財團法人驗船中心
CR CLASSIFICATION SOCIETY

RULES FOR THE CONSTRUCTION AND CLASSIFICATION OF STEEL SHIPS 2023

AMENDMENT

January 2024

財團法人驗船中心
CR CLASSIFICATION SOCIETY

RULES FOR THE CONSTRUCTION AND CLASSIFICATION OF STEEL SHIPS 2023

AMENDMENT

January 2024

RULES FOR THE CONSTRUCTION AND CLASSIFICATION OF STEEL SHIPS 2023

AMENDMENT

The following Parts have been amended and the effective dates are:	
Part	**Effective date**
I	1 January, 2025
II	1 January, 2025
IV	1 January, 2025
VI	1 January, 2025
VIII	1 January, 2025
XI	1 January, 2025
XV	1 January, 2025

The Rules for the Construction and Classification of Steel Ships 2023 and this Amendment are to be consolidated and published as *January 2025 Edition*.

AMENDMENT TO "THE RULES FOR THE CONSTRUCTION AND CLASSIFICATION OF STEEL SHIPS 2023"

PART I CLASSIFICATION AND SURVEY

List of major changes in Part I from 2023 edition

Table I 1-5	Revised
2.1.2(a) & (q)	Revised
2.3.5	Revised
2.9	Revised
2.10	Revised
2.11	Revised
2.11.3(f)(i)	Revised
2.12	Revised
2.12.2(a)(i)	Revised
2.12.3(c)	Revised
2.13	Revised
2.14	Revised
2.14.1	Revised
2.14.3(e)(i)	Revised and Renumbered
2.15	Revised
2.15.1(g)	New
2.15.2(b)	Revised
2.15.3(c)	Revised
2.16	Revised
2.19	Revised
Table I 2-13	Revised
3.3.1	Revised
3.3.2(j) & (k)	New

Rules for the Construction and Classification of Steel Ships 2023 have been partly amended as follows:

Chapter 1
Classification of Steel Ship

Table I 1-5 has been amended as follows:

Table I 1-5
List of Additional Survey Notation

Notation	Description	Reference
IWS	This notation (**I**n **W**ater **S**urvey) may be assigned to ships which are provided with suitable arrangements to facilitate the In-Water Surveys.	Part I/1.6.7(b) & 2.2.2
PCM-OL(1)	This notation (**P**ropeller shaft **C**ondition **M**onitoring – **O**il **L**ubricated) will be assigned when oil lubricated propeller shaft arrangements with approved oil glands are fitted and the requirements of 2.3.5 of Part I of the Rules are complied with.	Part I/2.3.5
PCM-OLW(1)	This notation (**P**ropeller shaft **C**ondition **M**onitoring – **O**pen **L**oop **W**ater-lubricated) will be assigned when open loop water-lubricated propeller shaft arrangements are fitted and the requirements of 2.3.5 of Part I of the Rules are complied with.	Part I/2.3.5
PMS(1)	This notation (**P**lanned **M**aintenance **S**cheme for machinery) will be assigned to ships for which an approved planned maintenance scheme for machinery is adopted as an alternative to continuous survey for machinery.	Part I/1.6.4(g)
CM(1)	This notation (**C**ondition **M**onitoring for machinery) will be assigned to ships for which an approved condition monitoring system is fitted.	Part I/1.6.4(h)
CBM(1)	This notation (**C**ondition **B**ased **M**aintenance for machinery) will be assigned to ships for an approved condition based maintenance scheme.	Part I/1.6.4(h)

Note:
(1) Means notation, when assigned, to be added after the classification symbol **CMS**.

Chapter 2
Survey Requirements of Steel Ship

Paragraphs 2.1.2(a) & (q) have been amended as follows:

2.1 General

……

2.1.2 Definitions

(a) Ballast Tank

(i) Ballast Tank - All ships

A Ballast Tank is a tank which is used primarily for the carriage of salt water ballast.

(ii) Ballast Tank – Tankers ESP

A Ballast Tank is a tank which is used ~~solely~~ primarily for the carriage of salt water ballast.

(iii) Ballast Tank – Bulk Carriers ESP

A Ballast Tank is a tank which is used ~~solely~~ primarily for salt water ballast, or where applicable, a space which is used for both cargo and salt water ballast will be treated as a Ballast tank when substantial corrosion has been found in that space. A double side tank is to be considered as a separate tank even if it is in connection to either the topside tank or the hopper side tank.

……

(q) Tanker

A tanker is a ship which is constructed primarily to carry liquid cargo in bulk. Oil Tankers, Chemical Tankers and Liquefied Gas Carriers are included in this category.

(i) Oil Tanker (OT)

An oil tanker is a ship, which is constructed primarily to carry oil in bulk in cargo tanks forming an integral part of the ship's hull, including ~~and includes~~ ship types such as combination carriers (ore/oil and ore/bulk/oil ships, etc) but excluding ships carrying oil in independent tanks not forming part of the ship's hull such as asphalt carriers.

(ii) Double Hull Oil Tanker (DHOT)

A double hull oil tanker is a ship which is constructed primarily for the carriage of oil in bulk, which has the cargo tanks forming an integral part of the ship's hull and is protected by a double hull which extends for the entire length of the cargo area, consisting of double sides and double bottom spaces for the carriage of water ballast or void spaces.

(iii) Chemical Tanker (CT)

A chemical tanker is a ship constructed or adapted and used for the carriage in bulk of any liquid product listed in Chapter 17 of the IBC Code.

(iv) Liquefied Gas Carrier (LGC)

A liquefied gas carrier is a ship constructed or adapted and used for the carriage in bulk of any liquefied gas or other products listed in either "the IGC Code" or "the GC Code".

Paragraph 2.3.5 has been amended as follows:

2.3 Surveys of Propeller Shafts and Tube Shafts

Table I 2-13...

2.3.5 Propeller shaft condition monitoring (**PCM**)

This paragraph is to provide requirements for condition monitoring of the ship's propeller shaft and propeller shaft bearing, including its lubrication. The scope of the class notation **PCM-OL** or **PCM-OLW** provided an additional safety level related to the propeller shaft and propeller shaft bearing, including its lubrication by monitoring the temperature and lubricant conditon of this equipment. The class notation **PCM-OL** or **PCM-OLW** is applicable for a ship with oil-lubricated propeller shaft or open loop water-lubricated propeller shaft, provided the applicable requirements specified below are complied with.

(a) Oil lubricated shaft (**PCM-OL**)

Where oil lubricated shaft with approved oil glands are fitted, a class notation **PCM-OL** may be assigned, if it's relevant drawing(s) and data are submitted and approved by the Society. The management systems are to comply with the following:

(i) Lubricating oil analysis is to be carried out regularly at intervals not exceeding 6 months. The lubricating oil analysis documentation is to be available on board. Each analysis is to include the following minimum parameters:

(1) Water content;

(2) Chloride content;

(3) Bearing material and metal particles content; and

(4) Oil ageing (resistance to oxidation).
Oil samples are to be taken under service conditions and representative of the oil within the stern-tube.

(ii) Oil consumption is to be recorded monthly.

(iii) Bearing temperatures are to be recorded daily, (2 temperature sensors with alarm or other approved arrangements are to be provided).

(iv) Facilities are to be provided for measurement of bearing wear down.

(v) Oil glands are to be capable of being replaced without withdrawal of the propeller shaft or removal of the propeller.

(b) Open loop water-lubricated shaft (**PCM-OLW**)

Where requested by the Owner, the class notation **PCM-OLW** may be assigned to a ship whose propeller shaft specifically arranged with open loop water-lubricated stern tube bearings, provided the following requirements are complied with.

(i) The following documentation is to be submitted for approval.

(1) Arrangement of propeller shaft bearings
The information includes position and type of manual and remote wear down gauges/sensor(s) for aft propeller shaft bearing and type approval reference documents of the remote wear down sensor.

(2) Piping diagram of open loop water-lubricated system
The information includes lubrication system for stern tube bearing together with bearing manufacturer's specified quality of lubricant and provision for emergency supply of lubricant.

(3) Propeller shaft and bearing inspection procedure
The information includes location of inspection covers and borescope receptacles where required.

(4) Shaft alignment calcuation including maximum allowable wear down for aft propeller shaft bearing

(5) Arrangement for shaft corrosion protection, including shaft material and, if proposed, cladding, coatings, and liners that cover the entire shaft.

(6) Arrangement of stern tube system and external shaft protection, including location of external protective devices and details of supplementary cathodic protection where required.

(7) Documentation of stern tube bearing and lubricant alarm system

(8) Documents for reference:

- Details of type approval of aft propeller shaft bearings
- Details of coatings used for corrosion protection
- Shafting material specification

(ii) General requirements

(1) Propeller shaft is to be made out of approved corrosion resistant material or be provided with approved corrosion protection to cover and seal all parts of the shaft exposed to sea water where subjected to dynamic stresses. Approved corrosion protection involving coating is to be complemented by additional cathodic protection arrangement.

(2) For shafts constructed with material other than approved corrosion resistant steel and shafting installations with a combination of liners and protective coatings, provisions for alternative means of verifying satisfactory condition of all parts of the shaft, bearings, coating, sleeves and transient areas as applicable for respective installations in service are to be provided.
Inspection procedure is to be submitted and approved by the Society before assignment of the notation.
Alternative means of visual inspection should provide a similar level of information obtained from Shaft Survey Method 4 as specified in 2.3.3 of this Chapter.

Notes:

- A combination of inspection covers, removable bearing segments, methods using boroscope etc. are considered as alternative means.
- Shafts assembled with a continuous corrosion resistant liner fabricated in one piece do not require provisions for alternative means of inspection in service.

(3) Shaft aligment is to be approved in accordance with Chapter 6 in Part IV of the Rules.

(4) Approved methods to remotely monitor the aft propeller shaft bearing performance and wear are to be provided with redundancy. Redundancy may be exempted if the hardware is designed to be replaced without withdrawal of the shaft and/or propeller.
When a single sensor is installed, at least a spare sensor is to be kept onboard the ship.
Hardware used for monitoring is to be type approved by the Society. Case-by-case approval may be acceptable as an alternative.

Note:
Static remote wear monitoring devices, i.e. sensors, are considered as suitable methods for bearing performance and wear monitoring. Static remote wear monitoring sensors provide a wear down measurement reading when the shaft is in a stopped condition.

(5) An arrangement for bearing wear down measurement is to be provided. A manual gauge (i.e. poker gauge) is acceptable. The history of measurements is to be documented in the record files.

(6) The rate of bearing wear is to be documented and trended on a monthly basis. The bearing wear down measurement, rate of wear and the remaining operation time to reach the wear down limits are to be recorded in the record file.
If monitoring indicates that the rate of wear or the deterioration in bearing performance requires immediate remedial actions, the Society is to be informed.

(7) Propeller shaft bearings are to be type approved for the application. Nominal surface bearing pressure for aft propeller shaft bearing is not to exceed 0.6 N/mm^2.

(8) Stern tube sealing devices are to be of a type which allow them to be replaced without withdrawal of the shaft or removal of the propeller. Open loop water-lubricated systems are normally with a forward stern tube seal only.

(9) The maximum allowable wear down of propeller shaft bearing is to be indicated by the manufacturer.

(10) Onboard procedure is to be in place to document and trend the rate of bearing wear monthly using reading obtained from performance monitoring devices. The procedure is to include identification of prospective deterioration of bearing performance with subsequent remedial actions within a pre-defined safe operating margin before exceeding the wear down limit or failure.

(11) A shaft grounding device is to be installed.

(12) Open bearings fitted in strut and A-bracket bearings without forced lubricated arrangement of adequate quality are to be designed to withstand external abrasive conditions.

(iii) Lubricant supply and monitoring

(1) The propeller shaft bearings are to be lubricated and cooled by a lubricant of adequate quality and circulation to ensure satisfactory operating conditions of the shaft, bearings and sealing arrangemnet.
Maximum design temperature of the lubricant supply shall be capable of maintaining the bearing temperature below the manufacturer's limits.
A lubricant of adequate quality is to comply with the minimun filtration requirements defined by the bearing manufacturer.

Note:
Filtration may not be applicable for bearing fitted in struts and A-brackets exposed to open sea from both ends where forced supply of lubricant is not feasible.

(2) Active components and filters in the lubricant system are to be provided with sufficient redundancy to ensure and uninterrupted service of the propulsion system.
Automatic start of pumps are to be arranged upon failure of circulation of the lubricant below acceptable limits.
Duplicated filters are to be provided with provisions for easy change over in service.

Note:
This does not apply for bearings fitted in struts and A-brackets exposed to open sea.

(3) Provisions for alternative means of lubricant supply are to be arranged to maintain a lubricant flow of adequate quality in the event of emergency.

Note:
Grounding is one of most common cases of emergency where sea chests may not necessarily provide clean water.

(4) Monitoring of lubricant temperature, flow and pressure are to be provided on the lubricant supply piping to the stern tube with means of warning.
Lubricant flow is to be maintained in all modes of operation including stopped condition. This is not applicable for bearings fitted in struts and A-brackets exposed to open sea from both ends where forced supply of lubricant is not feasible.

(5) Lubricant is to be continuously filtered to the specification specified by the bearing manufacturer.

(6) Consideration is to be given to design temperature of the lubricant since the critical pitting limit for the shaft material.

Note:
Consequential risk of shaft pitting from galvanic effect is regulated by the operating temperature of the lubricant.

(iv) Monitoring

Monitoring of open loop water-lubricated system is to be arranged according to the following table. The alarms and indications listed in the following table are to be provided at main control station. However, there is no main control station, the alarms and indication are to be installed at locations easily accessible to the crew.

Monitored Item	Alarm	Auto Start	Indication	Remarks
Lubricant flow	Low	X(1)		Refer to 2.3.5(b)(iii)(2) & (4) of this Chapter
Lubricant pressure	Low		X(2)	Refer to 2.3.5(b)(iii)(2) & (4) of this Chapter
Lubricant temperature at stern tube inlet	High		X(2)	Refer to 2.3.5(b)(iii)(4) of this Chapter
Aft bearing wear down			X(2)	Refer to 2.3.5(b)(ii)(4) of this Chapter

Notes:

(1) Automatic start of standby pump.

(2) Indicating the values.

(~~b~~c) For maintenance of the **PCM-OL** or **PCM-OLW** notation, Annual Survey is to be carried out as follows:

(i) For **PCM-OL** notation

Satisfactory operating conditions of the propeller shaft are to be confirmed, including the verification of the records of lubricating oil analysis, lubricating oil consumption, bearing temperatures and wear down readings.

(ii) For **PCM-OLW** notation

The survey is to include:

(1) Examination of the record file and documentation

- Verification that the aft stern tube bearing wear down measurements have been recorded monthly with respective wear rate calculations and remaining operational time to reach the wear down limits.
- If there are performed any overhauls or similar, this is to be recorded in the record file.
- Verification that manual wear down measurements have been taken and recorded at every dry-docking.

(2) Testing of alarm and automatic covering the following:

- Lubricant low flow
- Lubricant low pressure
- Automatic start of standby lubricant supply pump upon detection of low flow of lubricant
- Lubricant high temperature at lnlet
- Remote weardown monitoring sensor function

(3) Visual inspection of inboard shaft seal for leakage, as far as practicable.

(4) Verify:

- Functionality of propeller shaft grounding device.
- The manual wear down measurements and remote wear down monitoring readings are consistent with.
- Evidence that lubricant flow has been maintained during all operating conditions including stopped condition of the shaft.
- The lubricant filtering units are in satisfactory condition.

(5) When the ship in dry dock

Inspection using alternative means of ascertaining the condition of the shaft, coating, bearing and liners as applicable is to be carried out in accordance with approved procedures. See also 2.3.5(b)(ii)(2) of this Chapter.

Verification that the propeller is free of damage which may cause the propeller to be out of balance.

(6) If the In-Water Survey is carried out, external inspection of accessible parts of the propeller shaft is to be carried out with specific attention on the condition of the coating, where applicable. This applies for installations with external propeller shaft bearings with parts of tail shaft exposed to sea, e.g. struts and A-brackets etc.

(~~c~~d) Where the notation **PCM-OL** or **PCM-OLW** has been assigned, the propeller shaft need not be withdrawn at surveys as required by 1.6.8 provided all condition monitoring data is found to be within permissible limits and all exposed areas of the shaft are examined by a magnetic particle crack detection method. Where the Surveyor considers that the data presented is not entirely to his satisfaction the shaft will be required to be withdrawn in accordance with 1.6.8.

(~~d~~e) For ships with **PCM-OL** or **PCM-OLW** notation, the maximum propeller shaft survey interval required by 2.3.2~~(c) or (d)~~ and 2.3.3 of this part shall not exceed 15 years provided:

(i) Annual Surveys are carried out to the satisfaction of the attending Surveyors, and

(ii) The followings are carried out at each propeller shaft survey due date required by 2.3.2(c) or (d).

(1) Bearing wear down measurement.

(2) Verification that the propeller is free of damage which may cause the propeller to be out of balance.

(3) Verification of effective inboard and outboard seals.

(4) Renewal of outboard seal in accordance with manufacturer's recommendation.

~~(5) For keyed propellers, the fore part of the shaft taper and shaft keyway are to be examined by an appropriate surface crack detection method(such as magnetic particle or dye penetration), for which dismantling of the propeller and removal of the key will be required.~~

(~~e~~f) Initial survey for existing ships obtaining **PCM-OL** or **PCM-OLW** notation

(i) All systems required by 2.3.5(a) or 2.3.5(b) of this Part are to be examined and tested in accordance with the approval plans, and

(ii) Propeller shaft survey as per ~~2.3~~ 2.3.2 or 2.3.3 of this Part ~~will~~ is to be required including drawing the shaft and examining the entire shaft ~~if the last propeller shaft survey was carried out more than 5 years prior to the initial survey~~, or

(iii) For **PCM-OL** notation

If the last propeller shaft survey was carried out not more than 5 years prior to the initial survey, ~~T~~the propeller shaft survey may be waived subject to satisfactory review of the following records:

(1) Six-monthly records of stern bearing oil analysis for water and metal contents, covering the last 5 years.

(2) Monthly records of stern bearing oil consumption, covering the last 5 years.

(3) Monthly records of stern bearing temperature monitoring, covering the last 5 years.

(4) Propeller shaft, stern bearing assembly and propeller operation and repair records, if available.

(5) Records of stern bearing clearance and weardown measurement from new building and last dry docking.

.....

Section 2.9 has been amended as follows:

2.9 ~~Hull Surveys~~ Additional Survey Requirements of General Dry Cargo Ships

2.9.1 General

Procedures for class related services, see 2.1.4 of this Chapter. Provision for surveys, see 2.1.5 of this Chapter.

(a) The requirements apply to all self-propelled general dry cargo ships of 500 gross tonnage and above carrying solid cargoes other than (see Note 1):

- ships subject to 2.12 or 2.15 of this Chapter;

.....

Section 2.10 has been amended as follows:

2.10 ~~Surveys~~ Additional Survey Requirements of Liquefied Gas Carriers

2.10.1 Annual Surveys

(a) Hull Surveys

In addition to the surveys as per applicable requirements of 2.5 and the applicable requirements of 2.11.1, the Annual Survey is also to include the following:

(i) General

The log books are to be examined with regard to correct functioning of the cargo containment and cargo handling systems. The hours per day of the reliquefaction plants or the boil-off rate is to be considered.

.....

Section 2.11 has been amended as follows:

2.11 ~~Hull Surveys~~ Additional Survey Requirements of Oil Tankers

Procedures for class related services, see 2.1.4 of this Chapter. Provision for surveys, see 2.1.5 of this Chapter. Preparation for enhanced survey for ESP ships, see 2.1.6 of this Chapter.

2.11.1 Annual Surveys

.....

Paragraph 2.11.3(f)(i) has been amended as follows:

2.11.3 Special Survey

Concurrent crediting to both Intermediate Survey (IS) and Special Survey (SS) for surveys and thickness measurements of spaces are not acceptable.

.....

(f) Extent of Tank Testing

(i) The minimum requirements for ballast tank testing at Special Survey are given in 2.11.3(f)(iii) and Table I 2-2.

The minimum requirements for cargo tank testing at Special Survey are given in 2.11.3(f)(iv) and Table I 2-2.

Cargo tank testing carried out by the ~~vessel's~~ ship's crew under the direction of the Master may be accepted by the Surveyor provided the following conditions are complied with:

(1) a tank testing procedure, specifying fill heights, tanks being filled and bulkheads being tested, has been submitted by the owner and reviewed by the Society prior to the testing being carried out;

(2) the tank testing is carried out prior to overall survey or close-up survey.

(3) the tank testing ~~has been satisfactorily~~ is carried out within Special Survey window and not more than 3 months prior to the date ~~of the survey~~ on which the overall or close up survey is completed;

(~~2~~4) the tank testing has been satisfactorily carried out and there is no record of leakage, distortion or substantial corrosion that would affect the structural integrity of the tank;

(~~4~~5) the satisfactory results of the testing is recorded in the ship's logbook; and

(~~5~~6) the internal and external condition of the tanks and associated structure are found satisfactory by the Surveyor at the time of the overall and close up survey.

(ii) The Surveyor may extend the tank testing as deemed necessary.

(iii) Boundaries of ballast tanks are to be tested with a head of liquid to the top of air pipes.

(iv) Boundaries of cargo tanks are to be tested to the highest point that liquid will rise under service conditions.

