration Surveys

2.1.1 Drawings and Other Documents to be Submitted

1 Drawings for approval

The following drawing is to be submitted to the Society for approval:

(1) Equipment added for personnel transfers

2 Documents for reference

The following document is to be submitted to the Society for reference:

(1) Operation manual for personnel transfers

3 The operation manual specified in **-2(1)** is to contain the following **(1)** to **(3)**:

(1) Restrictions on personnel transfer operations, which contain at least the following:

(a) Wind velocity, wave height, and visibility

(b) The maximum angle and slewing radius of cranes (horizontal and vertical distance to the object of embarkation or disembarkation)

(c) Safe working loads and hoisting, lowering, and swinging speeds

(d) Embarkation areas of equipment used to transport personnel such as baskets (hereinafter referred to as "the basket")

(2) Items regarding persons engaged in personnel transfer operations, which contain at least the following:

(a) Roles of the operational master

(b) Qualification of the crane operator

(c) Arrangement of signalmen in cases where the object of embarkation or disembarkation cannot be visible from the crane control position

(d) Means to ensure the safety of persons in the basket and engaged in the operation

(e) Communications between the operational master and persons involved

(f) Means to address the emergency situations such as rescue means in the case of crane malfunctions

(g) Inspection and testing items prior to personnel transfer operations

(3) Items to be checked prior to use of the basket, which contain at least the following:

(a) Specifications of the basket such as its own weight, SWL and capacity

(b) Maintenance records

(c) Certifications issued by an official body or a third-party body

2.1.2 Examinations at Registration Surveys

1 Crane appliances are to be examined and ascertained to be in good order by the following tests and surveys:

(1) Operation tests of the equipment added for personnel transfers

(2) Other tests considered necessary by the Society

2 Appliances specified in **Chapter 6** on board the ship and Markings specified in **Chapter 7** are to be examined.

2.2 Annual Thorough Surveys

At annual thorough surveys, crane appliances are to be examined and ascertained to be in good order by the following tests and surveys, in addition to the requirements in **2.4.2 of the Rules**.

(1) Operation tests specified in **2.1.2-1(1)**

(2) Examinations specified in **2.1.2-2**

Chapter 3 CRANES

3.1 Safe Working Load

The safe working load of the cranes for use for personnel transfers is to be less than 50 % of the safe working load specified in **Chapter 1 of the Rules**. The total weight of the basket (sum of its own weight and capacity load) is not to be more than this load.

Chapter 4 LOOSE GEAR

4.1 General

The safety factor of any loose gear is to be 10 and more against the safe working load specified in **3.1**.

4.2 Wire Ropes

In addition to the requirements specified in **6.3.1 of the Rules,** wire ropes are to be of an anti-rotation type.

Chapter 5 MACHINERY, ELECTRICAL INSTALLATIONS AND CONTROL ENGINEERING SYSTEMS

5.1 General

The machinery, electrical installations and control engineering systems used in the cargo handling appliances are to be arranged to prevent accidental falls of the basket and are to be able to lower the basket in the case of a power supply malfunction.

5.2 Brakes

1 The braking system of hoisting machinery is to comply with the following **(1)** and **(2)**:

(1) Brakes normally equipped on hoisting machinery are to be provided with an override device.

(2) Hoisting machinery is to be provided with an additional brake which:

(a) complies with **7.2.2-1(4) of the Rules**;

(b) is capable of being operated by circuits other than those for the brakes specified in **(1)**; and

(c) is provided with an override device.

2 Hydraulic cylinders used for luffing or extending jibs are to be provided with mechanical devices which can maintain the position of the hydraulic cylinders in the case of a loss of power.

Chapter 6 OTHER APPLIANCES

6.1 Communication Devices

Appropriate communication devices are to be provided to the operational master, the crane operator, the signalmen, and persons in the basket.

6.2 Wind Gauge

Wind gauge is to be provided to ensure that the operational master can be informed of the wind velocity.

Chapter 7 CERTIFICATION, MARKING AND DOCUMENTATION

7.1 Marking of Safe Working Load, etc.

7.1.1 Marking for Cranes

1 At the location specified in **9.3.1 of the Rules,** the safe working load, the maximum slewing radius, and other restrictive conditions of personnel transfers are to be marked.

2 At the locations of the crane control position and embarkation area, a notice indicating the safe working load, the maximum slewing radius, maximum wind velocity, maximum wave height, minimum visibility, and other restrictive conditions for personnel transfers is to be provided.