財團法人驗船中心
CR CLASSIFICATION SOCIETY

RULES FOR THE CONSTRUCTION AND CLASSIFICATION OF STEEL SHIPS 2019

AMENDMENT No.2

技術委員會審查稿

November 2021

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The following Parts have been amended and the effective dates are:	
Part	**Effective date**
I	1 July, 2022
II	1 July, 2022
III	1 July, 2022
IV	1 July, 2022
V	1 July, 2022
VI	1 July, 2022
VII	1 July, 2022
VIII	1 July, 2022
IX	1 July, 2022
XI	1 July, 2022
XV	1 July, 2022

The Rules for the Construction and Classification of Steel Ships 2019 and amendments thereof are to be consolidated and published as *July 2022 Edition*.

AMENDMENT TO "THE RULES FOR THE CONSTRUCTION AND CLASSIFICATION OF STEEL SHIPS 2019 AND AMENDMENTS THEREOF "

PART I CLASSIFICATION AND SURVEY

List of major changes in Part I from 2019 edition

1.6.4(d)(iii)	Revised	2.7.2(e)	Revised
1.6.4(h)(i)(5)	New	2.7.2(k) & (n)	Revised
1.6.7(a)(ii)	Revised	2.7.2 (r)(vi) & (vii)	Revised
1.15.1(d)	Revised	2.8.3	Deleted
Table I 1-2	Revised	2.10.3(a)(viii)	Revised
Table I 1-3	New	2.14.3(a)(ii)	Revised
Table I 1-5	Revised and New	2.14.3(d)(ii)	Revised
Table I 1-6	New	2.14.3(e)(i)	Revised
2.1.4(a)(ix)	Revised	2.16.2(a)(ii)	Revised
2.1.6(a)(iv)	Revised	2.17.2(a)(i)	Revised
2.1.6(e)(ii)(2)	Revised	2.17.3(b)	Deleted
2.1.6(f)(vi)	New	2.19	New
2.1.6(g)	Revised	Table I 2-5A	Revised
2.2.1(h)	New	Table I 2-18	Revised
2.2.1 (i)	New	Table I 2-27~2-31	Deleted
2.2.2	Revised	Table I 2-27~2-29	New
2.2.2(b)(iii) & (iv)	New	Appendix 3	Revised
2.2.2(c)	Revised	Appendix 4	New
2.2.2(d) & (e)	Deleted	Table I A4-1~A4-5	New
2.2.3	New		
2.3.5(a)	Revised		
2.3.5(e)	Revised		
2.5.1(o)	New		
2.5.1(p)	New		
2.6.4(h)	New		
2.7.1(m)	Revised		
2.7.1(p)	New		

Rules for the Construction and Classification of Steel Ships 2019 and amendments thereof have been partly amended as follows:

Chapter 1 Classification of Steel Ship

Paragraph 1.6.4(d)(iii) has been amended as follows:

1.6 Surveys of Steel Ships

1.6.4 Special Survey

(d) Extension of Special Surveys

(i) If a ship at the time when the Special Survey is due but not in a port in which it is to be surveyed, the Society may upon the Owner's written request in advance in each case extend a period not exceeding 3 months. Such extension is, however, only to be granted for allowing the ship to complete its voyage to the port in which it is to be surveyed, and only in cases where it is considered proper and reasonable to do so.

(ii) If a Special Survey is completed after the due date, the due date of the next Special Survey is based upon a date not exceeding 5 years from the due date of the existing Special Survey.

(iii) A maximum 3 months extension of Special Survey beyond the due date may be granted provided an occasional survey has been carried out satisfactorily based on a scope of Annual Survey and the additional items considered by ~~the Head Office of~~ the Society.

(e) If a Special Survey has been completed and a new final certificate can't be issued or placed on board the ship before the expiry date of the existing certificate, the attending Surveyor authorized by the Society may endorse the existing certificate and such a certificate is to be accepted as valid for a further period which is not to exceed 6 months from the expiry date.