Section 2.12 has been amended as follows:

2.12 ~~Hull Surveys~~ Additional Survey Requirements of Bulk Carriers

Procedures for class related services, see 2.1.4 of this Chapter. Provision for surveys, see 2.1.5 of this Chapter. Preparation for enhanced survey for ESP ships, see 2.1.6 of this Chapter.

2.12.1 Annual Survey

.....

Paragraph 2.12.2(a)(i) has been amended as follows:

2.12.2 Intermediate Survey

Those items which are additional to the requirements of the Annual Survey in 2.12.1 and the applicable requirements of the Intermediate Survey in 2.6 may be surveyed either at or between the 2nd and 3rd Annual Survey.

Concurrent crediting to both Intermediate Survey (IS) and Special Survey (SS) for surveys and thickness measurements of spaces are not acceptable.

(a) Examination of Bulk Carriers 5-10 years of age. The following is to apply:

(i) Ballast Tanks

(1) For tanks used for water ballast, an overall survey of representative spaces selected by the Surveyor is to be carried out. The selection is to include fore and aft peak tanks and a number of other tanks, taking into account the total number and type of ballast tanks. If such overall survey reveals no visible structural defects, the examination may be limited to verification that the corrosion prevention system remains efficient.

(2) Where ~~POOR coating~~ a hard coating is found to be less than GOOD condition, corrosion or other defects are found in water ballast tanks or where a hard protective coating was not applied from the time of construction, the examination is to be extended to other ballast tanks of the same type.

(3) In ballast tanks other than double bottom tanks, where a hard Protective Coating is found ~~in POOR~~ to be in less than GOOD condition, and it is not renewed, or where soft or semi-hard coating has been applied, or where a hard protective coating was not applied from the time of construction, the tanks in question are to be examined and thickness measurements carried out as considered necessary at annual intervals. When such breakdown of hard protective coating is found in ballast double bottom tanks, or where a soft or semi-hard coating has been applied, or where a hard protective coating has not been applied, the tanks in question may be examined at annual intervals. When considered necessary by the Surveyor, or where extensive corrosion exists, thickness measurements are to be carried out.

(4) In addition to the requirements above, suspect areas identified at previous surveys are to be overall and close-up surveyed.

.....

Paragraph 2.12.3(c) has been amended as follows:

2.12.3 Special Survey

Concurrent crediting to both Intermediate Survey (IS) and Special Survey (SS) for surveys and thickness measurements of spaces are not acceptable.

.....

(c) ~~Tank~~ Space Protection

(i) Where provided, the condition of the corrosion prevention system of ballast tanks is to be examined. For ballast tanks, excluding double bottom tanks, where a hard protective coating is found ~~in POOR~~ to be in less than GOOD condition and it is not renewed, or where soft or semi-hard coating has been applied, or where a hard protective coating has not been applied from the time of construction, the tanks in question are to be examined at annual intervals. Thickness measurements are to be carried out as deemed necessary by the Surveyor.

When such breakdown of hard protective coating is found in water ballast double bottom tanks and it is not renewed, where a soft or semi-hard coating has been applied, or where a hard protective coating has not been applied from the time of construction, the tanks in question may be examined at annual intervals. When considered necessary by the Surveyor, or where extensive corrosion exists, thickness measurements are to be carried out.

(ii) Where a hard protective coating is provided in cargo holds, as defined by 23.1.7 of Part II and is found in GOOD condition, the extent of close-up surveys and thickness measurements may be specially considered.

Section 2.13 has been amended as follows:

2.13 ~~Hull Surveys~~ Additional Survey Requirements of Chemical Tankers

Procedures for class related services, see 2.1.4 of this Chapter. Provision for surveys, see 2.1.5 of this Chapter. Preparation for enhanced survey for ESP ships, see 2.1.6 of this Chapter.

2.13.1 Annual Surveys

.....

Section 2.14 has been added as follows:

2.14 ~~Hull Surveys~~ Additional Survey Requirements of Double Hull Oil Tankers

Procedures for class related services, see 2.1.4 of this Chapter. Provision for surveys, see 2.1.5 of this Chapter. Preparation for enhanced survey for ESP ships, see 2.1.6 of this Chapter.

.....

Paragraph 2.14.1 has been amended as follows:

2.14.1 Annual Survey

.....

(d) Examination of cargo pump rooms and pipe tunnels, if fitted

(i) Examination of all pump room bulkheads for signs of oil leakage or fractures and, in particular, the sealing arrangements of all penetrations of pump room bulkheads.

~~(ii) Examination of the condition of all piping systems.~~

(ii) Confirmation that there are no potential sources of ignition in or near the cargo pump room and cargo area and that pump room access ladders are in good condition.

(iii) Operation of pump room bilge pumping system.

(iv) Pump room ventilation system including ducting, dampers and screens.

(v) Visual examination of the cargo piping system including valves and fittings.

(vi) Verification that bolts on the cargo pumps and associated fittings, such as pedestal fixing bolts, pump casing bolts and bolts securing shaft guards are secure.

(e) Examination of ballast tanks

~~(i)~~ Examination of ballast tanks where required as a consequence of the results of the Special Survey (see 2.14.3(b)) and Intermediate Survey (see 2.14.2(b)(i) and 2.14.2(b)(ii)) is to be carried out. When considered necessary by the Surveyor, or when extensive corrosion exists, thickness measurement are to be carried out and if the results of these thickness measurements indicate that Substantial Corrosion is found, the extent of thickness measurements is to be increased in accordance with Table I 2-15. These extended thickness measurements are to be carried out before the survey is credited as completed. Suspect Areas identified at previous surveys are to be examined. Areas of substantial corrosion identified at previous surveys are to have thickness measurements taken.

For ships built under IACS Common Structural Rules, the identified substantial corrosion areas are required to be examined and additional thickness measurements are to be carried out.

……

(g) Emergency Towing Arrangements

For double hull oil tankers of 20,000 tonnes deadweight and above, emergency towing arrangements are to be examined.

(h) Examination of cargo tanks

Cargo tank openings including gaskets, covers and coamings.

Pressure/vacuum relief valves, flame arresters, and flame screens. Tank vent protective devices are to be examined externally for proper assembly and installation, damage, deterioration or traces of carryover at the outlet. Where deemed suspect, the tank protective device is to be opened for examination.

(i) Examination of electrical bonding and electrical equipment

Electrical bonding arrangements on the weather deck and in cargo pump rooms, including bonding straps where fitted, of cargo piping systems carrying flammable liquids and piping systems routed through hazardous areas. Bonding of cargo tanks to hull, where applicable, is to be examined.

Confirmation that electrical equipment in hazardous locations including the cargo pump room, has been properly maintained, including the following items.

(i) Intrinsically safe and explosion-proof features of electrical equipment installed in the hazardous areas, in particular any associated sealing arrangement.

(ii) The physical condition of cables (wiring) and fixtures and test of insulation resistance of the circuits. In cases where proper record of testing is maintained consideration may be given to accepting recent readings.

(iii) The cable supports and the means of cable protection from mechanical damage, as originally provided.

(iv) Gas detection system in the cargo pump room, if fitted.

(v) Temperature-sensing devices fitted on bulkhead shaft glands, pump bearings and casings.

.....

Paragraph 2.14.3(e)(i) has been amended and renumbered as follows:

2.14.3 Special Survey

.....

(e) Extent of tank testing

(i) The minimum requirements for cargo and ballast tank testing at Special Survey are given in 2.14.3(e)(iii) and 2.14.3(e)(iv) below, and Table I 2-16.

Cargo tank testing carried out by the ship's crew under the direction of the Master may be accepted by the Surveyor provided the following conditions are complied with:

(1) a tank testing procedure, specifying fill heights, tanks being filled and bulkheads being tested, has been submitted by the owner and reviewed by the Society prior to the testing being carried out;

(2) the tank testing is carried out prior to overall survey or close-up survey;

(3) the tank testing ~~has been satisfactorily~~ is carried out within Special Survey window and not more than 3 months prior to the date ~~of the survey~~ on which the overall or close-up survey is completed;

(~~2~~4) the tank testing has been satifactorily carried out and there is no record of leakage, distortion or substantial corrosion that would affect the structural integrity of the tank;

(~~4~~5) the satisfactory results of the testing is recorded in the ship's logbook; and

(~~5~~6) the internal and external condition of the tanks and associated structure are found satisfactory by the Surveyor at the time of the overall and close-up survey.

(ii) The Surveyor may extend the tank testing as deemed necessary.

(iii) Boundaries of ballast tanks are to be tested with a head of liquid to the top of air pipes.

(iv) Boundaries of cargo tanks are to be tested to the highest point that liquid will rise under service conditions.

(v) The testing of double bottom tanks and other spaces not designed for the carriage of liquid may be omitted, provided a satisfactory internal examination together with an examination of the tanktop is carried out.

Section 2.15 has been amended as follows:

2.15 ~~Hull Surveys~~ Additional Survey Requirements of Double Skin Bulk Carriers

Procedures for class related services, see 2.1.4 of this Chapter. Provision for surveys, see 2.1.5 of this Chapter. Preparation for enhanced survey for ESP ships, see 2.1.6 of this Chapter.

Paragraph 2.15.1(g) has been added as follows:

2.15.1 Annual Survey

.....

(f) Additional Annual Survey Requirements after Determining Compliance with SOLAS XII/12 and XII/13

(i) For ships complying with the requirements of SOLAS XII/12 for hold, ballast and dry space water level detectors, the Annual Survey is to include an examination and a test, at random, of the water ingress detection systems and of their alarms.

(ii) For ships complying with the requirements of SOLAS XII/13 for the availability of pumping systems, the Annual Survey is to include an examination and a test, of the means for draining and pumping ballast tanks forward of the collision bulkhead and bilges of dry spaces any part of which extends forward of the foremost cargo hold, and of their controls.

(g) Examination of double-side skin void spaces for bulk carriers exceeding 20 years of age and of 150 m in length and upwards

Examination of double-side skin void spaces, for bulk carriers exceeding 20 years of age and of 150 m in length and upwards, are to be carried out when required as a consequence of the results of the Special Survey and Intermediate Survey. When considered necessary by the Society, or when extensive corrosion exists, thickness measurements are to be carried out. If the results of these thickness measurements indicate that substantial corrosion is found, the extent of thickness measurements is to be increased in accordance with Table I 2-22. These extended thickness measurements are to be carried out before the survey is credited as completed. Suspect areas identified at previous surveys are to be examined. Areas of substantial corrosion identified at previous surveys are to have thickness measurements taken.

For bulk carriers built under the IACS Common Structural Rules, the annual thickness gauging may be omitted where a protective coating has been applied in accordance with the coating manufacturer's requirements and is maintained in GOOD condition.

Paragraph 2.15.2(b) has been amended as follows:

2.15.2 Intermediate Survey

(a) General

(i) In addition to the requirements of Annual Survey in 2.15.1 and the applicable requirements of the Intermediate Survey in 2.6, those items herein are to be carried out.

(ii) Concurrent crediting to both Intermediate Survey (IS) and Special Survey (SS) for surveys and thickness measurements of spaces are not acceptable.

(iii) The survey extent is dependent on the age of the ship as specified in 2.15.2(b) to 2.15.2(d) and shown in Table I 2-21.

(b) Double Skin Bulk Carriers 5-10 years of age. The following is to apply:

(i) Ballast Tanks

(1) For tanks used for water ballast, an overall survey of representative tanks selected by the Surveyor is to be carried out. The selection is to include fore and aft peak tanks and a number of other tanks, taking into account the total number and type of ballast tanks. If such overall survey reveals no visible structural defects, the examination may be limited to verification that the corrosion prevention system remains efficient.

(2) Where ~~POOR coating~~ a hard coating is found to be in less than GOOD condition, corrosion or other defects are found in water ballast tanks or where a hard protective coating was not applied from the time of construction, the examination is to be extended to other ballast tanks of the same type.

(3) In ballast tanks other than double bottom tanks, where a hard protective coating is found in ~~POOR~~ to be in less than GOOD condition, and it is not renewed, or where soft or semi-hard coating has been applied, or where a hard protective coating was not applied from the time of construction, the tanks in question are to be examined and thickness measurements carried out as considered necessary at annual intervals. When such breakdown of hard protective coating is found in ballast double bottom tanks, or where a soft or semi-hard coating has been applied, or where a hard protective coating has not been applied, the tanks in question may be examined at annual intervals. When considered necessary by the Surveyor, or where extensive corrosion exists, thickness measurements are to be carried out.

(4) In addition to the requirements above, suspect areas identified at previous surveys are to be overall and close-up surveyed.

.....

Paragraph 2.15.3(c) has been amended as follows:

2.15.3 Special Survey

Concurrent crediting to both Intermediate Survey (IS) and Special Survey (SS) for surveys and thickness measurements of spaces are not acceptable. .....

(c) ~~Tank~~ Space Protection

(i) Where provided, the condition of the corrosion prevention system of ballast tanks is to be examined. For ballast tanks, excluding double bottom tanks, where a hard protective coating is found ~~in POOR~~ to be in less than GOOD condition, and it is not renewed, where soft or semi-hard coating has been applied, or where a hard protective coating has not been applied from the time of construction, the tanks in question are to be examined at annual intervals. Thickness measurements are to be carried out as deemed necessary by the Surveyor.

When such a breakdown of hard protective coating is found in water ballast double bottom tanks and it is not renewed, where a soft or semi-hard coating is applied, or where a hard Protective Coating has not been applied from the time of construction, the tanks in question may be examined at annual intervals. When considered necessary by the Surveyor, or where extensive corrosion exists, thickness measurements are to be carried out.

(ii) Where a hard protective coating is provided in cargo holds, as defined by 23.1.7 of Part II and is found in GOOD condition, the extent of close-up surveys and thickness measurements may be specially considered.

(iii) For double-side skin void spaces bounding cargo holds for bulk carriers exceeding 20 years of age and of 150 m in length and upwards, where provided, the condition of the corrosion prevention system of void spaces is to be examined. Where a hard protective coating is found to be in POOR condition, and it is not renewed, or where a soft or semi-hard coating has been applied, or where a hard protective coating has not been applied from the time of construction, the void spaces in question are to be examined at annual intervals. Thickness measurements are to be carried out as deemed necessary by the Surveyor.

.....

Section 2.16 has been amended as follows:

2.16 ~~Hull Surveys~~ Additional Survey Requirements of Craft for FRP and Aluminum Alloys Construction

2.16.1 Annual Survey

.....

Section 2.19 has been amended as follows:

2.19 ~~Hull and Special Equipment Survey~~ Additional Survey Requirements of Mobile Offshore Unit

2.19.1 General

(a) Definition

.....

Table I 2-13 has been amended as follows:

Table I 2-13
Minimum Requirements for Close-up Survey at Hull Special Survey of Double Hull Oil Tankers

SS No. 1 (Age ≤ 5)	SS No. 2 (5 < Age ≤ 10)	SS No. 3 (10 < Age ≤ 15)	SS No. 4 and Subsequent (15 < Age)
1 web frame (1), in a ballast tank[1]	All web frames (1), in a ballast tank[1] The knuckle area and the upper part (5 meters approximately) of 1 web frame in each remaining ballast tank (6)	All web frames (1), in all ballast tanks	As for Special Survey for age from 10 to 15 years Additional transverse areas as deemed necessary by the Society
1 deck transverse, in a cargo oil tank (2)	1 deck transverse (2), in 2 cargo oil tanks	All web frames (7), including deck transverse and cross ties, if fitted. in a cargo oil tank 1 web frame (7), including deck transverse and cross ties, if fitted, in each remaining cargo oil tank	
1 transverse bulkhead (4), in a ballast tank[1]	1 transverse bulkhead (4), in each ballast tank[1]	All transverse bulkheads in all cargo oil (3) tanks All transverse bulkheads in all ballast (4) tanks	
1 transverse bulkhead (5), in a cargo oil center tank 1 transverse bulkhead (5), in a cargo oil wing tank[2]	1 transverse bulkhead (5), in 2 cargo oil center tanks 1 transverse bulkhead (5), in a cargo oil wing tank[2]		

(1) ~ (7) are areas to be subjected to close-up surveys and thickness measurements (See IACS URZ10.4, Figure 9 and Figure 10)

(1) Web frame in a ballast tank means vertical web in side tank, hopper web in hopper tank, floor in double bottom tank and deck transverse in double deck tank (where fitted), including adjacent structural members. In fore and aft peak tanks web frame means a complete transverse web frame ring including adjacent structural members

(2) Deck transverse, including adjacent deck structural members (or external structure on deck in way of the tank, where applicable)

(3) Transverse bulkhead complete in cargo tanks, including girder system, adjacent structural members (such as longitudinal bulkheads) and internal structure of lower and upper stools, where fitted

(4) Transverse bulkhead complete in ballast tanks, including girder system and adjacent structural members, such as longitudinal bulkheads, girders in double bottom tanks, inner bottom plating, hopper side, connecting brackets

(5) Transverse bulkhead lower part in cargo tank, including girder system, adjacent structural members (such as longitudinal bulkheads) and internal structure of lower stool, where fitted

(6) The knuckle area and the upper part (5 meters approximately), including adjacent structural members. Knuckle area is the area of the web frame around the connections of the slope hopper plating to the inner hull bulkhead and the inner bottom plating, up to 2 meters from the corners both on the bulkhead and the double bottom

(7) Web frame in a cargo oil tank means deck transverse, longitudinal bulkhead structural elements and cross ties, where fitted, including adjacent structural members

.....

Chapter 3
Survey Requirements for Additional Systems and Services

Paragraphs 3.3.1 has been amended as follows:

3.3 Surveys of Inert Gas Systems

3.3.1 Annual Surveys

At each Annual Survey the inert gas system is to be generally examined so far as can be seen and placed in satisfactory condition. The survey is to include the following items:

(a) ...

(i) Verification of the operation of the following alarms and safety devices using simulated conditions where necessary.

(i) Flue gas systems

(1) Low water pressure or low water flow rate to the flue gas scrubber, including automatic shut-down of the inert gas blowers and gas regulating valve.

(2) .....

(4) Failure of inert gas blowers, including automatic shut-down of the gas regulating valve.

(5) ~~Oxygen content in excess of 8% by volume.~~ High oxygen content of gas in the inert gas main.

(6) Failure of the power supply to the automatic control system for the gas regulating valve and to the oxygen content and gas pressure indicating devices.

(7) Low water level in the water seal.

(8) Gas pressure less than 100 mm water gauge (For combination carrier, the alarm arrangements are to ensure that the pressure in slop tanks can be monitored at all times.).

(9) Additional low gas pressure audible alarm system independent of alarm system for gas pressure less than 100mm water gauge, if fitted.

(10) Automatic shutdown of cargo pumps to operate on predetermined limits of low pressure in the inert gas mains, if fitted.

(11) High gas pressure.

(12) Accuracy of fixed and portable oxygen measuring equipment by means of a calibration gas.

(ii) Inert gas generating systems

(1) Low water pressure or low water flow rate to the inert gas scrubber, including automatic shut-down of the inert gas blowers, gas regulating valve and fuel oil supply to the gas generator.

(2) .....

(4) Failure of the inert gas blowers, including automatic shut-down of the gas regulating valve.

(5) ~~Oxygen content in excess of 8% by volume.~~ High oxygen content of gas in the inert gas main.

(6) Failure of the power supply to the automatic control system for the gas regulating valve and to the oxygen content and gas pressure indicating devices.

(7) .....

(j) The Surveyor is to examine the permanent records to check the operation and maintenance of the system. Consideration may be given by the Surveyor for the crediting of certain items that have been properly documented and recorded.

~~(k) Additional requirements for separate inert gas generator~~

~~(i) Automatic combustion control system is to be examined and tested.~~

~~(ii) Combustion chamber and mountings are to be examined internally and externally.~~

~~(iii) Forced draft fans are to be examined.~~

~~(iv) Fuel oil service pumps are to be examined.~~

~~(l) Additional requirements for inert gas stored in bottles~~

~~(i) Bottles are to be examined internally and externally. If they can not be examined internally they are to be gauged. When considered necessary by the Surveyor, they are to be hydrostatically tested to at least 1.2 times the working pressure. Relief valves are to be proven operable.~~

~~(ii) Where an alkali (or other) scrubber is fitted in the system the scrubber, circulating pump, valves and piping are to be examined internally and externally.~~

.....

Paragraphs 3.3.2(j)&(k) has been added as follows:

3.3.2 Special Survey of inert gas system

At each Special Survey of inert gas system in addition to the requirements for the Annual Surveys in 3.3.1, the following are to be complied with:

(a) All valves, including valves at boiler uptakes, air seal valves at uptakes, scrubber isolating valves, fan inlet and outlet isolating valves, main isolating valves, re-circulating valves (if fitted), pressure/vacuum breakers and cargo tank isolating valves are to be examined.

.....

(j) Additional requirements for separate inert gas generator system

Surveys for separate inert gas generator systems are to comply with all applicable requirements for Special Survey given in this section, together with the following:

(i) Automatic combustion control system is to be examined and tested as necessary.

(ii) Combustion chamber and mountings are to be examined internally and externally.

(iii) Forced draft fan is to be examined.

(iv) Fuel oil service pumps are to be examined.

(k) Additional requirements for inert gas stored in bottles

Systems using inert gas stored in bottles are to comply with all applicable requirements for Special Survey given in this section together with the following:

(i) Bottles are to be examined internally and externally. If they can not be examined internally they are to be gauged. When considered necessary by the Surveyor, they are to be hydrostatically tested to at least 1.2 times the working pressure. Relief valves are to be proven operable.

(ii) Where an alkali (or other) scrubber is fitted in the system, the scrubber, circulating pump, valves and piping are to be examined internally and externally.

.

AMENDMENT TO "THE RULES FOR THE CONSTRUCTION AND CLASSIFICATION OF STEEL SHIPS 2023"

PART II HULL CONSTRUCTION AND EQUIPMENT

List of major changes in Part II from 2023 edition

1.6.8	New
Table II 1-6	Revised
Table II 1-7	Revised
24.1.4(b)	Revised
Fig. II 24-4	Revised
24.4.7(c)	Revised
Fig. II 24-5	Revised
Fig. II 24-7	Revised
24.5.2(a)	Revised
Fig. II 24-7A	New
Fig. II 24-7B	New
24.5.4(b) & (c)	Revised
Fig. II 24-8	Revised
24.7.2	Revised
Table II 24-3	Revised

Rules for the Construction and Classification of Steel Ships 2023 have been partly amended as follows:

Chapter 1
General

Paragraph 1.6.8 has been added as follows:

1.6 Scantlings

1.6.1 The midship part and end parts of the ship used when describing the location of structural members and their scantlings are defined in 1.2.13 and 1.2.14 respectively.

1.6.2 Unless specified otherwise, scantlings of structural members of the midship part can be reduced gradually over the length of 0.1L afore and abaft.

.....

1.6.7 Group of stiffeners

Scantlings of stiffeners based on requirements in this Part may be decided based on the concept of grouping designated sequentially placed stiffeners of equal scantlings on a single stiffened panel. The scantling of the group is to be taken as the greater of the following:

- The average of the required scantling of all stiffeners within a group.
- 90% of the maximum scantling required for any one stiffener within the group.

1.6.8 Rounding of calculated thickness

The required thickness, t, is given by rounding the calculated plate thickness to the nearest half millimeter. For example:

- For $10.75 \leq t_{calc} < 11.25$ mm, the Rule required thickness is 11.0 mm.
- For $11.25 \leq t_{calc} < 11.75$ mm, the Rule required thickness is 11.5 mm.

Table II 1-6 has been amended as follows:

Table II 1-6
Minimum Material Grades for Membrane Type Liquefied Gas Carriers with Length Exceeding 150 m (1)

Structural member		Material grade
Longitudinal plating of strength deck where contributing to the longitudinal strength		Grade B/AH within 0.4L amidships
Continuous longitudinal plating of strength members above the strength deck	Trunk deck plating	Class II within 0.4L amidships
	• Inner deck plating • Longitudinal strength member plating between the trunk deck and inner deck	Grade B/AH within 0.4L amidships

Notes:

(1) Table II 1-6 is applicable to membrane type liquefied gas carriers with deck arrangements as shown in the following figure. Table II 1-6 may apply to similar ship types with a "double deck" arrangement above the strength deck.

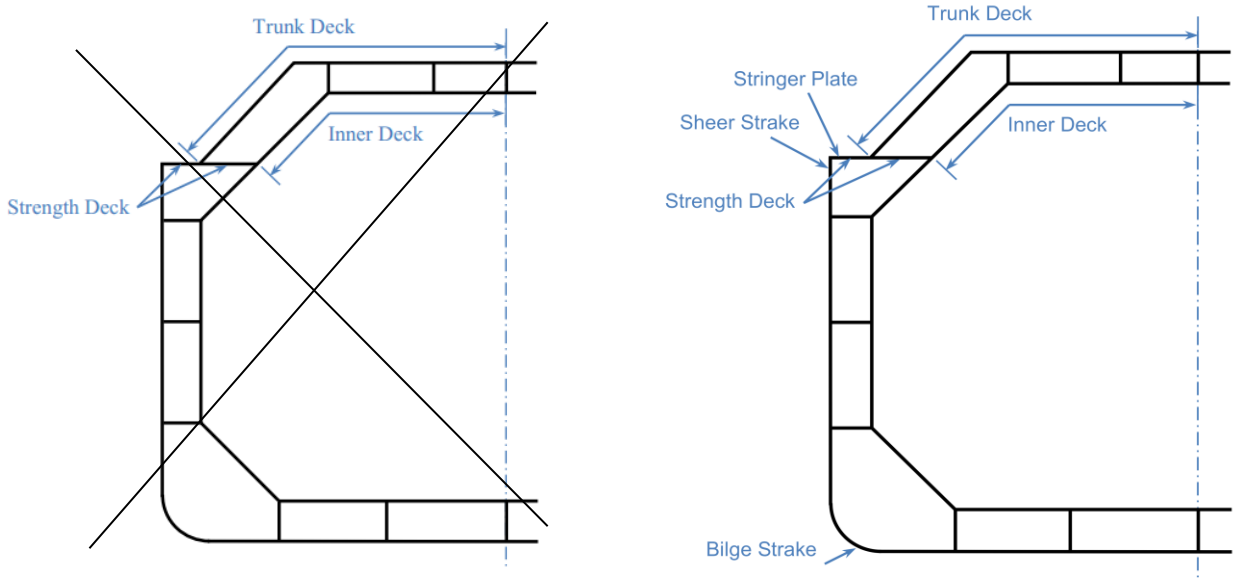


Figure: Typical deck arrangement for membrane type Liquefied Natural Gas Carriers

Table II 1-7 has been amended as follows:

Table II 1-7
Minimum Material Grades for Ships with Length Exceeding 250 m

Structural member category	Material grade
Shear strake at strength deck(1)	Grade E/EH within 0.4L amidships
Stringer plate in strength deck(1)	Grade E/EH within 0.4L amidships
Bilge strake(1)	Grade D/DH within 0.4L amidships

(1) Single strakes required to be of Grade D/DH or Grade E/EH and within 0.4L amidships are to have breadths not less than 800+5L (mm), need not be greater than 1800 (mm), unless limited by the geometry of the ship's design.

Chapter 24
Rudders

Paragraph 24.1.4(b) has been amended as follows:

24.1 General

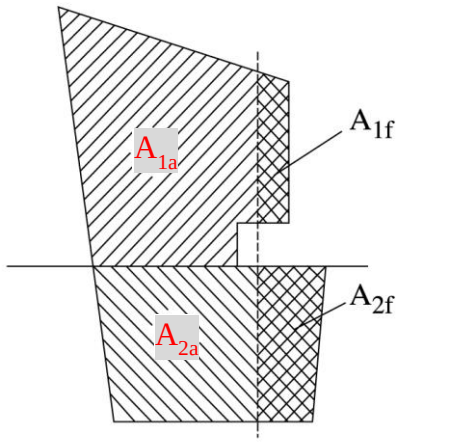
24.1.4 Welding and design details

……

(b) In way of the rudder horn recess of semi-spade rudders, the radii in the rudder plating except in way of solid part in cast steel are not to be less than 5 times the plate thickness, but in no case less than 100 mm. Welding in side plate is to be avoided in or at the end of the radii. Edges of side plate and weld adjacent to radii are to be ground smooth.

Fig. II 24-4 has been amended as follows:

24.2 Rudder Force and Rudder Torque



$A_1=A_{1a}+A_{1f}$

$A_2=A_{2a}+A_{2f}$

~~A_1 and A_2 include A_{1f} and A_{2f} respectively~~

Fig. II 24-4
Rudder Blade with Cut-outs

Paragraph 24.4.7(c) has been amended as follows:

24.4 Rudder Plates, Rudder Webs and Rudder Main Pieces

24.4.7 Connections of rudder blade structure with solid parts

……

(c) Minimum section modulus of the connection with the rudder stock housing.

The section modulus of the cross-section of the structure of the rudder blade, in cm^3, formed by vertical web plates and rudder plating, which is connected with the solid part where the rudder stock is housed is to be not less than:

~~$W_s = C_s d_c^3 \left[\frac{H_E - H_x}{H_E} \right] \frac{K}{K_s} 10^{-4} \quad cm^3$~~

$$W_s = C_s \, d_c^3 \left[\frac{H_E - H_x}{H_E} \right]^2 \frac{K}{K_s} \, 10^{-4} \quad cm^3$$

where:

C_s = Coefficient, to be taken equal to:

1.0: if there is no opening in the rudder plating or if such openings are closed by a full penetration welded plate

1.5: if there is an opening in the considered cross-section of the rudder

d_c = Rudder stock diameter, in [mm], according to 24.3.2 of this Chapter

H_E = Vertical distance between the lower edge of the rudder blade and the upper edge of the solid part, in m

H_x = Vertical distance between the considered cross-section and the upper edge of the solid part, in m

K = Material factor for the rudder blade plating as given in 1.5.2(a) of this Part

K_s = Material factor for the rudder stock as given in 1.5.2(c) of this Part

The actual section modulus of the cross-section of the structure of the rudder blade is to be calculated with respect to the symmetrical axis of the rudder. The breadth of the rudder plating, in m, to be considered for the calculation of section modulus is to be not greater than:

$$b = s_v + \frac{2H_x}{3} \quad m$$

where:

s_v = Spacing between the two vertical webs, in m (see Fig. II 24-5 of this Chapter)

Where openings for access to the rudder stock nut are not closed by a full penetration welded plate, they are to be deducted.

Fig. II 24-5 has been amended as follows:

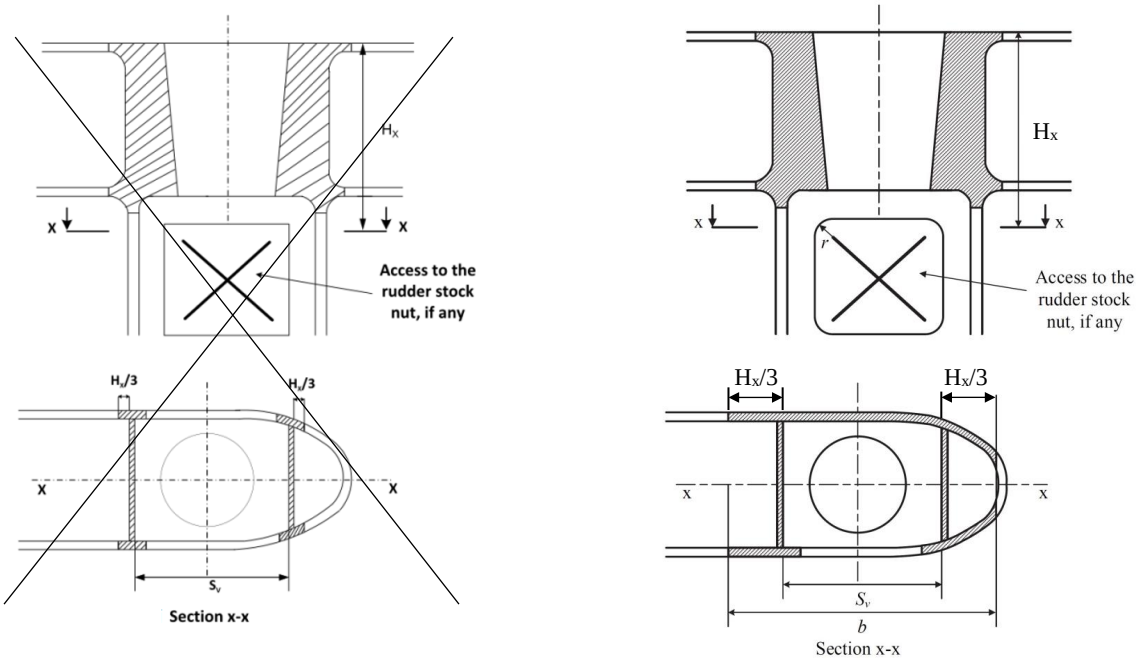


Fig. II 24-5
Cross-section of the Connection Between Rudder Blade Structure and Rudder Stock Housing

Paragraph 24.5.2(a) has been amended as follows:

24.5 Rudder Stock Couplings

24.5.2 Cone couplings with key

(a) Cone couplings without hydraulic arrangements for mounting and dismounting the coupling should have a taper c on diameter of 1:8 - 1:12, where:

$$c = \frac{d_0 - d_u}{l_c}$$ (see Fig. II 24-7 and Fig. II 24-7B of this Chapter)

The diameters d_0 and d_u are shown in Fig. II 24-7 and the cone length l_c is defined in Fig. II 24-7B.

The cone coupling is to be secured by a slugging nut. The nut is to be secured, e.g. by a securing plate.

Fig. II 24-7 has been amended as follows:

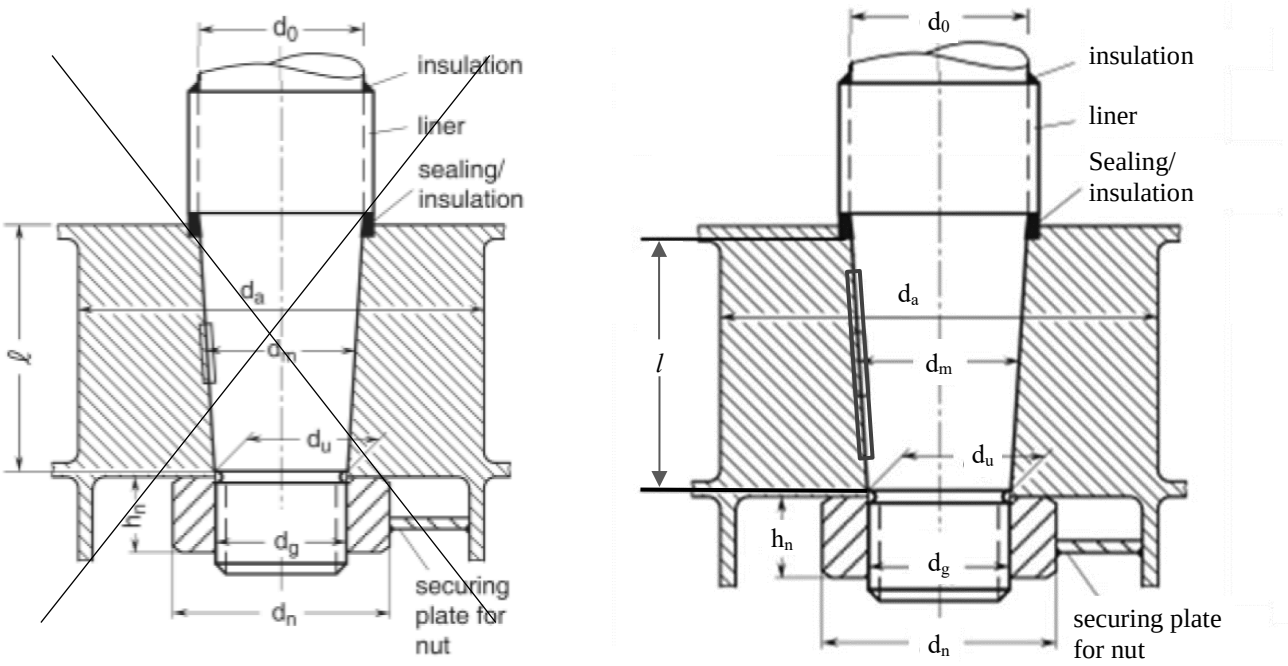


Fig. II 24-7
Cone Coupling with Key

Fig. II 24-7A has been added as follows:

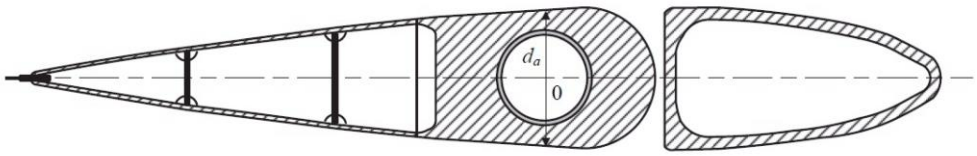


Fig. II 24-7A
Gudgeon Outer Diameter(d_a) Measurement

Fig. II 24-7B has been added as follows:

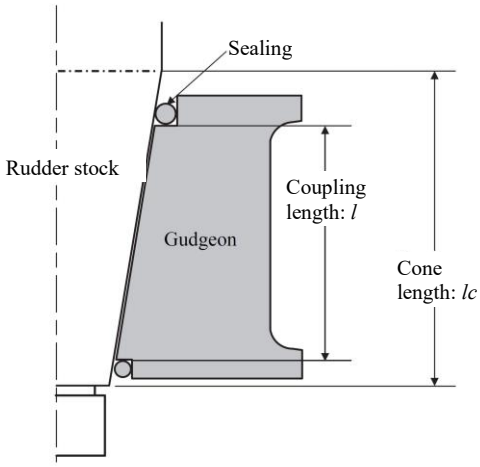


Fig. II 24-7B
Cone Length and Coupling Length

Fig. II 24-8 has been amended as follows:

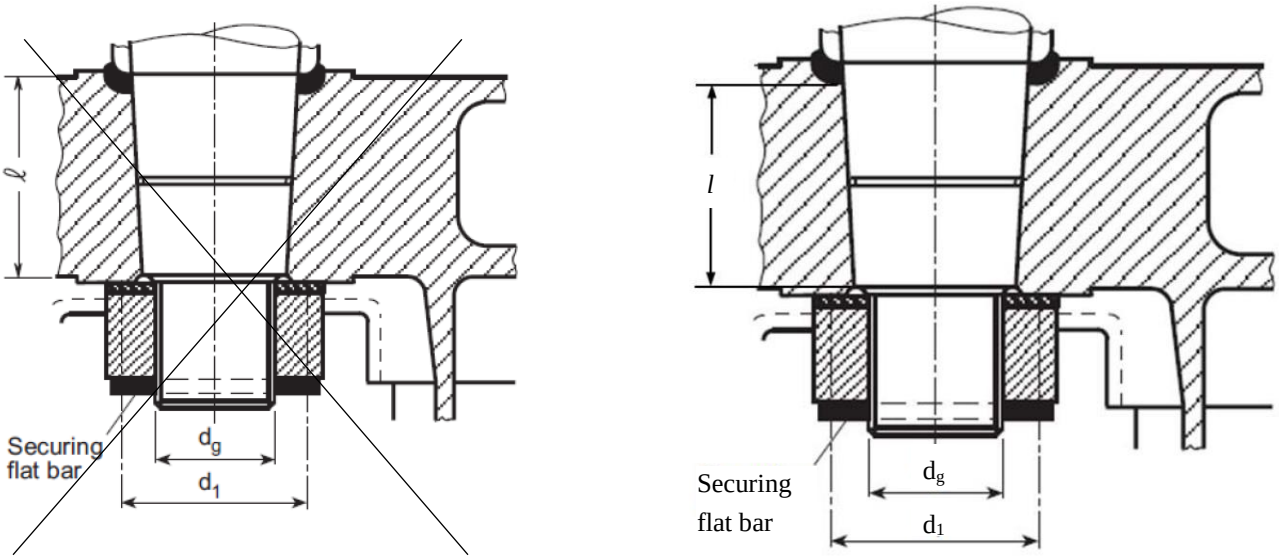


Fig. II 24-8
Cone Coupling without Key

Paragraphs 24.5.4(b) & (c) have been amended as follows:

24.5.4 Cone couplings with special arrangements for mounting and dismounting the couplings

(a) .....

(b) Push-up pressure

The push-up pressure, is not to be less than the greater of the two following values:

$$p_{req1} = \frac{2Q_F}{d_m^2 l \pi \mu_0} 10^3 \qquad N/mm^2$$

$$p_{req2} = \frac{6M_b}{l^2 d_m} 10^3 \qquad N/mm^2$$

where:

Q_F	=	design yield moment of rudder stock, as defined in 24.5.2(i) of this Chapter, in Nm
d_m	=	mean cone diameter in mm, see Fig. II 24-7 of this Chapter
l	=	cone length in mm
μ_0	=	frictional coefficient, equal to 0.15
M_b	=	bending moment in the cone coupling (e.g. in case of spade rudders), in Nm

It has to be proved by the designer that the push-up pressure does not exceed the permissible surface pressure in the cone. The permissible surface pressure, in N/mm^2, is to be determined by the following formula:

~~$p_{perm} = \frac{0.8R_{eH}(1 - a^2)}{\sqrt{3 + a^4}}$ N/mm^2~~

$$p_{perm} = \frac{0.95R_{eH}(1 - a^2)}{\sqrt{3 + a^4}} - p_b \qquad N/mm^2$$

where:

$$p_b = \frac{3.5M_b}{d_m l^2} 10^3$$

R_{eH}	=	minimum yield stress of the material of the gudgeon in N/mm^2
a	=	d_m / d_a
d_m	=	diameter, in mm, see Fig. II 24-7 of this Chapter
d_a	=	outer diameter of the gudgeon, in mm ~~to be not less than 1.5 d_m~~, see Fig. II 24-7 and Fig. II 24-7A of this Chapter. (The least diameter is to be considered).

The outer diameter of the gudgeon in mm shall not be less than 1.25 d_0 , with d_0 defined in Fig. II 24-7.