Paragraph 1.6.4(h)(i)(5) has been added as follows:

(h) Condition Monitoring and Condition Based Maintenance Schemes

(i) Application

(1) These requirements apply to the approved Condition Monitoring and Condition Based Maintenance schemes where the condition monitoring results are used to influence the scope and/or frequency of Class survey.

(2) This scheme may be applied to components and systems covered by Machinery Continuous Survey (**MCS**), and other components and systems as requested by the owner. The extent of Condition Based Maintenance and associated monitoring equipment to be included in the maintenance scheme is decided by the Owner.

(3) These requirements can be applied only to ships operating on approved PMS survey scheme.

(4) The scheme may be applied to any individual items and systems. Any items not covered by the scheme shall be surveyed and credited in accordance with the requirements of 2.7.2 and/or 1.6.4(g) of this Part.

(5) When the **CM** or **CBM** is approved, the notation **CM** or **CBM** will be assigned to the ship.

Paragraph 1.6.7(a)(ii) has been amended as follows:

1.6.7 Bottom Survey

(a) Survey intervals

(i) There is to be a minimum of 2 examinations of the outside of the ship's bottom and related items during each 5-year Special Survey period. One such examination is to be carried out in conjunction with the Special Survey. In all cases the interval between any 2 such examinations is not to exceed 36 months.

For ships operating solely in fresh water, the maximum interval is not to exceed 5 years.

(ii) An extension of examination of the ship's bottom up to 3 months beyond the due date may be granted in exceptional circumstances(1) provided an occasional survey has been carried out satisfactorily with the survey items 2.2.3(a) or 2.2.3(b) of this chapter required by the Head Office of the Society.

Note: (1) "Exceptional circumstances" means, e.g., unavailability of repair facilities, unavailability of essential materials, equipment or spare parts, or delays incurred by action taken to avoid severe weather conditions.

Paragraph 1.15.1(d) has been amended as follows:

1.15 Sea Trials

1.15.1 In the classification survey of all ships, sea trials specified in following (a) to (j) are to be carried out in full load condition, in the calmest possible sea and weather condition and at the deep unrestricted water. However, where sea trials cannot be carried out in full load condition, sea trials may be carried out in an appropriate loaded condition. The noise measurements specified in (k) are to be carried out at either the full load condition or the ballast condition.

(a) Speed test.

(b) Astern test.

(c) Steering test and the change-over test from the main to auxiliary steering gear.

(d) Turning test.

The turning test of an individual ship may be dispensed with, provided that sufficient data is available from the turning test of a sister ship and subject to special approval by the Society.

Table I 1-2 has been amended as follows:

Table I 1-2
List of Ship Type Notation

Notation	Description	Reference
Barge	Non-self-propelled barges intended to be towed or pushed	Part II and Part III Chapter 9
Bulk Carrier	For ships intended primarily to carry dry cargo in bulk, generally having single deck, topside tanks, hopper side tanks and double bottom in cargo spaces, cargo holds bounded by single or double side skin.	Part III Chapter 1 and 1A
Chemical ~~Carrier~~ Tanker	For ships which are constructed generally with integral tanks and intended primarily to carry chemicals in bulk.	Part III Chapter 5
Container Carrier	For ships which are built for the carriage of containers in holds or on decks.	Part III Chapter 3
Fire-fighting Ship N	Ships intended for fire-fighting operation are to be assigned this class notation, with N being **1**, **2** or **3**.	Part III Chapter 12
.....	.....	.....
RO/RO Cargo Ship	For ships which are specially designed and constructed for the carriage of vehicles, and cargoes in pallet form or in containers and loaded/unloaded by wheeled vehicles.	Part III Chapter 6
Tug	For ships which are built for the purpose of towing or pushing other ships ~~vessels~~.	Part III Chapter 11
Escort Tug (Fs, t, v)	An escort tug is a tug intended for escort operation. The escort rating number (**Fs, t, v**) shall be determined by approved full scale trials.	Part III Chapter 11A
Mobile Offshore ~~Service~~ Unit	For all mobile offshore units ~~Ships~~ built for the purpose of ocean service.	Part III Chapter 13
~~HLA~~	~~This notation (Heavy Lift Appliance) will be assigned to ships equipped with heavy lift appliance.~~	~~Rules for the Construction and Survey of Cargo Gears~~
Self-Propelled Unit	This notation will be assigned to units designed with means of propulsion capable of propelling the unit during long distance ocean transits without external assistance.	Part III Chapter 13
Non Self-Propelled Unit	This notation will be assigned to units that are not a self-propelled unit.	Part III Chapter 13
Self-Elevating Unit	This notation will be assigned to units with movable legs capable of raising its hull above the surface of the sea and lowering it back into the sea.	Part III Chapter 13
.....	.....	.....