(c) Push-up length

The push-up length Δl, in mm, Δl is to comply with the following formula:

$$\Delta l_1 \leq \Delta l \leq \Delta l_2$$

where:

Δl_1 = $\dfrac{p_{req} d_m}{E\left(\dfrac{1 - a^2}{2}\right)c} + \dfrac{0.8R_{tm}}{c}$ mm

Δl_2 = ~~$\dfrac{1.6R_{eH} d_m}{Ec\sqrt{3 + a^4}}$~~ $\dfrac{p_{perm} d_m}{E\left(\dfrac{1 - a^2}{2}\right)c} + \dfrac{0.8R_{tm}}{c}$ mm

R_{tm} = mean roughness, in mm taken equal to 0.01

c = taper on diameter according to 24.5.4(a) of this Chapter

E = Young's modulus of the material of the gudgeon, in N/mm^2

d_m, ~~R_{eH}~~ a, p_{req}, p_{perm} = As specified in 24.5.4(b) above.

~~Notwithstanding the above, the push-up length is not to be less than 2 mm.~~

Note: In case of hydraulic pressure connections the required push-up force P_e , in N, for the cone may be determined by the following formula:

$$P_e = p_{req} d_m \pi l \left(\frac{c}{2} + 0.02\right)$$

The value 0.02 is a reference for the friction coefficient using oil pressure. It varies and depends on the mechanical treatment and roughness of the details to be fixed. Where due to the fitting procedure a partial push-up effect caused by the rudder weight is given, this may be taken into account when fixing the required push-up length, subject to approval by the Society.

Paragraph 24.7.2 has been amended as follows:

24.7 Rudder Stock Bearings, Rudder Shaft Bearing and Pintle Bearings

24.7.2 The length/diameter ratio of the bearing surface is not to be ~~less than 1.0 or~~ greater than 1.2~~, unless calculations are submitted and approved which show the clearance at both ends of the bearing is acceptable~~.

The bearing length L_p of the pintle, in mm, is to be such that:

$$D_p \leq L_p \leq 1.2 D_p$$

where:

D_p = Actual pintle diameter, in mm, measured on the outside of liners.

Table II 24-3 has been amended as follows:

Table II 24-3
Allowable Surface Pressure, q_a

Bearing material	q_a (N/mm^2)
Lignum-vitae	2.5
White metal, oil lubricated	4.5
Synthetic material with hardness ~~between 60 and 70~~ greater than 60 Shore D(1)	5.5(2)
Steel(3) and bronze and hot-pressed bronze-graphite materials	7.0

Notes:

(1) Indentation hardness test at 23°C and 50% moisture, according to a recognized standard. Synthetic bearing materials are to be of an approved type.

(2) Surface pressures exceeding 5.5 N/mm^2 may be accepted in accordance with bearing manufacturer's specification and tests, but in no case more than 10 N/mm^2.

(3) Stainless and wear-resistant steel in an approved combination with stock liner. Higher values than given in the Table may be taken if they are verified by tests.

AMENDMENT TO "THE RULES FOR THE CONSTRUCTION AND CLASSIFICATION OF STEEL SHIPS 2023"

PART IV MACHINERY INSTALLATIONS－CONSTRUCTION AND SHAFTING

List of major changes in Part IV from 2023 edition

4.2.1(e)	Revised

Rules for the Construction and Classification of Steel Ships 2023 have been partly amended as follows:

Chapter 4
Deck Machinery and Essential Auxiliaries

Paragraph 4.2.1(e) has been amended as follows:

4.2 Steering Gears

4.2.1 General

.....

(e) Definitions relating to steering gear

(i) Steering gear control system means the equipment by which orders are transmitted from the navigating bridge to the steering gear power units. Steering gear control systems comprise transmitters, receivers, hydraulic control pumps and their associated motors, motor controllers, piping and cables. Steering gear control system is also understood to cover "the equipment required to control the steering gear power actuating system".

(ii) Main steering gear means the machinery, rudder actuator(s), the steering gear power units, if any, and ancillary equipment and the means of applying torque to the rudder stock (e.g. tiller or quadrant) necessary for effecting movement of the rudder for the purpose of steering the ship under normal service conditions.

(iii) Steering gear power unit means:

(1) in the case of electric steering gear, an electric motor and its associated electrical equipment,

(2) in the case of electrohydraulic steering gear, an electric motor and its associated electrical equipment and connected pump,

(3) in the case of other hydraulic steering gear, a driving engine and connected pump.

(iv) Auxiliary steering gear means the equipment other than any part of the main steering gear necessary to steer the ship in the event of failure of the main steering gear but not including the tiller, quadrant of components serving the same purpose.

(v) Power actuating system means the hydraulic equipment provided for supplying power to turn the rudder stock, comprising a steering gear power unit or units, together with the associated pipes and fittings, and a rudder actuator. The power actuating systems may share common mechanical components, i.e. tiller, quadrant and rudder stock, or components serving the same purpose.

(vi) Maximum ahead service speed means the greatest speed which the ship is designed to maintain in service at sea at her deepest sea going draught at maximum propeller RPM and corresponding engine MCR.

(vii) Rudder actuator means the component which converts directly hydraulic pressure into mechanical action to move the rudder.

(viii) Maximum working pressure means the maximum expected pressure in the system when the steering gear is operated to comply with 4.2.2(b).

(ix) Hydraulic locking means all situations where two hydraulic systems (usually identical) oppose each other in such a way that it may lead to loss of steering. It can either be caused by pressure in the two hydraulic systems working against each other or by hydraulic "bypass" meaning that the systems puncture each other and cause pressure drop on both sides or make it impossible to build up pressure.

AMENDMENT TO "THE RULES FOR THE CONSTRUCTION AND CLASSIFICATION OF STEEL SHIPS 2023"

PART VI PIPING AND PUMPING SYSTEMS

List of major changes in Part VI from 2023 edition

5.8.1(g)	New

Rules for the Construction and Classification of Steel Ships 2023 have been partly amended as follows:

Chapter 5
Oil Tanks Piping Systems

Paragraph 5.8.1(g) has been added as follows:

5.8 Inert Gas System

5.8.1 General

.....

(f) Detailed instruction manuals are to be provided on board covering the operations, safety and maintenance requirements and occupational health hazards relevant to the inert gas system and its application to the cargo tank system. The manuals are to include guidance on procedures to be followed in the event of a fault or failure of the inert gas system.

(g) The inert gas system satisfying the provisions of Chapter 15 of the FSS Code may be deemed to comply with the requirements of 5.8 of this section.

AMENDMENT TO "THE RULES FOR THE CONSTRUCTION AND CLASSIFICATION OF STEEL SHIPS 2023"

PART VIII AUTOMATIC OR REMOTE CONTROL AND MONITORING SYSTEMS

List of major changes in Part VIII from 2023 edition

3.2.12	New

Rules for the Construction and Classification of Steel Ships 2023 have been partly amended as follows:

Chapter 3
General

Paragraph 3.2.12 has been added as follows:

3.2 Systems Requirements

……

3.2.12 Cyber Resilience

All stakeholders are advised to refer to IACS Recommendation 166 "Recommendation on Cyber Resilience"

(a) The purpose of the IACS Recommendation 166 is to provide technical guidance to stakeholders which would lead to delivery of cyber resilient ships, whose resilience can be maintained throughout their service life.

(b) It is intended that the recommendation provides guidance for mitigating the risk related to events affecting onboard computer-based systems, recognizing that, if no measures are implemented, such events could potentially affect the human safety, safety of vessel and/or the threat to the marine environment.

(c) For new construction ship that have a contract signing on or after 1 January 2024, the following requirment have to be complied with.

(1) IACS UR E26 – Cyber Resilience of Ships

(2) IACS UR E27 – Cyber Resilience of On-Board Systems and Equipment

AMENDMENT TO "THE RULES FOR THE CONSTRUCTION AND CLASSIFICATION OF STEEL SHIPS 2023"

PART XI MATERIALS

List of major changes in Part XI from 2023 edition

Chapter 6	Revised
8.1.4	New
8.2.7	Revised
Table XI 8-1	Revised
Table XI 8-2	Revised
8.4	Revised
8.5	Revised and Renumbered
Fig. XI 8-1	New
Fig. XI 8-1~8-8	Renumbered
Fig. XI 8-10	New
Table XI 8-3	Revised
Table XI 8-4	Revised
8.7	Revised and Renumbered
8.8.2	Revised
8.9.2	Revised and Renumbered
9.5	New

Rules for the Construction and Classification of Steel Ships 2023 have been partly amended as follows:

Chapter 6
Steel Castings

Chapter 6 has been amended as follows:

6.1 General

6.1.1 This Chapter gives the requirements for steel castings intended for ~~ship~~hull and machinery applications for ships and offshore units for worldwide services ~~construction,~~ and for use in liquefied gas piping systems where the design temperature is lower than 0°C. The requirements also make consideration for grades that are intended for fabrication by welding, as well as grades not intended for welding.

6.1.2 The material grades of steel castings specified in this Chapter are designated as follows:

(a) "C1-xxx", "C2-xxx" and "C3-xxx" for carbon steel castings, where xxx is a figure to represent the specified minimum tensile strength in N/mm^2 of the design purpose.

(b) "A1-xxx", "A2-xxx" for alloy steel castings, where xxx is a figure to represent the specified minimum tensile strength in N/mm^2 of the design purpose.

(c~~b~~) "C3-LA", "C3-LB", "C4-LA" and "C4-LB" for low temperature service steel castings.

6.1.3 ~~For low-alloy and alloy steel castings, the steel-making processes, chemical compositions, heat treatments, mechanical properties, etc. are to comply with the requirements of the recognized national or international standards or of the special design specifications approved by the Society.~~ C and C-Mn steel castings and alloy steel castings which comply with national or proprietary specifications may be accepted provided such specifications give reasonable equivalence to these requirements or are otherwise specially approved or required by the Society. For such materials, the grade marks designated by the standards or the approved design specifications are applicable.

6.1.4 Where steel castings having characteristics differing from those prescribed in this Chapter are used, the requirements in 1.1.2 and 1.1.3 of this Part are to be complied with.

6.2 Manufacture

6.2.1 Steel castings are to be made at foundries which have been approved by the Society in compliance with the requirements given in 1.2 of this Part.

6.2.2 Steel castings are to be made from killed steels and to be of uniform grain, free from blowholes, porous spots or other defects which may affect the service performance of the casting.

6.2.3 All flame cutting, scarfing or arc-air gouging to remove surplus metal is to be undertaken in accordance with recognized good practice and is to be carried out before the final heat treatment. Preheating is to be employed where

necessitated by the chemical composition and/or thickness of the casting. The affected areas are to be either machined or ground smooth.

6.2.4 Where two or more castings are joined by welding to form a composite component: ~~item, details of the proposed welding procedure are to be submitted for approval.~~

The requirement for welding procedure of steel castings for hull construction and marine structures are to be complied with Chapter 2 of Part XII of the Rules. Welders for hull structural steel castings are to be qualified in accordance with Chapter 3 of Part XII of the Rules. Requirements for other welding procedure specification (WPS) and qualification thereof, for welder certification and for type approval of welding consumables are at the discretion of the Society.

6.2.5 Temporary welds made for operations such as lifting, handling, staging, etc., are to be in accordance with approved welding procedures and qualified welders, and are to be removed, ground and inspected using suitable NDT methods.

6.2.6~~5~~ All castings are to be free from surface or internal defects, which would be prejudicial to their proper application in service. The surface finish is to be in accordance with good practice and any specific requirements of the approved plan. The surfaces of steel castings are not to be hammered, peened nor treated in any way which may obscure defects.

6.3 Chemical Composition

6.3.1 The chemical composition of ~~carbon~~ C, C-Mn and alloy steel castings and low temperature service steel castings are to comply with the requirements given in Tables XI 6-1A & 6-1B and XI 6-4 respectively.

6.3.2 All castings are to be made from killed steel and the chemical composition is to be appropriate for the type of steel and the mechanical properties specified for the castings. The chemical composition of each heat is to be determined by the manufacturer on a sample taken preferably during the pouring of the heat. When multiple heats are tapped into a common ladle, the ladle analysis shall apply. The manufacturer is to make a ladle analysis of each heat ~~melt~~ and the results are to be reported to the Surveyor.

6.3.3 Except where otherwise specified, suitable grain refining elements may be used at the discretion of the manufacturer. The content of such elements is to be reported in the ladle analysis.

6.3.4 Where it is proposed to use carbon-manganeses steels of higher specified minimum tensile strength than required by this Chapter, or alloy steels, particulars of the chemical composition, mechanical properties and heat treatment are to be submitted for approval. ~~Carbon steel castings which are intended for parts of a welded fabrication are to be of weldable quality with a carbon content generally not exceeding 0.23%.~~

~~6.3.5 Where carbon steel with higher carbon content than 0.23%, or low alloy and alloy steels, are intended for welding, full details of the proposed welding procedure and specification including preheating temperature and any post-weld heat treatment proposed are to be submitted to the Society for approval.~~

Table XI 6-1A
~~Chemical Composition of Carbon Steel Castings for Ship and Machinery Construction~~ Chemical Composition Limits for Hull and Machinery Steel Castings (%): C, C-Mn steels

~~Material Grade~~ Steel type	Applications	Chemical Composition (%)					Residual elements (max.)				Total residuals (max.)
		C (max.)	Si (max.)	Mn	P (max.)	S (max.)	Cu	Cr	Ni	Mo	
C, C-Mn Carbon Steel Castings	~~Cl.~~ Castings for non-welded construction	0.40	0.60	0.50 ~ 1.60 ~~Max. 1.60~~	0.0~~40~~35	0.0~~40~~35	0.30	0.30	0.40	0.15	0.8
	~~Cl.~~ Castings for welded construction	0.23									

Table XI 6-1B
Chemical Composition Limits for Hull and Machinery Alloy Steel Castings (%): Alloy Steels

Steel type	Applications	C (max.)	Si (max.)	Mn	P (max.)	S (max.)	Alloy elements (1) (min.)			
							Cu	Cr	Ni	Mo
Alloy	non-welded construction	0.45	0.60	0.50 ~ 1.60	0.030	0.035	0.30	0.40	0.40	0.15
	welded construction	alloying element values to be agreed with the Society								

Notes:
(1) At least 1 of the elements shall comply with the minimum content.

6.4 Heat Treatment

6.4.1 ~~All steel castings, except otherwise specified and approved, are to be suitably annealed, normalized, normalized and tempered, or quenched and tempered to refine the grain structure. The temperature of tempering is to be not less than 550°C.~~ Castings are to be supplied in one of the following delivery conditions:

(a) Carbon and carbon-manganese steels:
- Fully annealed
- Normalized
- Normalized and tempered
- Quenched and tempered.

(b) Alloy steels:
- Normalized
- Normalized and tempered
- Quenched and tempered

For all types of steel the tempering temperature is to be not less than 550°C.
The delivery condition shall meet the design and application requirements. It is the manufacturers responsibility to select the appropriate heat treatment method to obtain the required mechanical properties.

6.4.2 If a steel casting is locally reheated, or any cold work operation is performed after the final heat treatment, a subsequent stress relieving heat treatment is to be required in order to avoid the possibility of harmful residual stresses. The manufacturer shall have strict control of this temperature in order to avoid any detrimental effects to the final heat treatment and resultant microstructure and mechanical properties of the casting.

6.4.3 Heat treatment is to be carried out in properly constructed furnaces to comply with the requirements given in 1.4.2 of this Part.

6.4.4 Castings for components such as crankshafts and engine bedplates, where dimensional stability and freedom from internal stresses are important, are to be given a stress relief heat treatment. This is to be carried out at a temperature of not less than 550°C followed by furnace cooling to 300°C or lower.

6.4.5 The foundry is to maintain records of heat treatment identifying the furnace used, furnace charge, date, temperature and time at temperature. The records are to be presented to the Surveyor on request.

6.5 Mechanical Properties

6.5.1 Mechanical properties and test requirements for ~~carbon~~ steel castings and low temperature steel castings are to comply with the requirements given in Tables XI 6-2A & 6-2B, XI 6-3 and XI 6-5.

(a) Tables XI 6-2A & 6-2B and XI 6-3 give the minimum requirements for yield stress (or proof stress at 0.2% non-proportional elongation), elongation,~~and~~ reduction of area and impact test energy values corresponding to steel types and different strength levels~~, and it is not intended that these are necessarily to be regarded as specific grades~~. Where it is proposed to use a steel with a specified minimum tensile strength intermediate to those given, corresponding minimum values for the other properties may be obtained by interpolation.

(b) ~~Steel c~~Castings may be supplied to any specified minimum tensile strength selected within the general limits detailed in Tables XI 6-2A & 6-2B and XI 6-3, respectively.

Table XI 6-2A
Mechanical Properties for ~~Acceptance Purposes and Test Requirements of Carbon Steel Castings for Ship and Machinery Construction~~ Steel Castings Intended for Welding

Material Grade~~(4)~~		Tensile Test				Charpy V-notch impact test(2)		No. of Test Specimens
		Tensile Strength (1) ~~(3)~~min. (N/mm²)	Yield Stress min. (N/mm²)	Elongation on $L = 5.65\sqrt{A}$ min. (%)	Reduction of Area min. (%)	Test temperature (°C)	Minimum average energy (J)	
Carbon Steel Castings	C1-	400 440 480 520 560 600	200 220 240 260 300 320	25 22 20 18 15 13	40 30 27 25 20 20	0	27	See Table XI 6-6
Alloy	A1-	550	355	18	30	0	27	
		600	400	16	30			
		650	450	14	30			
		700	540	12	28			

Notes:

~~(1) Where it is proposed to use a steel casting with a specified minimum tensile strength intermediate to those given in the above Table, corresponding minimum values for the yield stress, elongation and reduction of area may be obtained by interpolation. In this case, the fractions below 0.5 of the figures are to be disregarded, and the figures of 0.5 and over are to be rounded up.~~

~~(2) For steel castings intended to be used for the propellers granted the notation **Ice Class** and for elevated temperature service, the mechanical properties and test requirements are to be specially considered.~~

~~(3) The difference in tensile strength in cases where more than one tensile test specimen is taken from a casting is not to exceed 62 N/mm².~~

(1) A tensile strength range of 150 N/mm² may additionally be specified.

(2) Special consideration may be given to alternative requirements for Charpy V-notch impact test, depending on design and application, and subject to agreement by Society.

~~(4) The material grade is to be denoted as C1- affixed with the figure to represent the minimum tensile strength in N/mm² specified on the design document or in the material specification where it is proposed to be used.~~

Table XI 6-2B
Mechanical Properties for Machinery Steel Castings Not Intended for Welding

Material Grade	Tensile Test				Charpy V-notch Impact Test(2)		
Steel Type	Tensile Strength(1) min. (N/mm^2)	Yield Stress min. (N/mm^2)	Elongation on $L = 5.65\sqrt{A}$ min. (%)	Reduction of Area min. (%)	Test temperature (°C)	Minimum average energy(J)	No. of Test Specimens
C2-	400 440 480 520 560 600	200 220 240 260 300 320	25 22 20 18 15 13	40 30 27 25 20 20	AT(3)	27	See Table XI 6-6
A2-	550	340	16	35	AT(3)	27	
	600	400	16	35			
	650	450	14	32			
	700	540	12	28			

Notes:

(1) A tensile strength range of 150 N/mm^2 may additionally be specified.

(2) Special consideration may be given to alternative requirements for Charpy V-notch impact test, depending on design and application, and subject to agreement by the Society.

(3) AT refers to Ambient Temperature (i.e. 23°C±5°C), which is specified in ISO 148-1:2016

Table XI 6-3
Mechanical Properties for Acceptance Purposes and Test Requirements of Carbon Steel Castings for Crank Throws

Material Grade	Tensile Test				Impact Test (2)	
	~~Specified Minimum~~ Tensile Strength min. (N/mm^2)	Yield Stress min. (N/mm^2)	Elongation on $L = 5.65\sqrt{A}$ min. (%)	Reduction of Area min. (%)	Absorbed Energy min. (3) Average of 3 Test Specimens (J)	No. of Test Specimens
C3~~1~~-	410 450 480 520 550	205 225 240 260 275	28 26 24 22 20	45 45 40 40 35	32 (30) 28 (27) 25 (25) 20 (22) 18 (20)	See Table XI 6-6

Notes:

(1) Notes 1, and 2~~ and 3~~ of Table XI 6-2A & 6-2B are also applicable.

(2) The impact test may be either a test specimen of Type N1 or Type N2 as given in Table XI 2-3 at the option of the manufacturer and is to be carried out at ambient temperature.

(3) The specified values of minimum absorbed energy of impact test are required to a test specimen of Type N1. Where a test specimen of Type N2 is taken, the values shown in parentheses are to be applied.

Table XI 6-4
Chemical Composition of Steel Castings for Low Temperature Service

Material Grade	Deoxidation	Chemical Composition (%)						
		C	Si	Mn	P	S	Ni	Mo
C3-LA	Killed and fine grain treated (See Note)	0.30 max.	0.60 max.	1.00 max	0.035 max.	0.035 max.	–	–
C3-LB		0.25 max.		0.50 ~ 0.80			–	0.45 ~ 0.65
C4-LA					0.030 max.	0.030 max.	2.00 ~ 3.00	–
C4-LB		0.15 max.					3.00 ~ 4.00	–

Note: The grain refining elements and residual elements are to comply with the manufacturing specifications approved by the Society.

Table XI 6-5
Mechanical Properties and Requirements of Steel Castings for Low Temperature

Material Grade	Applicable Design Temperature (°C)	Tensile Test				Impact Test		No. of Test specimens
		Tensile Strength (N/mm^2)	Yield Stress (N/mm^2)	Elongation on $L = 5.65\sqrt{A}$ (%)	Reduction of Area (%)	Test Temperature (°C)	Absorbed Energy (Average of three test specimens) (2) (J)	
C3-LA	–40	450 min.	245 min.	21 min.	35 min.	–45 (1)	27 min.	See Table XVI 6-6
C3-LB	–55					–60 (1)		
C4-LA	–65		275 min.			–70	34 min.	
C4-LB	–90					–95		

Notes:

(1) For Grades C3-LA and C3-LB castings intended to be applied in a higher design temperature, the impact test may be carried out at a temperature 5°C below design temperature or –20°C, whichever is the lower.

(2) The specified values of minimum absorbed energy of impact test are required to a test specimen of Type N1 as given in Table XI 2-3.

~~6.5.2 Test specimens~~

~~(a) The test specimens for steel castings are, except as specified in 6.5.2(c) below, to be taken directly from the body of casting or the test samples which are either integrally cast or gated to the casting to be inspected.~~

~~(b) The test samples are not to be detached from the casting until the heat treatment of the casting has been completed, and when detached are to be properly identified by the Surveyor.~~

~~(c) In case of group castings of similar form and size cast from same charge and heat treated simultaneously in the same furnace, each of test samples may be cast separately, provided the Surveyor is furnished with an affidavit by the manufacturer stating that the test samples were cast from the same charge as the castings represented and that they were heat treated together with the castings.~~

~~(d) The test samples are to have a thickness of not less than 30 mm.~~

6.5.2 Mechanical tests

(a) Test material, sufficient for the required tests and for possible retest purposes is to be provided for each casting or batch of castings.

(b) The size of the test blocks for mechanical testing is to be such that the heat treatment and microstructure is representative for the section of the casting with the ruling section, i.e. the section for which the specified mechanical properties apply, see also ISO 683-1:2018 and ISO 683-2:2018, respectively.
For C, C-Mn steel castings this is in general to be achieved as follows:
The test block shall have a thickness (t_S) of not less than the ruling section of the casting, or 30 mm, whichever is larger.
For large thickness castings other than stern tube, stern frame, anchor and rudder horn, t_S normally need not to exceed 150 mm. Length and width of the test block is normally to be at least three times t_S, unless otherwise agreed with the Society, as shown in Fig. XI 6-1. (Note that longer or wider test blocks may be necessary in order to accommodate the required test specimens.)
For castings for stern tube, stern frame, anchor and rudder horn the test block thickness t_S shall represent the ruling section.

Notes:
Shorter width or length may be accepted for test blocks where actual casting width or length (t_A) is in the range between t_S and $3t_S$.
Example 1: For a general casting with dimensions 140 x 160 x 1250 mm the required test block size would typically be 140 x 160 x 420 mm (that is: t_S x t_A x $3t_S$).
Example 2: For a stern tube casting with ruling section t_S = 170 mm and width/height/length $t_{A1}/t_{A2}/t_{A3}$ = 1000/600/1800 mm, the required test block size would typically be 170 x 510 x 510 mm (that is: t_S x $3t_S$ x $3t_S$) see Fig. XI 6-2.

For alloy steel castings the manufacturer shall propose dimensions for the test block and demonstrate the representative nature of it.

(c) For test blocks with thickness ≤ 56 mm, the longitudinal axis of the test specimens is to be located at ≥ 14 mm from the surface in the thickness direction. For test blocks with thickness > 56 mm, the longitudinal axis of the test specimens is to be located at ≥ $t_S/4$ from the surface. Test specimens shall be taken in such a way that no part of the gauge length is machined from material closer than t_S to any of the other surfaces. For impact testing, this requirement shall apply to the complete test specimen - refer to Fig. XI 6-1 for location of test specimens in relation to the test block.

(d) For certain components including steel castings subjected to surface hardening process, the proposed method of manufacture may require special approval by the Society. The number and position of test blocks is to be agreed with the Society having regard to the method of manufacture employed.

(e) The preparation of test specimens and the procedures used for mechanical testing are to comply with the relevant requirements of Chapter 2 of this Part. Unless otherwise agreed all tests are to be carried out in the presence of the Surveyors.

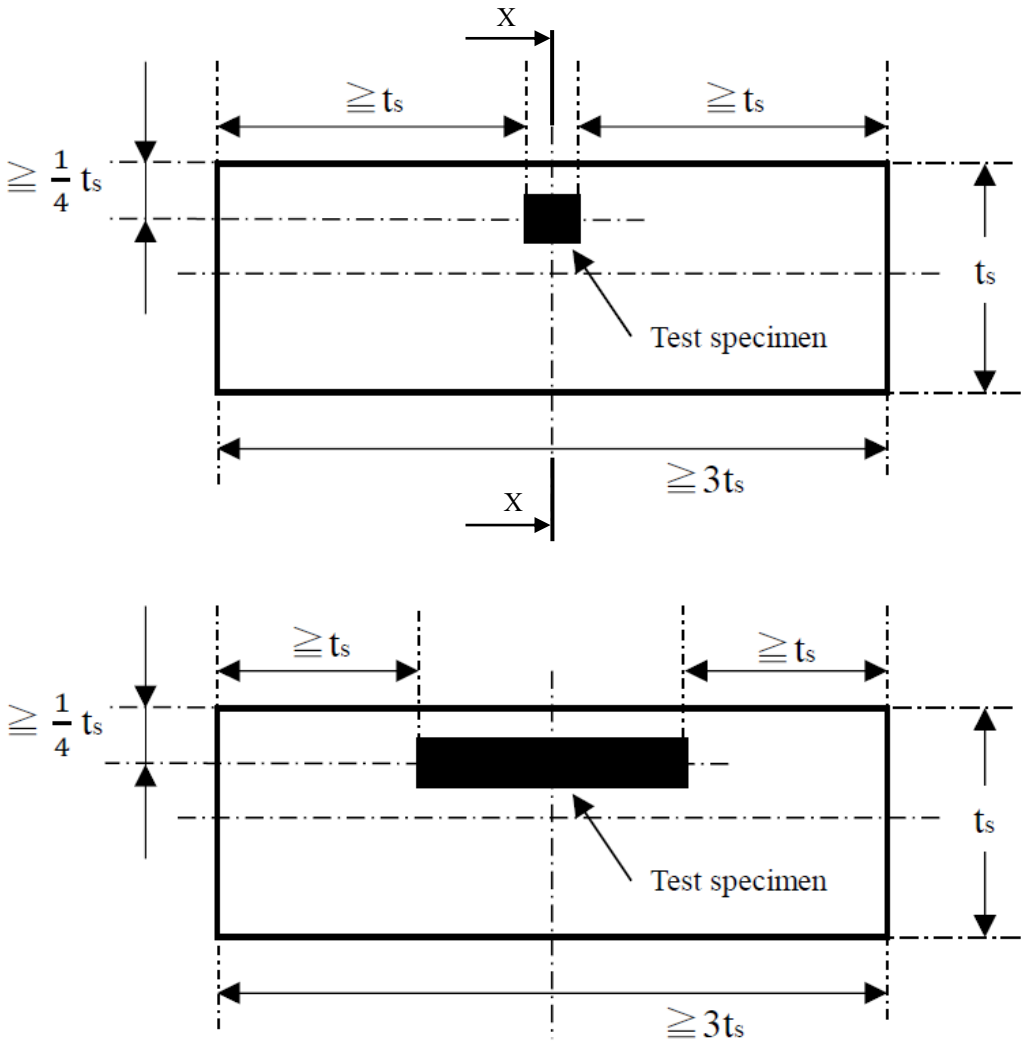


Fig. XI 6-1
Specimen Positions Relative to The Test Block in accordance with ISO 4990:2015

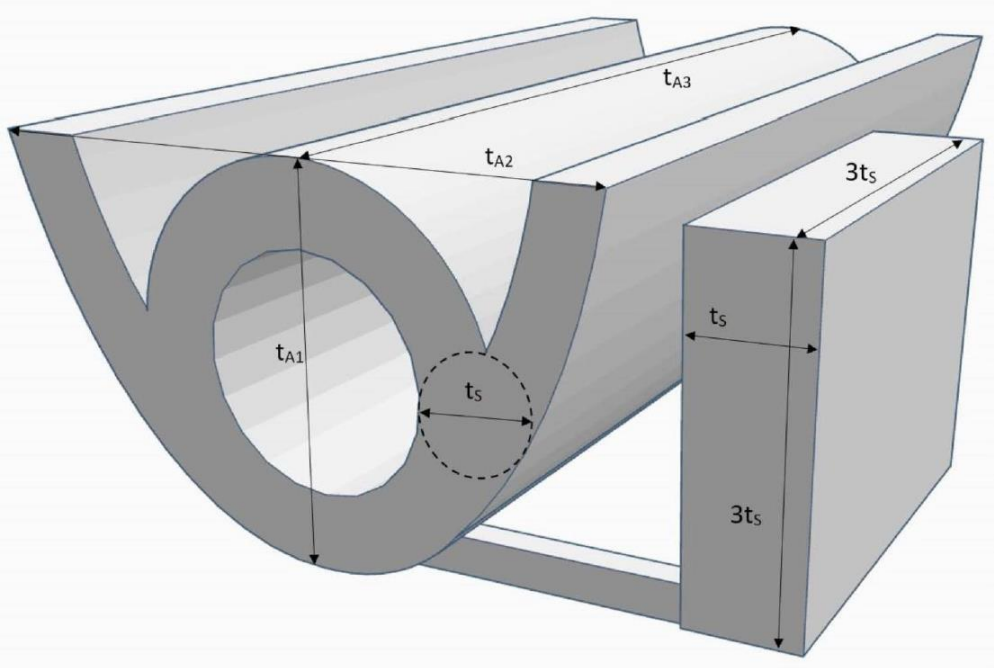


Fig. XI 6-2
Test Block Gated to Stern Tube Casting

6.5.3 Selection of test specimens for steel castings is to comply with the requirements given in Table XI 6-6.

(a) Test specimens for steel castings are, after final heat treatment, to be taken from the test block cast integral with the body of casting. "However, test blocks may be separated from the body of the casting before final heat treatment in cases where deemed appropriate by the Society. At least one test block is to be provided for each casting, and one set of test specimen is to be taken from each test block.

(b) Except where specified otherwise by the Society, one test block is to be taken from each steel casting. In cases where the mass of one steel casting (as heat treated, hereinafter referred to as the "mass") is more than ten tons, two test blocks are to be taken from each steel casting from the heaviest section, located as far as practicable from each other.

(c) In cases where a number of small castings of about the same size, each of which is under 1000kg in mass, are made from 1 cast and heat treated in the same furnace charge, a batch testing procedure may be adopted using separately cast test blocks of suitable dimensions. At least 1 test block is to be provided for each batch of castings.

(d) In cases where one steel casting is made from two or more casts, which are not mixed in a ladle prior to pouring, one test block is to be taken from each charge regardless of the requirements in (b) or (c) above.

Table XI 6-6
Selection of Test Specimens for Steel Castings

Condition of Castings	Mass of Castings, kg		No. of Test Specimens (1)
Individual castings as heat treated	~~e~~w ≤ 10000		1 set
	~~e~~w > 10000		2 sets
Group castings cast from same charge and heat treated simultaneously	~~e~~w ≤ 1000	~~W ≤ 2000~~	1 set
		~~W > 2000~~	~~2 sets~~
~~Group castings of similar form and size cast from same charge and heat treated simultaneously~~	~~e< 500~~		~~1 set~~
Where: ~~e~~w = Mass of individual casting as heat treated, in kg. ~~W = Total mass of group castings as heat treated, in kg.~~			

Notes:

(1) One set of test specimens specified in the above Table ~~means:~~ includes 1 tensile and 3 impact test specimens.

~~For steel castings intended for ship and machinery construction: One tensile.~~

~~For steel castings intended for crank webs: One tensile and three impacts.~~

~~For steel castings intended for low temperature service: One tensile and three impacts.~~

~~(2) Where the casting is of complex design, two sets of test specimens are to be taken from well separated locations if deemed necessary by the Surveyor.~~

~~(3) Where large castings are made from two or more casts which are not mixed in a ladle prior to pouring, one set of test specimens is required from each test coupon provided corresponding to the number of casts involved. These test coupons are to be integrally cast at locations as widely separated as possible.~~

6.6 Inspection and Non-Destructive Examination

6.6.1 All castings are to be cleaned and adequately prepared for examination; suitable methods include pickling, caustic cleaning, wire brushing, local grinding, shot or sand blasting. The surfaces are not to be hammered, peened or treated in any way which may obscure defects.

6.6.2 Before acceptance all castings are to be presented to the Surveyors for visual examination. Where applicable, this is to include the examination of internal surfaces. Unless otherwise agreed, the verification of dimensions is the responsibility of the manufacturer.

6.6.3~~1~~ Where specified hereinafter, the non-destructive examination is to be carried out before acceptance. All such tests are to be carried out by competent operators using reliable and efficiently maintained equipment. The testing procedures are to be agreed with the Surveyor.

6.6.4~~2~~ Non-destructive examination is to be carried out by the manufacturer at an appropriate stage of the manufacturing process and the test reports are to be submitted to the Surveyor. Acceptance criteria for non-destructive testing shall be agreed with the Society. For hull castings, IACS Recommendation No. 69 is regarded as an example of an acceptable standard.

6.6.5~~3~~ The important parts of the following steel castings are to be subjected to ultrasonic examination:

(a) Steel castings intended for stern frame, rudder horn and other important structural members.

(b) Steel castings specified in Table IV 3-4.

6.6.6~~4~~ The important parts of the following steel castings are to be subjected to magnetic particle test:

(a) Steel castings intended for stern frame, rudder frame and other important structural members.

(b) Turbine castings (also see 2.9.4 of Part IV).

(c) Steel castings specified in Table IV 3-4.

(d) Propellers (Surfaces of the blade root).

6.6.7~~5~~ In place of the test methods specified above, the Society may accept the application of other nondestructive inspections considered adequate by the Society.

6.6.8~~6~~ The welding parts of steel castings used for welded construction are to be subjected to nondestructive examination considered adequate by the Society.

6.6.9~~7~~ The Society may require nondestructive examination by radiographic test, ultrasonic test, magnetic particle test or penetrant test not only for the steel castings specified above, but also if deemed necessary by the Society.

6.6.10 When required by the relevant construction Rules castings are to be pressure tested before final acceptance. These tests are to be carried out in the presence of the Surveyor and are to be to their satisfaction.

6.6.11 In the event of any casting proving to be defective during subsequent machining or testing it is to be rejected notwithstanding any previous certification.

6.7 Repair of Defects

6.7.1 ~~In the event of finding unacceptable defects in a steel casting, the defects may be removed by machining, chipping or grinding, etc. Flame scarfing or arc-air gouging may also be used provided that preheating is employed when necessary and that the surfaces of the resulting depression are subsequently ground smooth.~~General

(a) Where castings are to be repaired, the manufacturer shall exercise robust controls of all repair operations regarding the repair of castings, with respect to dimensions, heat treatment, inspection and quality control.

(b) The approval of the Society is to be obtained where steel castings from which defects were removed are to be used with or without weld repair.

(c) Defects and unacceptable indications must be repaired as indicated below:
Defective parts of material may be removed by grinding, or by chipping and grinding, or by arc air-gouging and grinding. Thermal methods of metal removal are to only be allowed before the final heat treatment. All grooves shall have a bottom radius of approximately 3 times the groove depth and should be smoothly blended to the surface area with a finish equal to that of the adjacent surface.

(d) For NDT of steel castings after repair, see 6.6.4.

(e) Where the defective area is to be repaired by welding, the excavations are to be suitably shaped to allow good access for welding. The resulting grooves are to be subsequently ground smooth and complete elimination of the defective material is to be verified by Magnetic particle Testing(MT) or Penetrant Test(PT).

(f) Shallow grooves or depressions resulting from the removal of defects may be accepted provided that they will cause no appreciable reduction in the strength of the casting or affect the intended use, and the depth of defect removal is not over 15mm or 10% of wall thickness, whichever is less. The resulting grooves or depressions are to be subsequently ground smooth and complete elimination of the defective material is to be verified by Magnetic particle Testing(MT) or Penetrant Test(PT). Small surface irregularities sealed by welding are to be treated as weld repairs, see 6.7.5.

6.7.2 After removing the defects, adequate non-destructive examinations are to be carried out to ensure that all defects have been removed completely.

~~6.7.3 Defective castings may, with the Surveyor's approval, be repaired by welding using an approved procedure.~~

6.7.3~~4~~ Where steel castings from which defects were removed are used in that condition or after repaired by welding, the employment of repaired castings is to be approved by the Surveyor.

~~6.7.5 All steel castings are to be suitably preheated prior to welding depending on their chemical composition and the dimensions and positions of the weld repairs.~~

~~6.7.6 Welding materials used are to be of an approved type giving a weld deposit with mechanical properties similar and in no way inferior to those of the parent castings. Welding is to be done by qualified welders with adequate supervision.~~

~~6.7.7 After repair welding is completed, the castings are to be given the grain refining heat treatment, or a stress relieving heat treatment at a temperature of not less than 550°C The type of heat treatment required will be dependent on the chemical composition of the casting and the dimensions, positions and nature of the defects. Special consideration may be given to a local stress relieving heat treatment where the repaired area is small and machining of the casting has reached on advanced stage.~~

~~6.7.8 On completion of heat treatment, the weld repairs and adjacent metal are to be ground smooth and examined by magnetic particle, or liquid penetrant testing. Ultrasonic or radiographic examination may also be required.~~

6.7.4~~9~~ For hull castings, the procedure of removal of defects and weld repairs is to be in accordance with IACS Recommendation No. 69.

6.7.5 Weld Repairs

In addition to the requirements given in 6.7.1, the following requirements apply for weld repairs:

(a) For C and C-Mn steel castings weld repairs shall be suitably classified as major or minor. For alloy steel castings, repair requires approval from the Society.

(i) Major repairs are those where:

- the depth is greater than 25% of the wall thickness or 25mm whichever is less, or
- the total weld area on a casting exceeds 0.125m^2 of the casting surface noting that where a distance between 2 welds is less than their average width, they are to be considered as 1 weld.

(ii) Minor weld repairs: Weld repairs not classified as major are considered as minor and need to be carried out in accordance with a qualified welding procedure.

(b) The following is required for major repairs:

(i) Shall be carried out before the final delivery heat treatment condition

(ii) Shall comply with the requirements in 6.7.5(d)

(iii) Before welding is started, full details of the extent and location of the repair, the proposed welding procedure, heat treatment and subsequent inspection procedures are to be submitted for approval.

(c) The following is required for minor repairs:

(i) Shall be carried out before the final delivery heat treatment condition

(ii) Shall comply with the requirements in 6.7.5(d) below (also with respect to records, see 6.7.5(d)(vii) and (viii)).

(iii) With the exception of alloy steels, do not require prior approval by the Society, except as given in 6.7.5(d).

(iv) The Society may request minor repairs in critical areas to be treated as major repairs.

(d) The following requirements apply for all weld repairs (major and minor):

(i) All castings in alloy steels and all castings for crankshafts are to be suitably pre-heated prior to welding. Castings in carbon or carbon-manganese steel may also require to be pre-heated depending on their chemical composition and the dimensions and position of the weld repairs.

(ii) Welding procedures are to be qualified and shall match the delivery condition of the casting. Qualification of welding procedures shall follow Chapter 2 of Part XII of the Rules, or subject to agreement with the Society, a recognised standard (e.g. ISO 11970:2016).

(iii) Welding is to be done under cover in positions free from draughts and adverse weather conditions by qualified welders with adequate supervision. As far as possible, all welding is to be carried out in the downhand (flat) position.

(iv) The welding consumables used are to be of an appropriate composition, giving a weld deposit with mechanical properties similar and in no way inferior to those of the parent castings. Welding procedure tests are to be carried out by the manufacturer to demonstrate that satisfactory mechanical properties can be obtained after heat treatment as detailed in 6.4.1.

(v) After welding has been completed the castings are to be given either a suitable heat treatment in accordance with the requirements of 6.4.1 or a stress relieving heat treatment at a temperature of not less than 550°C for C and C-Mn steel castings. For alloy steel castings, the heat treatment has to be agreed with the Society. The type of heat treatment employed will be dependent on the chemical composition of the casting and the dimensions, positions and nature of the repairs, and should not affect the properties of the casting.

(vi) Subject to the prior agreement of the Society, special consideration may be given to the omission of post weld heat treatment or to the acceptance of local stress-relieving heat treatment where the repaired area is small and machining of the casting has reached an advanced stage.

(vii) On completion of heat treatment the weld repairs and adjacent material are to be ground smooth and examined by magnetic particle or liquid penetrant testing. Supplementary examination by ultrasonics or radiography ultrasonic or radiographic testing may also be required depending on the dimensions and nature of the original defect. Satisfactory results are to be obtained from all forms of non-destructive testing used.

(viii) The manufacturer is to maintain full records detailing the extent and location of repairs made to each casting and details of weld procedures and heat treatments applied for repairs. These records are to be available to the Surveyor and copies provided on request.

(ix) Recommendation for welding: For steels with $C \geq 0.23\%$ or $C_{eq} \geq 0.45\%$, the welding procedure qualification tests (WPQT) on which the welding procedure standard (WPS) is based, should be qualified on a base material having a C_{eq} as follows: the C_{eq} of the base material should not fall below more than 0.02% of the material to be welded.
(Example: WPQT for a material with actual $C_{eq} = 0.50\%$ may be qualified on a material with $C_{eq} \geq 0.48\%$.)