Note:

(1) For ships deemed necessary by the Society, an appropriate notation except specified above may be affixed to classification characters.

Table I 1-3 has been added as follows:

Table I 1-3
List of Additional Service Notation

Notation	Description	Reference
CSR	This notation will be assigned to bulk carriers or oil tankers which fully comply with the IACS's **C**ommon **S**tructural **R**ules.	IACS's **C**ommon **S**tructural **R**ules
BC-A	This notation will be assigned to bulk carriers designed to carry dry bulk cargoes of cargo density 1.0 t/m^3 and above with specified holds empty at maximum draught in addition to **BC-B** conditions.	Part III/1.2
BC-B	This notation will be assigned to bulk carriers designed to carry dry bulk cargoes of cargo density of 1.0 t/m^3 and above with all cargo holds loaded in addition to **BC-C** conditions.	Part III/1.2
BC-C	This notation will be assigned to bulk carriers designed to carry dry bulk cargoes of cargo density less than 1.0 t/m^3.	Part III/1.2
.....	.....	.....
BC-XII	This notation will be assigned to ships where the applicable requirements in Chapter 14 of Part III are complied with.	Part III Chapter 14
SPS	This notation will be assigned to ships that comply with the IMO Code of Safety for Special Purpose Ships (SPS Code).	SPS Code
VR	This notation will be assigned to ships which comply with the limits for vibration of ISO 20283-5:2016, as given in Table II 34-2.	Part II Chapter 34
Smartship{Hx; Mx; Ex; Nx; Cx; Ix}	This notation will be assigned to ships which comply with the requirements of the Guidelines in terms of smart hull, smart machinery, smart energy efficiency management, smart navigation, smart cargo management, smart integration platform. If the ship complies with the additional requirements for specific operations or design condition, the corresponding qualifiers specified in Guidelines for Smart Ships will be affixed to this notation.	Guidelines for Smart Ships
HLA	This notation (**H**eavy **L**ift **A**ppliance) will be assigned to ships equipped with heavy lift appliance.	Rules for the Construction and Survey of Cargo Gears

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 ~~will~~ be assigned to ships ~~which are suitable for in-water survey in lieu of bottom survey in dry dock.~~ provided with suitable arrangements to facilitate the In-Water Surveys.	Part I/1.6.7(b) & 2.2.2
PCM(1)	This notation (**P**ropeller shaft **C**ondition **M**onitoring) will be assigned when oil lubricated propeller shaft arrangements with approved oil glands are fitted and the requirements of 2.3.4 of Part I of the Rules are complied with.	Part I/2.3.4
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**.

Table I 1-6 has been added as follows:

Table I 1-6
List of Special Equipment Notation

Notation	Description	Reference
CCB	This notation (**C**entralized **S**ystem for **C**argo and **B**allast Water Handling) will be assigned to ships provided with centralized system for cargo and ballast water handling.	Part VIII/7.10
DPS-N	This notation (**D**ynamic **P**ositioning **S**ystem), with N being **I**, **II** or **III**, will be assigned to ships provided with dynamic positioning system.	Part IV Chapter 10
ETA	This notation (**E**mergency **T**owing **A**rrangement) will be assigned to tankers provided with emergency towing arrangements.	Part II/25.7
.....	.....	.....
Gas Fuel(1)	This notation (**Gas Fuel**) will be assigned to ships where only the gas fuel is used for main propulsion engines.	Guidelines for Natural Gas-Fuelled Engine Installations
Dual Fuel(1)	This notation will be assigned to ships where the gas fuel and oil fuel are used for main propulsion engines.	Guidelines for Natural Gas-Fuelled Engine Installations
Gas Fuel Ready-N	This notation, with **N** being **I**, **II**, **III**, will be assigned to the ships where the applicable requirements in the Guidelines for LNG Fuel Ready Ships are complied with.	Guidelines for LNG Fuel Ready Ships
Walk-to-work	The notation (**Walk-to-work)** will be assigned to ships which comply with the requirements of the Guidelines for Offshore Access Walk to Work Gangway.	Guidelines for Offshore Access Walk to Work Gangway
HVSCS	The notation (**HVSCS)** will be assigned to ships which comply with the requirements of the Guidelines for High Voltage Shore Connection Systems.	Guidelines for High Voltage Shore Connection Systems
Cyber-S	The notation (**Cyber-S)** will be assigned to ships which comply with the requirements of the Guidelines for Cyber Security Onboard Ships.	Guidelines for Cyber Security Onboard Ships
SCR	The notation (**SCR)** will be assigned to ships which comply with the requirements of the Guidelines for Selective Catalytic Reduction Systems.	Guidelines for Selective Catalytic Reduction Systems
CLB	The notation (**CLB)** will be assigned to ships which comply with the requirements of the Guidelines for Lithium-Ion Batteries Applied to Marine System / Equipment.	Guidelines for Lithium-Ion Batteries Applied to Marine System / Equipment
ADW	This notation will be assigned to ships intended for regular anchoring at deep and unsheltered water.	Part II/25.11

Note:

(1) It means that the notation, when assigned, is to be added after the classification symbol **CMS**.

Chapter 2 Survey Requirements of Steel Ship

Paragraph 2.1.4(a)(ix) has been amended as follows:

2.1 General

2.1.4 Procedures for class related services

(a) Thickness measurements and close-up surveys - hull structures

(i) Thickness measurements are to be carried out by a firm approved by the Society in accordance with the procedures for certification of firms engaged in thickness measurement of hull structures as specified in "Guidelines for Approval of Service Suppliers" of the Society, except that in respect of measurements of non-ESP ships less than 500 gross tonnage and all fishing vessels, the firm need not be so approved.

……

(viii) For structure built with a material other than steel, alternative thickness measurement requirements may be developed and applied as deemed necessary by the Society.

(ix) Thickness Measurements Acceptance Criteria.

The Acceptance Criteria for thickness measurements are according to Appendix 4 ~~Table I 2-27 to Table I 2-31~~ and/or specific IACS URs depending on ship age and structural elements concerned, e.g URs S18 for corrugated transverse bulkhead, URs S21A for all hatch covers and coamings on exposed decks.

Paragraph 2.1.6(a)(iv) has been amended as follows:

2.1.6 Preparation for enhanced survey for ESP ships

The regime of enhanced surveys given in 2.11, 2.12, 2.13, 2.14 and 2.15 of this Chapter as appropriate, are applicable to a number of ship types falling within the broad definitions of oil tankers, chemical tankers and bulk carriers contained in the Rules.

(a) Survey Programme

(iv) The Society will advise the Owner of the maximum acceptable structural corrosion diminution levels applicable to the ships ~~vessels~~.

Paragraph 2.1.6(e)(ii)(2) has been amended as follows:

(e) Technical assessment in conjunction with the planning of enhanced surveys for oil tankers

(ii) Technical assessments of the relative risks of susceptibility to damage or deterioration of various structural elements and areas are to be judged and decided. Technical assessments, which may include quantitative or qualitative evaluation of relative risks of possible deterioration, of the following aspects of a particular ship may be used as a basis for the nomination of tanks and areas for survey:

(1) design features such as stress levels on various structural elements, design details and extent of use of high tensile steel;

(2) former history with respect to corrosion, cracking, buckling, indents and repairs for the particular ship as well as similar ships ~~vessels~~, where available; and