6.8 Special Requirements for Crank Throws

6.8.1 In case where it is proposed to use carbon steel castings for semi-built-up crank throws of internal combustion engine, the method of producing combined web and pin castings together with the selection of test specimens are to be approved by the Society.

6.8.2 Except where otherwise specially approved, the mechanical properties of the carbon steel castings intended to be used for crank throws are to comply with the requirements given in Table XI 6-3. The chemical composition limits for the carbon steel castings intended to be used for crank throws may refer to Table XI 6-1A.

Chapter 8
Steel Forgings

Paragraph 8.1.4 has been added as follows:

8.1 Scope

8.1.4 The material grades of steel forgings specified in this Chapter are designated as follows:

(a) "FH-xxx" and "FM-xxx" are for carbon steel forgings, H for ship's hull use, M for ship's machinery use, where xxx is a figure to represent the specified minimum tensile strength in N/mm^2 of the design purpose.

(b) "AFH-xxx" and "AFM-xxx" are for alloy steel forgings, H for ship's hull use, M for ship's machinery use, where xxx is a figure to represent the specified minimum tensile strength in N/mm^2 of the design purpose.

Paragraph 8.2.7 has been amended as follows:

8.2 Manufacture

8.2.7 When two or more forgings are joined by welding to form a composite component, the proposed welding procedure specification is to be submitted for approval. Welding procedure qualification tests may be required. Chapter 2 of Part XII of the Rules are to be referred. Welders intended to be engaged in fusion welding of steel forgings are to be qualified in accordance with Chapter 3 of Part XII of the Rules.

Table XI 8-1 has been amended as follows:

Table XI 8-1
Chemical Composition Limits for Hull Steel Forgings(1)(6)

Steel type	C	Si	Mn	P	S	Cr(4)	Mo(4)	Ni(4)	Cu(4)	Total residuals
C, C-Mn	0.23(2)(3)	0.45	0.30 - 1.50	0.035	0.035	0.30~~(4)~~	0.15~~(4)~~	0.40~~(4)~~	0.30	0.85
Alloy	(5)	0.45	(5)	0.035	0.035	(5)	(5)	(5)	0.30	-

Notes:

(1) Composition in percentage mass by mass maximum unless shown as a range.

(2) The carbon content may be increased above this level provided that the carbon equivalent (C_{eq}) is not more than 0.41%, calculated using the following formula:

$$C_{eq} = C + \frac{Mn}{6} + \frac{Cr + Mo + V}{5} + \frac{Ni + Cu}{15} \quad (\%)$$

(3) The carbon content of C and C-Mn steel forgings not intended for welded construction may be 0.65 maximum.

(4) Elements are considered as residual elements.

(5) Specification is to be submitted for approval.

(6) Rudder stocks and pintles should be of weldable quality.

Table XI 8-2 has been amended as follows:

Table XI 8-2
Chemical Composition Limits for Machinery Steel Forgings(1)

Steel type	C	Si	Mn	P	S	Cr(4)	Mo(4)	Ni(4)	Cu(3)(4)	Total residuals
C, C-Mn	~~0.65(2)~~ 0.23(2)(3)	0.45	0.30 - 1.50	0.035	0.035	0.30(3)	0.15(3)	0.40(3)	0.30	0.85
Alloy(4)	0.45	0.45	0.30 - 1.00	0.035	0.035	Min. 0.40(6~~5~~)	Min. 0.15(6~~5~~)	Min. 0.40(6~~5~~)	0.30	-

Notes:

(1) Composition in percentage mass by mass maximum unless shown as a range or as a minimum.

(2) ~~The carbon content of C and C-Mn steel forgings intended for welded construction is to be 0.23 maximum.~~ The carbon content may be increased above this level provided that the carbon equivalent (C_{eq}) is not more than 0.41%.

(3) The carbon content of C and C-Mn steel forgings not intended for welded construction may be 0.65 maximum.

(4~~3~~) Elements are considered as residual elements unless shown as a minimum.

(5~~4~~) Where alloy steel forgings are intended for welded constructions, the proposed chemical composition is subject to approval by the Society.

(6~~5~~) One or more of the elements is to comply with the minimum content.

Paragraphs 8.4.2 & 8.4.3 have been amended as follows:

8.4 Heat Treatment, Including Surface Hardening and Straightening

8.4.1 General

At an appropriate stage of manufacture, after completion of all hot working operations, forgings are to be suitably heat treated to refine the grain structure and to obtain the required mechanical properties.

8.4.2 Supply conditions

Except as provided in 8.4.6(b) and 8.4.6(c) forgings are to be supplied in one of the following conditions. For all types of steel the tempering temperature is to be not less than 550°C. ~~Where forgings for gearing are not intended for surface hardening, lower tempering temperature may be allowed.~~

(a) Carbon and carbon-manganese steels
- Fully annealed
- Normalized
- Normalized and tempered
- Quenched and tempered

(b) Alloy steels
- Normalized
- Normalized and tempered
- Quenched and tempered

8.4.3 The delivery condition is to meet the design and application requirements, it is the manufacturers responsibility to select the appropriate heat treatment method to obtain the required mechanical properties. Where forgings for gearing are not intended for surface hardening, lower tempering temperature may be allowed. ~~Alternatively, alloy steel forgings may be supplied in the normalized and tempered condition, in which case the specified mechanical properties are to be agreed with the Society.~~

Paragraphs 8.5.1 and 8.5.4 have been amended and renumbered as follows:

8.5 Mechanical Tests

8.5.1 Test material, sufficient for the required tests and for possible retest purposes, is to be provided with a cross-sectional area of not less than that part of the forging which it represents. This test material is to be integral with each forging except as provided in 8.5.~~7~~8 and 8.5.~~10~~11. Where batch testing is permitted according to 8.5.~~10~~11, the test material may alternatively be a production part or separately forged. Separately forged test material is to have a reduction ratio similar to that used for the forgings represented.

……

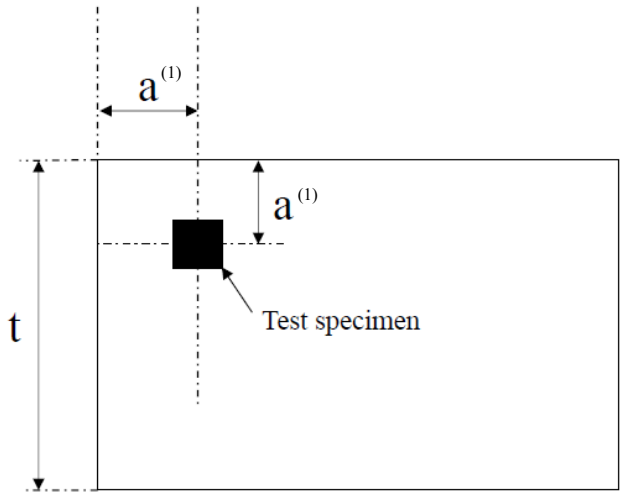
8.5.4 ~~Unless otherwise agreed, the longitudinal axis of~~ The test specimens ~~is~~ are to be positioned as follows:

(a) For forgings having a thickness, t, or diameter D up to maximum 50 mm, the longitudinal axis of the test specimen is to be located at a distance of t/2 or D/2 below the heat treated surfaces. ~~for thickness or diameter up to maximum 50 mm, the axis is to be at the mid-thickness or the center of the cross section.~~

(b) For forgings having a thickness, t, or diameter D greater than 50 mm, the longitudinal axis of the test specimen is to be located at a distance of t/4 or D/4 (mid-radius) or 80 mm, whichever is less, below any heat treated surface. Test specimen is to be located with its longitudinal axis at a distance from any heat treated surface as shown in Fig. XI 8-1. ~~for thickness or diameter greater than 50 mm, the axis is to be at one quarter thickness (mid-radius) or 80 mm, whichever is less, below any heat treated surface.~~

(c) For ring and disc forgings (noting that the test specimen locations for these shaped forgings may be different to elongated or free form forgings), tangential sample is to be taken at t/2 for thickness ≤ 25 mm and 12.5 mm below the surface for thickness > 25 mm, in both the vertical and horizontal direction.
Where achievable, for thickness > 25 mm, no part of the test material is to be closer than 12.5 mm to any heat treated surface, as shown in Fig. XI 8-1.

Fig. XI 8-1 has been added as follows:



Note:
(1) "a" is the distance from the test specimen to heat treated surface based on the above 8.5.4(b) or (c).

Fig. XI 8-1
Position of the Test Specimen

Paragraphs 8.5.5 ~ 8.5.12 have been amended and renumbered as follows:

8.5.5 Where the manufacturer can demonstrate that a proposed testing location or orientation is more representative of the required mechanical properties of a component, this may be agreed with the Society. In such cases, the heat treatment process, a proposed testing location or orientation, and technical justification is to be submitted to the Society for approval.

8.5.6~~5~~ Except as provided in 8.5.~~10~~11 the number and direction of test specimens ~~tests~~ is to be as follows.

(a) Hull components such as rudder stocks, pintles etc. and general machinery components such as shafting, connecting rods, etc.

~~One~~1 set of test specimens ~~tests~~ is to be taken from the end of each forging in a longitudinal direction except that, at the discretion of the manufacture, the alternative directions or positions as shown in Fig. XI 8-2~~1~~, Fig. XI 8-3~~2~~ and Fig. XI 8-4~~3~~ may be used. Where a forging exceeds both 4 tonnes in mass and 3 m in length, one set of test specimens ~~tests~~ is to be taken from each end. These limits refer to the 'as forged' mass and length but excluding the test specimen ~~test~~ material.

(b) Pinions

Where the finished machined diameter of the toothed portion exceeds 200 mm ~~one~~1 set of test specimens ~~tests~~ is to be taken from each forging in a tangential direction adjacent to the toothed portion (test specimen ~~test~~ position B in Fig. XI 8-5~~4~~). Where the dimensions preclude the preparation of test specimens ~~tests~~ from this position, test specimens ~~tests~~ in a tangential direction are to be taken from the end of the journal (test specimen ~~test~~ position C in Fig. XI 8-5~~4~~). If however, the journal diameter is 200 mm or less the test specimens ~~tests~~ are to be taken in a longitudinal direction (test specimen ~~test~~ position A in Fig. XI 8-5~~4~~). Where the finished length of the toothed portion exceed 1.25 m, ~~one~~1 set of test specimens ~~tests~~ is to be taken from each end.

(c) Small pinions

Where the finished diameter of the toothed portion is 200 mm or less ~~one~~1 set of test specimens ~~tests~~ is to be taken in a longitudinal direction (test specimen ~~test~~ position A in Fig. XI 8-5~~4~~).

(d) Gear wheels

~~One~~1 set of test specimens ~~tests~~ is to be taken from each forging in a tangential direction (test specimen ~~test~~ position A or B in Fig. XI 8-6~~5~~).

(e) Gear wheel rims (made by expanding)

~~One~~1 set of test specimens ~~tests~~ is to be taken from each forging in a tangential direction (test specimen ~~test~~ position A or B in Fig. XI 8-7~~6~~). Where the finished diameter exceeds 2.5 m or the mass (as heat treated ~~excluding~~including test specimen ~~test~~ material) exceeds 3 tonnes, ~~two~~2 sets of test specimens ~~tests~~ are to be taken from diametrically opposite positions (test specimen ~~test~~ positions A and B in Fig. XI 8-7~~6~~). The mechanical properties for longitudinal test specimen ~~test~~ are to be applied.

(f) Pinion sleeves

~~One~~1 set of test specimens ~~tests~~ is to be taken from each forging in a tangential direction (test specimen ~~test~~ position A or B in Fig. XI 8-8~~7~~). Where the finished length exceeds 1.25 m ~~one~~1 set of test specimens ~~tests~~ is to be taken from each end.

(g) Crankwebs

~~One~~1 set of test specimens ~~tests~~ is to be taken from each forging in a tangential direction.

(h) Solid open die forged crankshafts

~~One~~1 set of test specimens ~~tests~~ is to be taken in a longitudinal direction from the driving shaft end of each forging (test specimen ~~test~~ position A in Fig. XI 8-9~~8~~).

Where the mass (as heat treated but excluding test specimen ~~test~~ material) exceeds 3 tonnes, test specimens ~~tests~~ in a longitudinal direction are to be taken from each end (test specimen ~~test~~ positions A and B in Fig. XI 8-9~~8~~). Where, however, the crankthrows are formed by machining or flame cutting, the second set of test specimens ~~tests~~ is to be taken in a tangential direction from material removed from the crankthrow at the end opposite the driving shaft end (test specimen ~~test~~ position C in Fig. XI 8-9~~8~~).

(i) Forged rings (such as slewing rings)

1 set of test specimens is to be taken from each forging in a tangential direction (test specimen positions are shown in Fig. XI 8-10). Where the finished diameter exceeds 2.5 m or the mass (as heat treated, including test specimen material) exceeds 3 tonnes then 2 sets of test specimens are to be taken diametrically opposite positions.

8.5.~~6~~7 For closed die crankshaft forgings and crankshaft forgings where the method of manufacture has been specially approved in accordance with 8.2.5, the number and position of test specimens is to be agreed with the Society having regard to the method of manufacture employed.

8.5.~~7~~8 When a forging is subsequently divided into a number of components, all of which are heat treated together in the same furnace charge, for test purposes this may be regarded as one forging and the number of test specimens ~~tests~~ required is to be related to the total length and mass of the original multiple forging.

8.5.~~8~~9 Except for components which are to be carburized or for hollow forgings where the ends are to be subsequently closed, test specimen ~~test~~ material is not to be cut from a forging until all heat treatment has been completed.

8.5.~~9~~10 Forgings to be carburized

(a) When forgings are to be carburized, sufficient test specimen ~~test~~ material is to be provided for both preliminary test specimens ~~tests~~ at the forge and for final test specimens ~~tests~~ after completion of carburizing. For this purpose duplicate sets of test specimen ~~test~~ material are to be taken from positions as detailed in 8.5.~~5~~6, except that irrespective of the dimensions or mass of the forging, test specimens ~~tests~~ are required from one position only and, in the case of forgings with integral journals, are to be cut in a longitudinal direction.

(b) This test specimen ~~test~~ material is to be machined to a diameter of D/4 or 60 mm, whichever is less, where D is the finished diameter of the toothed portion.

(c) For preliminary test specimens ~~tests~~ at the forge, one set of test specimen ~~test~~ material is to be given a blank carburizing and heat treatment cycle simulating that which subsequently will be applied to the forging.

(d) For final acceptance test specimens ~~tests~~, the second set of test specimen ~~test~~ material is to be blank carburized and heat treated along with the forgings which they represent.

(e) At the discretion of the forgemaster or gear manufacture test samples of larger cross section may be either carburized or blank carburized, but these are to be machined to the required diameter prior to the final quenching and tempering heat treatment.

(f) Alternative procedures for testing of forgings which are to be carburized may be specially agreed with the Society.

8.5.~~10~~11Normalized forgings with mass up to 1,000 kg each and quenched and tempered forgings with mass up to 500 kg each may be batch tested. A batch is to consist of forgings of similar shape and dimensions, made from the same heat of steel, heat treated in the same furnace charge and with a total mass not exceeding 6 tonnes for normalized forgings and 3 tonnes for quenched and tempered forgings, respectively.

8.5.~~11~~12A batch testing procedure may also be used for hot rolled bars. A batch is to consist of either:

(a) material from the same rolled ingot or bloom provided that where this is cut into individual lengths, these are all heat treated in the same furnace charge, or

(b) bars of the same diameter and heat, heat treated in the same furnace charge and with a total mass not exceeding 2.5 tonnes.

8.5.~~12~~13The preparation of test specimens and the procedures used for mechanical testing are to comply with the relevant requirements of Chapter 2 of this Part. Unless otherwise agreed, all tests are to be carried out in the presence of the Surveyor.

Fig. XI 8-1~ 8-8 have been renumbered as follows:

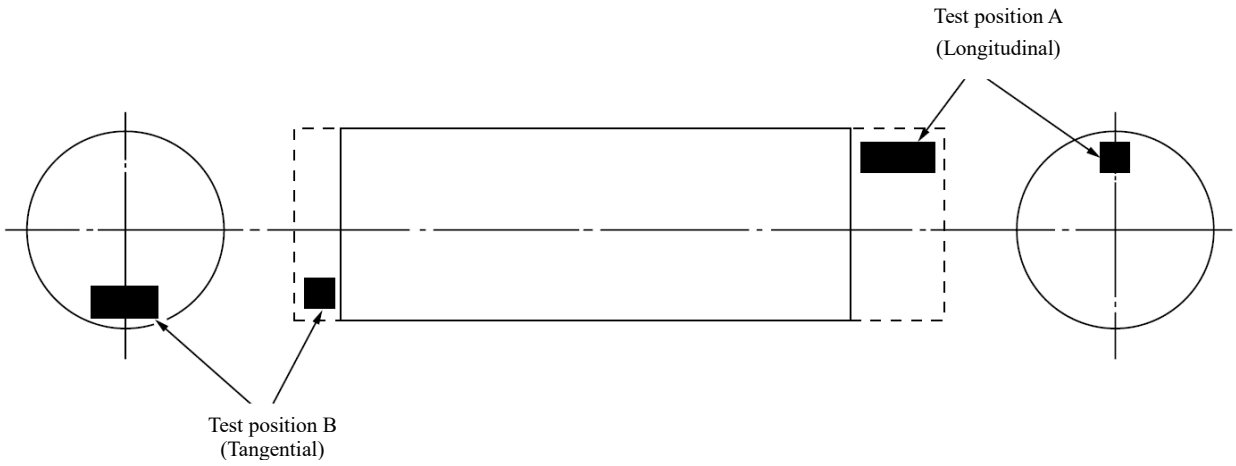


Fig. XI 8-2~~1~~
Plain Shaft

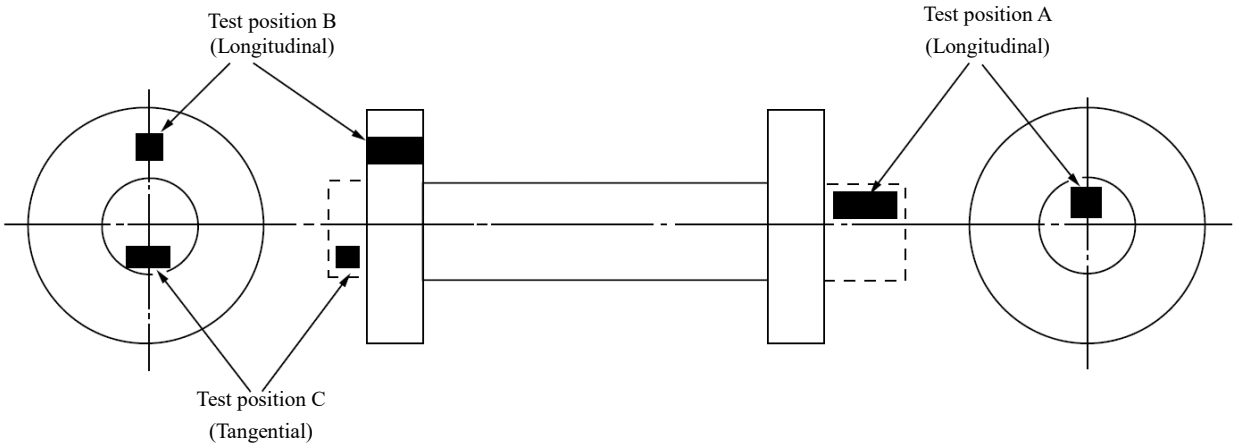


Fig. XI 8-32
Flanged Shaft

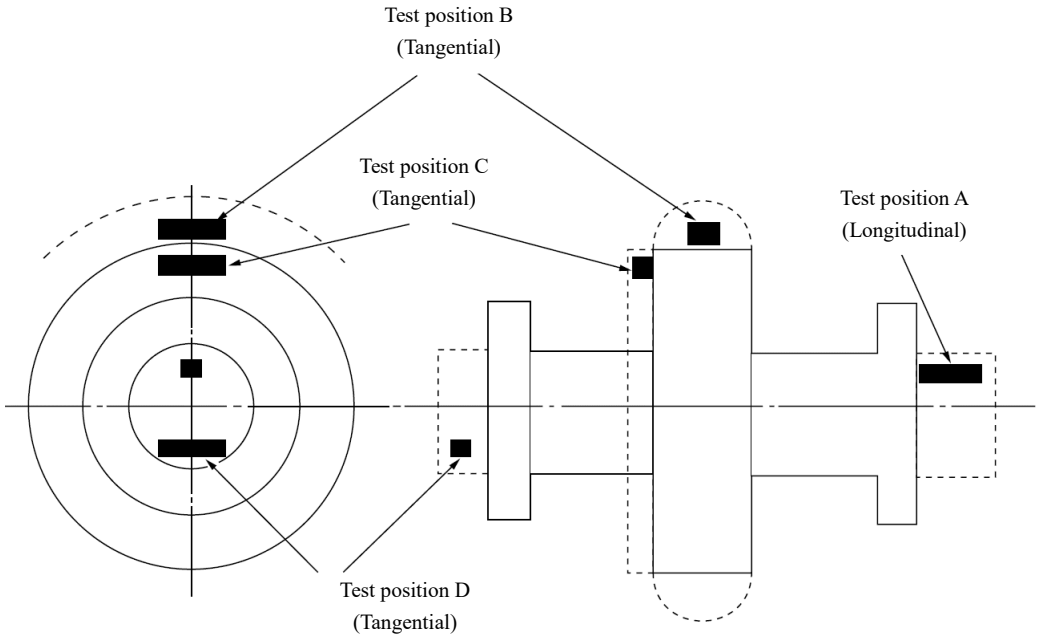
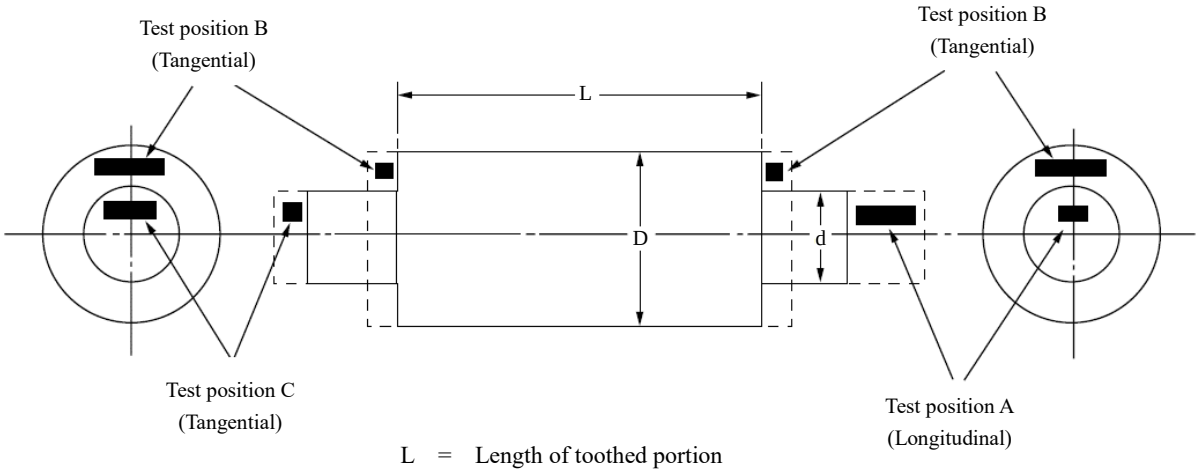


Fig. XI 8-43
Flanged Shaft with Collar



L = Length of toothed portion
D = Diameter of toothed portion
d = Journal diameter

Fig. XI 8-54
Pinion

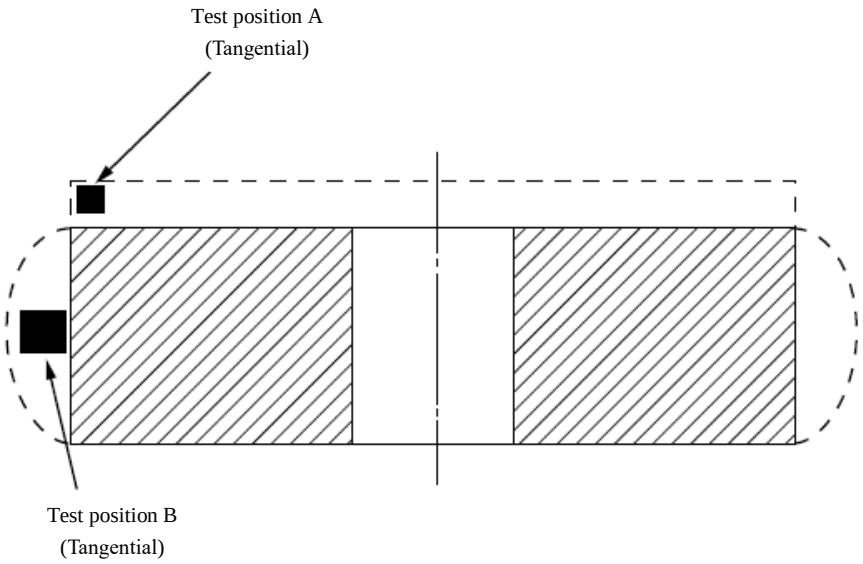


Fig. XI 8-65
Gear Wheel

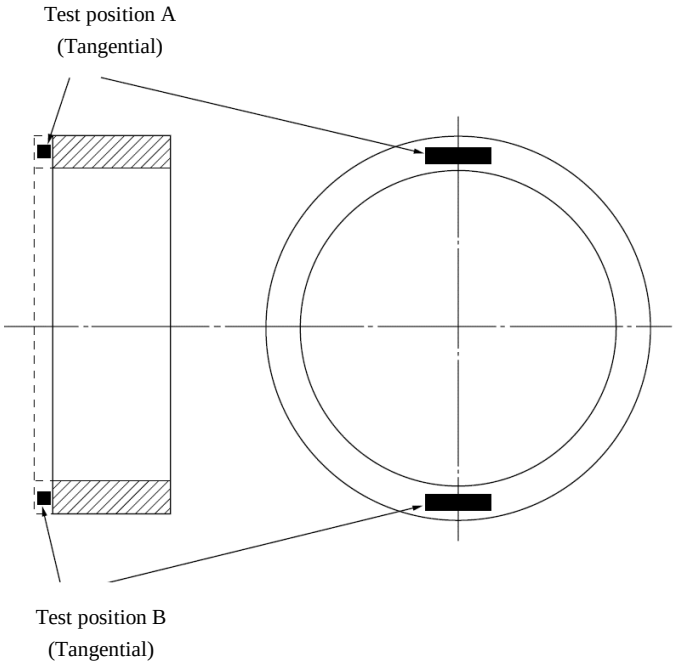


Fig. XI 8-7~~6~~
Gear Rim (Made by Expanding)

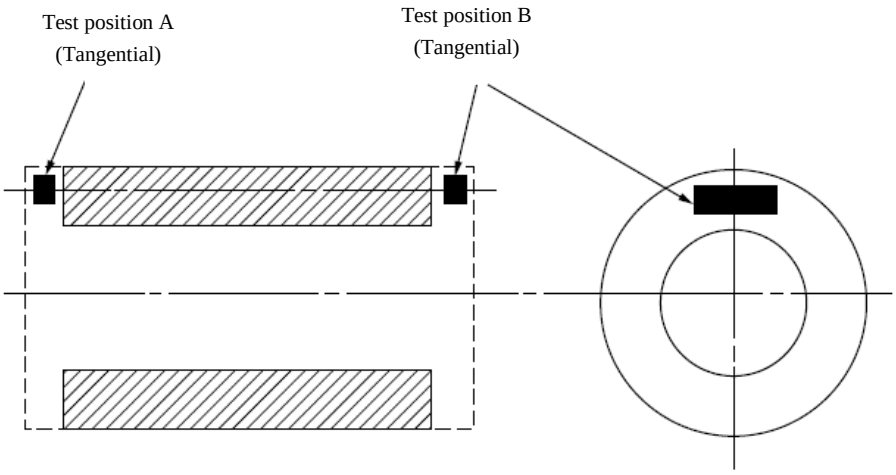


Fig. XI 8-8~~7~~
Pinion Sleeve

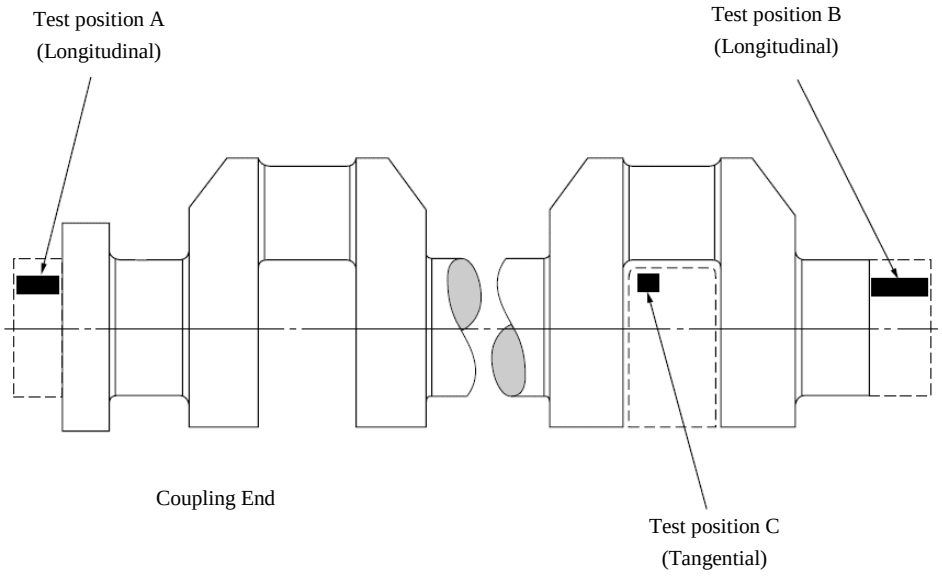


Fig. XI 8-9~~8~~
Solid Forged Crankshaft

Fig. XI 8-10 has been added as follows:

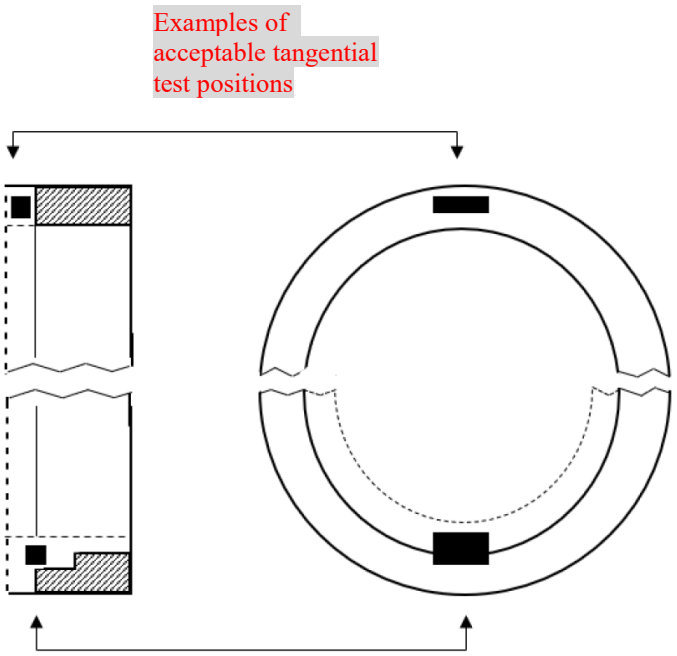


Fig. XI 8-10
Forged Rings

Table XI 8-3 has been amended as follows:

Table XI 8-3
Mechanical Properties for Hull Steel Forgings

~~Properties~~ Steel Type and Grade	Tensile Strength R_m[(1)] min. (N/mm^2)	Yield Stress R_e min. (N/mm^2)	Elongation A_5 min. (%)		Reduction of area Z min. (%)		Charpy V-notch impact test[(2)]		
			Long.	Tran.	Long.	Tran.	Test temperature (°C)	Minimum average energy(J)	
								Long.	Tran.
C and C-Mn (FH)	400	200	26	19	50	35	0	27	18
	440	220	24	18	50	35			
	480	240	22	16	45	30			
	520	260	21	15	45	30			
	560	280	20	14	40	27			
	600	300	18	13	40	27			
Alloy (AFH)	550	350	20	14	50	35			
	600	400	18	13	50	35			
	650	450	17	12	50	35			

Notes:
(1) The following ranges for tensile strength may be additionally specified:
specified minimum tensile strength: < 600 N/mm^2 ≥ 600 N/mm^2
tensile strength range: 120 N/mm^2 150 N/mm^2
(2) Special consideration may be given to alternative requirements for Charpy V-notch test, depending on design and application, and subject to agreement by the Society.

Table XI 8-4 has been amended as follows:

Table XI 8-4
Mechanical Properties for Machinery Steel Forgings~~(2)~~

~~Properties~~ Steel Type and Grade	Tensile Strength R_m[(1)] min. (N/mm^2)	Yield Stress R_e min. (N/mm^2)	Elongation A_5 min. (%)		Reduction of area Z min. (%)		Brinell Hardness[(3)]	Charpy V-notch impact test[(2)(4)]		
								Test temperature (°C)	Minimum average energy(J)	
			Long.	Tran.	Long.	Tran.			Long.	Tran.
C and C-Mn (FM)	400	200	26	19	50	35	110-150	AT[(5)]	27	18
	440	220	24	18	50	35	125-160			
	480	240	22	16	45	30	135-175			
	520	260	21	15	45	30	150-185			
	560	280	20	14	40	27	160-200			
	600	300	18	13	40	27	175-215			
	640	320	17	12	40	27	185-230			
	680	340	16	12	35	24	200-240			
	720	360	15	11	35	24	210-250			
	760	380	14	10	35	24	225-265			
Alloy (AFM)	600	360	18	14	50	35	175-215			
	700	420	16	12	45	30	205-245			
	800	480	14	10	40	27	235-275			
	900	630	13	9	40	27	260-320			
	1000	700	12	8	35	24	290-365			
	1100	770	11	7	35	24	320-385			

Notes:

(1) The following ranges for tensile strength may be additionally specified:

specified minimum tensile strength:	< 900 N/mm	≥ 900 N/mm
tensile strength range:	150 N/mm	200 N/mm

(2) For materials used for machinery exposed to sea water temperature, such as propeller shafts and shaft bolts, intended for ships with Ice Class notation **IAS**, **IA**, **IB** and **IC**, Charpy V-notch impact testing is to be carried out for all steel types at –10°C and the average energy value is to be minimum 20J (longitudinal test). One individual value may be less than the required average value provided that it is not less than 70% of this average value. ~~For propeller shafts intended for ships with Ice Class notation except the lowest one, Charpy V-notch impact testing is to be carried out for all steel types at –10°C and the average energy value is to be minimum 27 J (longitudinal test). One individual value may be less than the required average value provided that it is not less than 70% of this average value.~~

(3) The hardness values are typical and are given for information purposes only.

(4) Special consideration may be given to alternative requirements for Charpy V-notch test, depending on design and application, and subject to agreement by the Society.

(5) AT refers to Ambient Temperature (i.e. 23°C±5°C), which is specified in ISO 148-1:2016.

Section 8.7 has been amended and renumbered as follows:

8.7 Inspection

8.7.1 All forgings should be subjected to a 100% visual examination of all accessible surfaces by the manufacturer and made available to the Surveyor. Where applicable, this visual examination is to include the examination of internal surfaces and bores. ~~Before acceptance, all forgings are to be presented to the Surveyor for visual examination. Where applicable, this is to include the examination of internal surfaces and bores.~~ Unless otherwise agreed, the verification of dimensions is the responsibility of the manufacturer.

8.7.2 ~~Non-destructive testing(a)~~ When required by the relevant construction Rules, or by the approved procedure for welded composite components (refered to Chapter 2 of Part XII of the Rules ~~see 8.2.7~~), appropriate non-destructive testing is also to be carried out before acceptance and the results are to be reported by the manufacturer.

8.7.3 ~~(b)~~ Where required by the Rules or IACS Rec. No. 68, ultrasonic examination is to be carried out after the forgings have been machined to a condition suitable for this type of examination and after the final heat treatment. Both radial and axial scanning are to be carried out where appropriate for the shape and the dimensions of the forgings being examined. ~~The extent of testing and acceptance criteria are to be agreed with the Society. IACS Rec. No. 68 is regarded as an example of an acceptable standard.~~

8.7.4 The method and the extent of inspection, NDT and acceptance criteria are to be agreed with the Society. IACS Rec. No. 68 is regarded as an example of an acceptable standard.
For mass produced forgings the extent of examination is to be established at the discretion of the Society.

8.7.5 Unless otherwise agreed, examinations are to be carried out by the manufacturer, although Surveyors may request to be present in order to verify that the examination is being carried out in accordance with the agreed procedure.

8.7.6 If the forging is supplied in the 'as forged' condition for machining at a separate works, the manufacturer is to ensure that a suitable ultrasonic examination is carried out to verify the internal quality of the forging.

8.7.7 Where advanced ultrasonic testing methods are applied, e.g. Phased Array Ultrasonic Testing (PAUT) or Time-of-Flight Diffraction (TOFD), reference is made to UR W34 Advanced non-destructive testing of materials and welds –Dec. 2019, for general approach in adopting and application of these advanced methods.
In such cases, acceptance levels regarding accept/reject criteria may be as per the applicable section in the IACS Rec. No. 68.

8.7.8 ~~3~~ When required by the conditions of approval for surface hardened forgings (refered to 8.4.6(a) ~~refers~~) additional test samples are to be processed at the same time as the forgings which they represent. These test samples are subsequently to be sectioned in order to determine the hardness, shape and depth of the locally hardened zone and which are to comply with the requirements of the approved specification.

8.7.9 ~~4~~ In the event of any forging proving defective during subsequent machining or testing, it is to be rejected notwithstanding any previous certification.

Paragraph 8.8.2 has been amended as follows:

8.8 Rectification of Defective Forgings

8.8.2 Repair welding of forgings except those subjected to torsional fatigue, such as crankshaft forgings and propulsion shafting system forgings, may be permitted subject to prior approval of the Society. In such cases, full details of the extent and location of the repair, the proposed welding procedure, heat treatment and subsequent inspection procedures are to be submitted for the approval.

Paragraph 8.9.2 has been amended and renumbered as follows:

8.9 Identification of Forgings

8.9.2 Before acceptance, all forgings which have been tested and inspected with satisfactory results are to be clearly marked by the manufacturer. At the discretion of the Society, any of the following particulars may be required:

(a) Steel quality.

(b) Identification number, cast number or other marking which will enable the full history of the forging to be traced.

(c) Manufacturer's name or trade mark.

(d) Test pressure where applicable.

(e) Date of final inspection.

(f~~d~~) The Society's mark Ⓡ.

(g~~e~~) Abbreviated name of the Society's local office.

(h~~f~~) Personal stamp of Surveyor responsible for inspection.

Chapter 9
Stainless Steels and Clad Steels

Section 9.5 has been added as follows:

9.5 High Manganese Austenitic Steel for Cryogenic Service

The guidelines on Approval of High Manganese Austenitic Steel for Cryogenic Service are to be refer to IACS Rec. 169 providing guidance for manufacturing approval and batch release testing of high manganese austenitic steel as plate.

AMENDMENT TO "THE RULES FOR THE CONSTRUCTION AND CLASSIFICATION OF STEEL SHIPS 2023"

PART XV HULL CONSTRUCTION AND EQUIPMENT FOR SHIPS LESS THAN 90 M IN LENGTH

List of major changes in Part XV from 2023 edition

24.1.3(b)	Revised
24.2 & Fig. XV 24-4	Revised and Renumbered
Fig. XV 24-4B	New
24.6.3	Revised
24.6.4	Revised
24.8.3(a)	Revised
Fig. XV 24-7	Revised
Fig. XV 24-7A	New
Fig. XV 24-7B	New
Fig. XV 24-8	Revised
24.8.4(b) & (c)	Revised
Table XV 24-3	Revised
24.10.3	Revised

Rules for the Construction and Classification of Steel Ships 2023 have been partly amended as follows:

Chapter 24
Rudders

Paragraph 24.1.3(b) has been amended as follows:

24.1 General

24.1.3 Welding and design details

……

(b) In way of the rudder horn recess of Type I rudder, the radii in the rudder plating except in way of solid part in cast steel are not to be less than 5 times the plate thickness, but in no case less than 100 mm. Welding in side plate are to be avoided in or at the end of the radii. Edges of side plate and weld adjacent to radii are to be ground smooth.Section 24.2 have been amended as follows:

Paragraph 24.2.2 havs been amended as follows:

24.2.2 Rudder torque (for type II and type III rudders)

The rudder torque is to be calculated for both the ahead and astern condition from the following formula:

$Q = F \times r$ N-m

where:

Q	=	Rudder torque, in N-m.
r	=	b (α– k), in m,
	≥	0.1b for ahead condition, in m.
b	=	Mean breadth of rudder area, in m, see Fig. XV 24-4A.
α	=	0.33 for ahead condition.
	=	0.66 for astern condition.
k	=	Balance factor.
	=	$\frac{A_f}{A}$
A_f	=	Portion of the rudder blade area situated ahead of the center line of the rudder stock, in m^2.
A	=	As specified in 24.2.1~~(a)~~ above.