Paragraph 2.1.6(f)(vi) has been added as follows:

(f) Evaluation of longitudinal strength of hull girder for oil tankers of 130 m in length and upwards and of over 10 years of age for survey report

(vi) For CSR double hull oil tanker, the ship's longitudinal strength is to be evaluated by using the thickness of structural members measured, renewed and reinforced, as appropriate, during the Special Surveys carried out after the ship reached 10 years of age (or during the Special Survey No. 2, if this is carried out before the ship reaches 10 years of age) in accordance with the criteria for longitudinal strength of the ship's hull girder specified in Section 12 of IACS Common Structural Rules for Double Hull Oil Tanker or Part 1, Ch 13 of IACS Common Structural Rules for Bulk Carriers and Oil Tankers.

Paragraph 2.1.6(g) has been amended as follows:

(g) For CSR bulk carriers, the ship's longitudinal strength is to be evaluated by using the thickness of structural members measured, renewed and reinforced, as appropriate, during the Special Surveys carried out after the ship reached 15 years of age (or during the Special Survey No. 3, if this is carried out before the ship reaches 15 years) in accordance with the criteria for longitudinal strength of the ship's hull girder for CSR bulk carriers specified in Ch 13 of IACS Common Structural Rules for Bulk Carriers or Part 1, Ch 13 of IACS Common Structural Rules for Bulk Carriers and Oil Tankers.

Paragraphs 2.2.1(h)&(i) have been added as follows:

2.2 Bottom Surveys

2.2.1 Bottom Surveys in dry dock

At each Bottom Survey in dry dock the following requirements are to be complied with:

(a) Normally the ship is to be placed on blocks of sufficient height in a dry dock or on a slipway and cleaned, and proper staging is to be erected as may be necessary for examination. A docking survey covers an examination of elements such as shell plating including bottom and bow plating, stern frame and rudder, sea chests and vlaves, propellers, etc. The shell plating is to be examined for excessive corrosion, or deterioration due to chafing or contact with the ground and for any undue unfairness or buckling. Special attention is to be paid to the connection between the bilge strakes and the bilge keels. Important plate unfairness or other deterioration which do not necessitate immediate repairs are to be recorded.

…..

(g) Special consideration may be given in application of relevant requirements of this section to commercial ships owned or chartered by Governments, which are utilized in support of military operations or service.

(h) For maintenance of the **IWS** notation, a ship's markings and equipment installed for In-Water Survey are to be satisfactorily verified by the attending Surveyor at each Drydocking.

(i) For Mobile Offshore Unit

(i) Parts to be examined

(1) Surface-type Units (ship or barge type units)

External surfaces of the hull, keel, stem, stern frame, rudder, nozzles, and sea strainers are to be selectively cleaned to the satisfaction of the attending Surveyor and examined together with appendages, the propeller, exposed parts of stern bearing assembly, rudder pintle and gudgeon securing arrangements, sea chest and strainers, and their fastenings.
Propeller shaft bearing, rudder bearing, and steering nozzle clearances are to be ascertained and recorded.

(2) Self-Elevating Units

External surfaces of the upper hull or platform, spud cans, mat, underwater areas of legs, together with their connections as applicable, are to be selectively cleaned to the satisfaction of the attending Surveyor and examined.
At each Drydocking Survey or equivalent, after Special Survey No. 2, the Surveyor is to be satisfied with the condition of the internal structure of the mat or spud cans. Leg connections to mat and spud cans are to be examined at each Drydock Survey or equivalent. Non-destructive testing may be required of areas considered to be critical by the Society or found to be suspect by the Surveyor.

(3) Column-Stabilized Units

External surfaces of the upper hull or platform, footings, pontoons or lower hulls, underwater areas of columns, bracing and their connections, sea chests, and propulsion units as applicable, are to be selectively cleaned and examined to the satisfaction of the attending Surveyor. Non-destructive testing may be required of areas considered to be critical by the Society or found to be suspect by the Surveyor.