Paragraph 24.2.3 has been amended as follows:

24.2.3 Rudder torque (for type I rudders)

The total resulting torque may be taken as:

$Q = Q_1 + Q_2$ N-m

where:

Q	=	Total torque, in N-m.
	≥	$0.1F\left(\frac{A_1b_1 + A_2b_2}{A}\right)$ for ahead condition
Q_1	=	$F_1 \times r_1$ in N-m
Q_2	=	$F_2 \times r_2$ in N-m
r_1	=	$b_1(\alpha - k_1)$, lever of A_1, in m.
r_2	=	$b_2(\alpha - k_2)$, lever of A_2, in m.
b_1, b_2	=	Mean breadth of partial areas A_1 and A_2 respectively in accordance with Fig. XV 24-4A.
α	=	0.33 for ahead condition.
	=	0.66 for astern condition.
	=	0.25 for ahead condition with concerned rudder part behind a fixed structure such as rudder horn.
	=	0.55 for astern condition with concerned rudder part behind a fixed structure such as rudder horn.
k_1	=	$\frac{A_{1f}}{A_1}$
k_2	=	$\frac{A_{2f}}{A_2}$

The rudder area may be divided into two rectangular or trapezoidal parts with areas A_1 and A_2, so that $A = A_1+A_2$ (see Fig. XV 24-4B)

Fig. XV 24-4 has been amended and renumbered as follows:

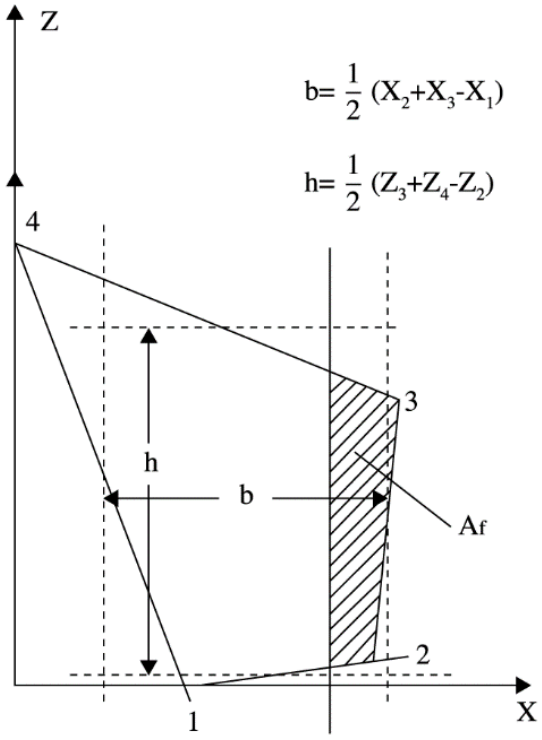
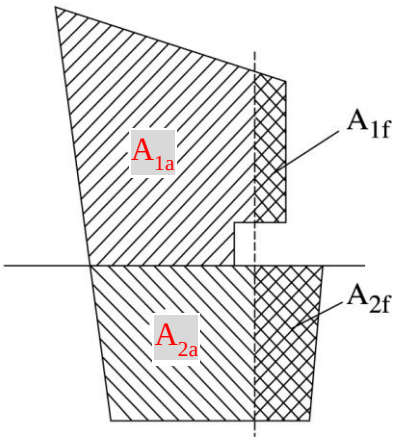


Fig. XV 24-4A
Rudder Blade without Cut-outs

Fig. XV 24-4B has been added as follows:



$A_1=A_{1a}+A_{1f}$

$A_2=A_{2a}+A_{2f}$

Fig. XV 24-4B
Rudder Blade with Cut-outs

Paragraph 24.6.3 has been amended as follows:

24.6 Connections of Rudder Blade Structure with Solid Parts

.....

24.6.3 Minimum section modulus of the connection with the rudder stock housing

The section modulus of the cross-section of the structure of the rudder blade (cm^3) formed by vertical web plates and rudder plating, which is connected with the solid part where the rudder stock is housed is to be not less than:

~~$C_s d^3 \left(\frac{H_E - H_x}{H_E}\right) \frac{K}{K_s} 10^{-4} \quad cm^3$~~

$$C_s d^3 \left(\frac{H_E - H_x}{H_E}\right)^2 \frac{K}{K_s} 10^{-4} \quad cm^3$$

where:

C_s	=	Coefficient, to be taken equal to:
	=	1.0 if there is no opening in the rudder plating or if such openings are closed by a full penetration welded plate
	=	1.5 if there is an opening in the considered cross-section of the rudder
d	=	Rudder stock diameter, in mm.
H_E	=	Vertical distance between the lower edge of the rudder blade and the upper edge of the solid part, in m.
H_x	=	Vertical distance between the considered cross-section and the upper edge of the solid part, in m.
K	=	Material factor for the rudder blade plating as given in 24.1.2(c) of this Chapter.
K_s	=	Material factor for the rudder stock as given in 24.1.2(c) of this Chapter.

The actual section modulus of the cross-section of the structure of the rudder blade is to be calculated with respect to the symmetrical axis of the rudder. The breadth of the rudder plating (m) to be considered for the calculation of section modulus is to be not greater than:

$b = s_v + 2H_x / 3$ m ~~(m)~~

where:

s_v = Spacing between the two vertical webs, in m (see Fig. XV 24-5 of this Chapter).

Where openings for access to the rudder stock nut are not closed by a full penetration welded plate, they are to be deducted.

Fig. XV 24-5 has been amended as follows:

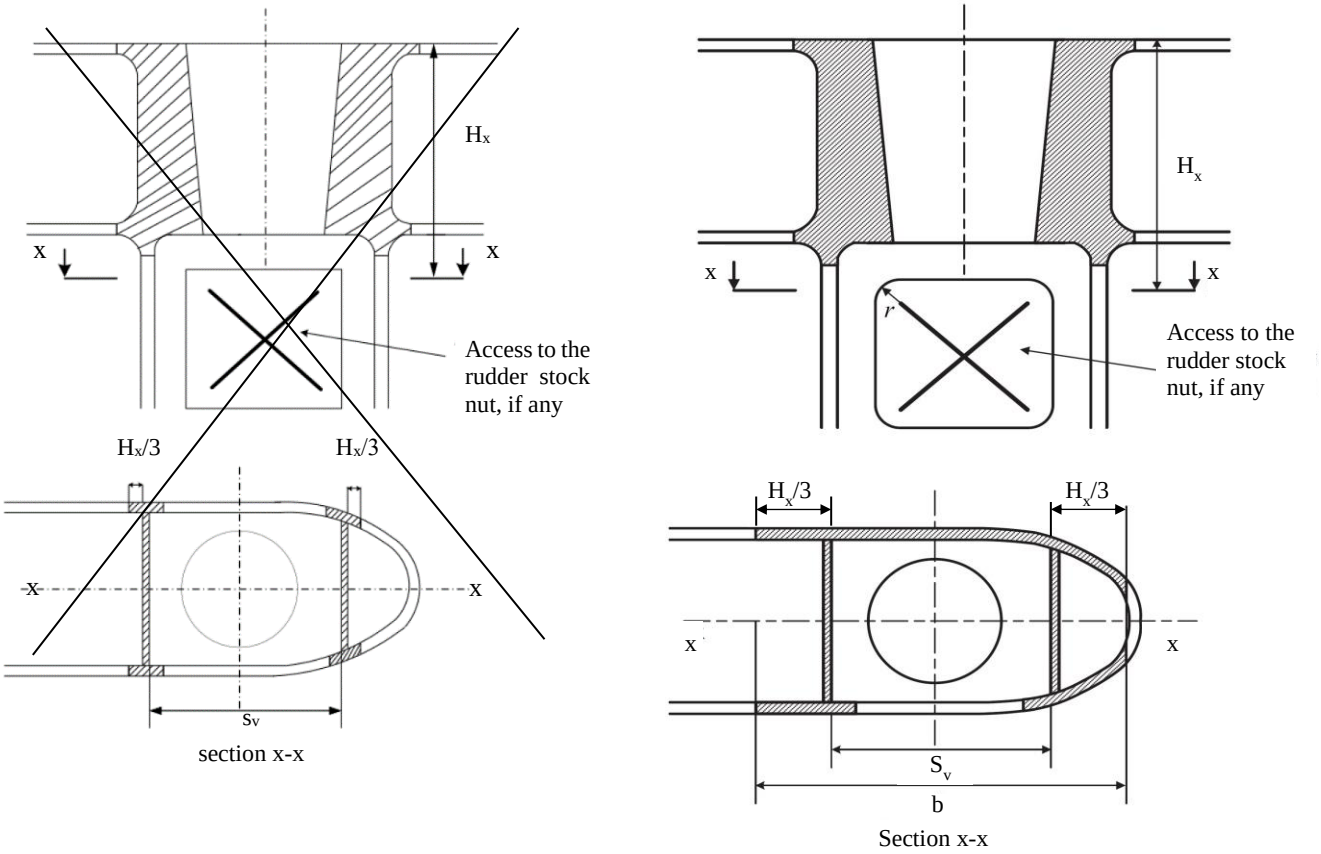


Fig. XV 24-5
Cross-section of the Connection Between Rudder Blade Structure and Rudder Stock Housing

Paragraph 24.8.3(a) has been amended as follows:

24.8 Rudder Stock Couplings

24.8.3 Cone couplings with key

(a) Cone couplings without hydraulic arrangements for mounting and dismounting the coupling should have a taper c on diameter of 1:8 ~ 1:12, where:

~~$c = (d_0 - d_u) / l$ (see Fig. XV 24-7 as below)~~

$c = \frac{d_0 - d_u}{l_c}$ (see Fig. XV 24-7 and Fig. XV 24-7B)

The diameters d_0 and d_u are shown if Fig. XV 24-7 and the cone length l_c is defined in Fig. XV 27-7B.

The cone coupling is to be secured by a slugging nut. The nut is to be secured, e.g. by a securing plate.

(b) The cone shapes are to fit exactly. The coupling length l is to be, in general, not less than $1.5d_0$.

Fig. XV 24-7 has been amended as follows:

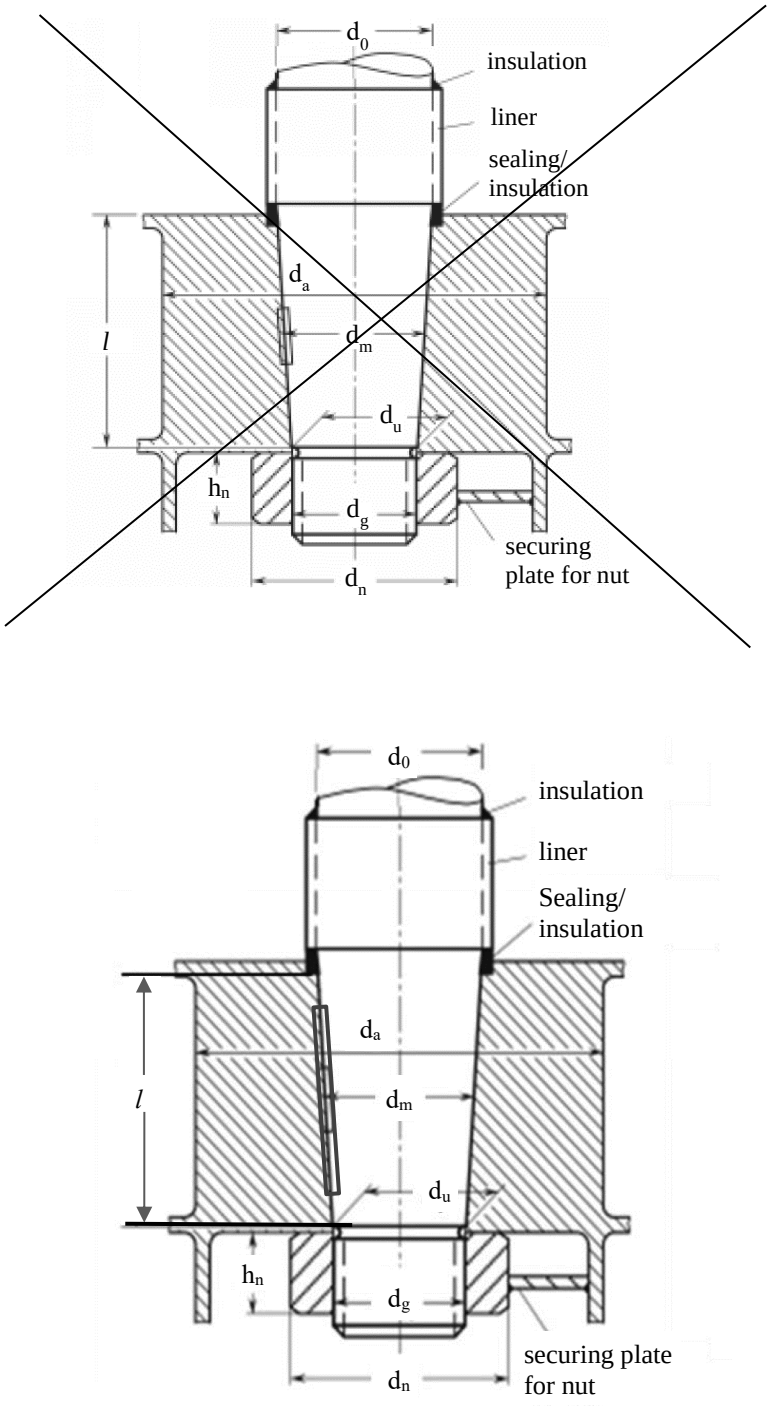


Fig. XV 24-7
Cone Coupling with Key

Fig. XV 24-7A has been added as follows:

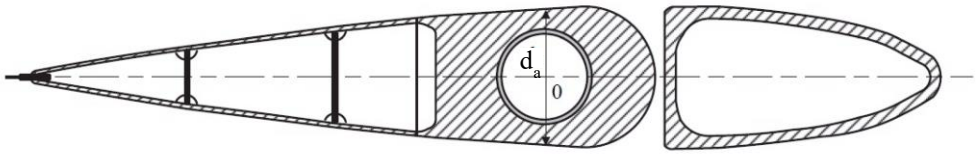


Fig. XV 24-7A
Gudgeon Outer Diameter(d_a) Measurement

Fig. XV 24-7B has been added as follows:

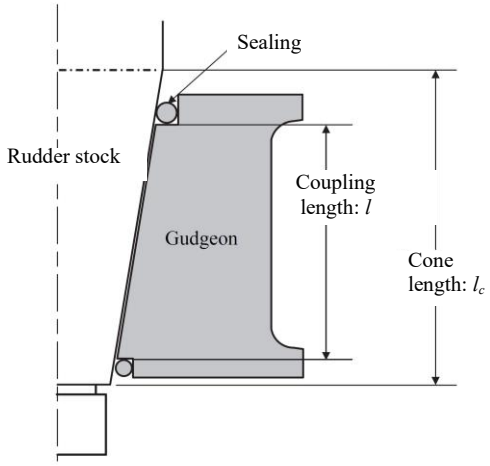


Fig. XV 24-7B
Cone Length and Coupling Length

Fig. XV 24-8 has been amended as follows:

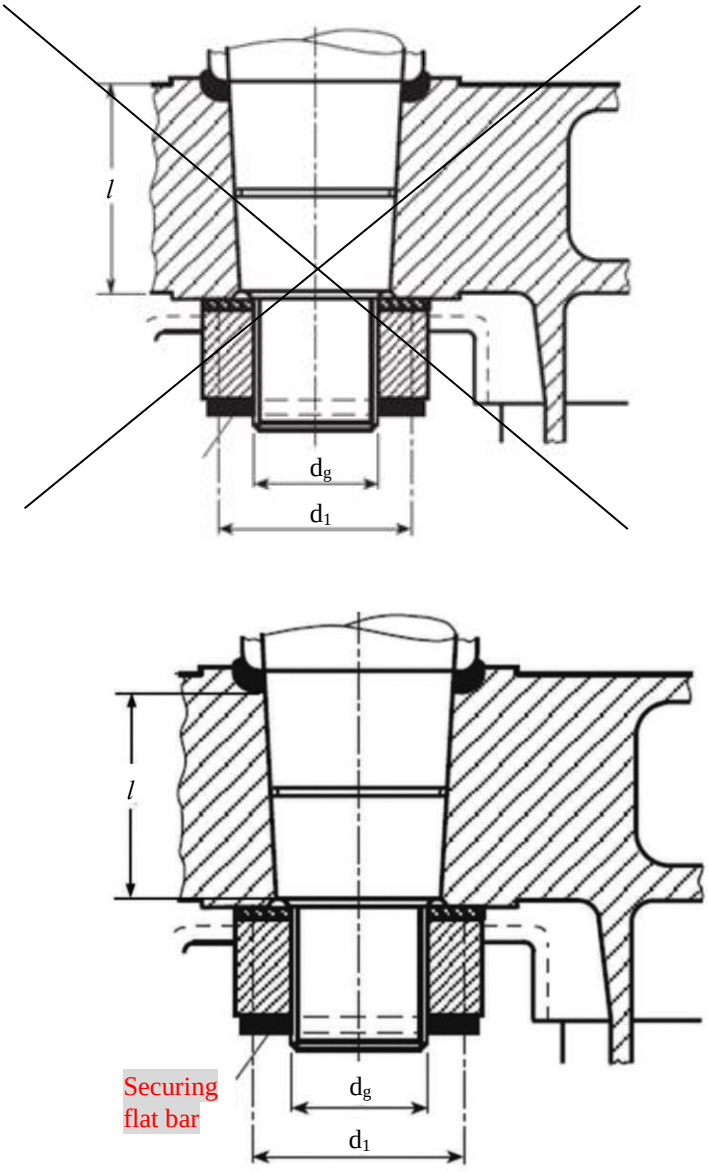


Fig. XV 24-8
Cone Coupling without Key

Paragraphs 24.8.4(b) & (c) have been amended as follows:

24.8.4 Cone couplings with special arrangements for mounting and dismounting the couplings

……

(b) Push-up pressure

The push-up pressure, is not to be less than the greater of the two following values:

$$p_{req1} = \frac{2Q_F}{d_m^2\, l\, \pi\mu_0} 10^3 \qquad N/mm^2$$

$$p_{req2} = \frac{6M_b}{l^2 d_m} 10^3 \qquad N/mm^2$$

where:

Q_F = Design yield moment of rudder stock, as defined in 24.8.3(c) above, in N-m.

d_m = Mean cone diameter in mm, see Fig. XV 24-7 of this Chapter.

l = Cone length in mm.

μ_0 = Frictional coefficient, equal to 0.15.

M_b = Bending moment in the cone coupling (e.g. in case of spade rudders), in N-m.

It has to be proved by the designer that the push-up pressure does not exceed the permissible surface pressure in the cone. The permissible surface pressure, in N/mm², is to be determined by the following formula:

~~$$p_{perm} = \frac{0.8R_{eH}(1 - a^2)}{\sqrt{3 + a^4}} \quad N/mm^2$$~~

$$p_{perm} = \frac{0.95R_{eH}(1 - a^2)}{\sqrt{3 + a^4}} - p_b \qquad N/mm^2$$

where:

P_b = $\frac{3.5M_b}{d_m l^2} 10^3$

R_{eH} = Minimum yield stress of the material of the gudgeon in N/mm².

a = d_m / d_a

d_m = Mean cone diameter in mm, see Fig. XV 24-7 of this Chapter.

d_a = Outer diameter of the gudgeon, in mm ~~to be not less than $1.5d_m$~~, see Fig. XV 24-7 and Fig. XV 24-7A of this Chapter. (The least diameter is to be considered.)

The outer diameter of the gudgeon in mm shall not be less than 1.25 d_0 , with d_0 defined in Fig. XV 24-7.

(c) Push-up length

The push-up length Δl, in mm, Δl is to comply with the following formula:

$\Delta l_1 \leq \Delta l \leq \Delta l_2$

where:

$$\Delta l_1 = \frac{p_{req} d_m}{E\left(\frac{1-a^2}{2}\right)c} + \frac{0.8R_{tm}}{c} \quad \text{mm}$$

~~$\Delta l_2 = \frac{1.6R_{eH} d_m}{Ec\sqrt{3+a^4}} + \frac{0.8R_{tm}}{c}$ mm~~

$$\Delta l_2 = \frac{P_{perm} d_m}{E\left(\frac{1-a^2}{2}\right)c} + \frac{0.8R_{tm}}{c} \quad \text{mm}$$

R_{tm} = Mean roughness, in mm taken equal to 0.01

c = Taper on diameter according to 24.8.4(a) of this Chapter

E = Young's modulus of the material of the gudgeon, in N/mm^2

d_m, ~~R_{eH}~~, a, p_{req}, p_{perm} = As specified in 24.8.4(b) above.

~~Notwithstanding the above, the push-up length is not to be less than 2 mm.~~

Note: In case of hydraulic pressure connections the required push-up force P_e, in N, for the cone may be determined by the following formula:

$$P_e = p_{req} d_m \pi l \left(\frac{c}{2} + 0.02\right)$$

The value 0.02 is a reference for the friction coefficient using oil pressure. It varies and depends on the mechanical treatment and roughness of the details to be fixed.

Where due to the fitting procedure a partial push-up effect caused by the rudder weight is given, this may be taken into account when fixing the required push-up length, subject to approval by the Society.

Table XV 24-3 has been amended as follows:

Table XV 24-3
Allowable Surface Pressure, q_a

Bearing material	q_a (N/mm^2)
Lignum-vitae	2.5
White metal, oil lubricated	4.5
Synthetic material with hardness ~~between 60 and 70~~ greater than 60 Shore D(1)	5.5(2)
Steel(3) and bronze and hot-pressed bronze-graphite materials	7.0

Notes:

(1) Indentation hardness test at 23°C and 50% moisture, according to a recognized standard. Synthetic bearing materials are to be of an approved type.

(2) Surface pressures exceeding 5.5 N/mm^2 may be accepted in accordance with bearing manufacturer's specification and tests, but in no case more than 10 N/mm^2.

(3) Stainless and wear-resistant steel in an approved combination with stock liner. Higher values than given in the Table may be taken if they are verified by tests.

Paragraph 24.10.3 has been amended as follows:

24.10.3 Bearing dimension

~~The bearing length is to be such that~~ The length/diameter ratio of the bearing surface is ~~neither less than 1.0 nor~~ not to be greater than 1.2.

The bearing length L_p of the pintle, in mm, is to be such that:

$$D_p \leq L_P \leq 1.2D_p$$

where:

D_p = Actual pintle diameter, in mm, measured on the outside of liners.

Tel: *+886 2 25062711*
Fax: *+886 2 25074722*
E-mail: *cr.tp@crclass.org*
Website: *http://www.crclass.org*