(ii) Ballast Spaces

In conjunction with Drydocking Surveys (or equivalent) after Special Survey No. 1 and between subsequent Special Surveys, the following ballast spaces are to be internally examined, thickness gauged, placed in satisfactory condition as found necessary, and reported upon. If such examination reveals no visible structural defects, the examination may be limited to a verification that the corrosion prevention arrangements remain effective.

(i) All Units

Particular attention is to be given to corrosion prevention systems in ballast spaces, free- flooding areas and other locations subjected to sea water from both sides.

(ii) Surface type units

One peak tank and at least two other representative ballast tanks between the peak bulkheads used primarily for water ballast.

(iii) Self elevating units

Representative ballast tanks or free-flooding compartments in mat or spud cans, if accessible, and at least two representative hull pre-load tanks.

(iv) Column stabilized units

Representative ballast tanks in footings, lower hulls, or free-flooding compartments as accessible, and at least two ballast tanks in columns or upper hull, if applicable.

Paragraph 2.2.2 has been amended as follows:

2.2.2 In-Water Survey with notation **IWS**

An In-Water Survey may normally be carried out if the ship has been granted the additional class notation **IWS**. Upon application by the Owner, the Society may also consider to accept, on a case by case basis, such In-Water Survey for ships not assigned with the additional class notation **IWS**.

(a) General requirements

(i) The underwater body is to be protected against corrosion by a full hard coating system and strongly recommended to be also protected by an impress current cathodic protection system.

.....

Paragraphs 2.2.2(b)(iii)&(iv) have been amendeded as follows:

(b) Plans and documents

When ships are intended to be subjected to an In-Water Survey, the following plans and documents are to be submitted to the Society:

(i) Plans of the shell plating below waterline showing the details of the location and sizes of shell opening, location of bottom plugs, location of water and oil tight bulkheads;

(ii) Detailed information or drawings of constructions and arrangement indicated in the item (c) below together with their colour photographs and detailed instruction for inspection of such constructions and arrangements; and

(iii) Documents showing the procedure which enables the Surveyor to confirm the clearance of the rudder bearing or the condition of the stern tube bearing based on a review of the operating history, the onboard testing or analysis of sampled stern lubricating oil or lubricating freshwater.
Where the bearing is found to be satisfactory, special consideration may be given to the requirements in 2.2.2(c)(ii) or 2.2.2(c)(v) below.

~~(iii)~~ (iv) Other data, if deemed necessary.

Paragraph 2.2.2(c) has been amended as follows:

(c) Constructions and arrangement

The constructions and arrangements of ships which are intended to be subjected to an In-Water Survey are to comply with the following. Where the documents specified in 2.2.3(b)(iii) above are submitted, special consideration may be given to 2.2.2(c)(ii) or 2.2.2(c)(v) below.

(i) Anodes are to be attached in such a manner as to be easily replaced where necessary.

(ii) Rudder is to be provided with the means of facilitating the measurement of clearances in way of each pintle. Liners on rudder stock and pintles are to be marked in such a way so that any relative movements can be checked.

(iii) Rope guard ring plates are to be of such constructions as to facilitate the inspection of shafts between propeller hubs and stern frame boss.

(iv) In case of water lubricating type stern-tube bearings, the devices which may indicate the clearance of propeller shaft strut and stern bearings are to be provided.

(v) In case of oil or freshwater lubricating type stern-tube bearings, suitable means of ascertaining the performances of stern-tube bearings including oil sealing devices are to be provided.

(vi) Suitable means of ascertaining the position and identifying each blade of propellers from inboard are to be provided.

(vii) ~~Sea connections are to be provided with the means of blanking their openings to the sea from outboard so that the sea connections may be opened up from inboard for examination and repairs.~~ ~~Grating of sea suctions are to be of hinged type as far as practicable.~~
Hinged gratings are installed on all sea chests and constructed so as to facilitate opening and closing by the driver.

(viii) ~~To the hull below load water line, provision is to be made for ready identification of the position of bulkheads and transverses (including indication of the number of transverses). To bottom shell plating, provision is to be made for ready identification of the flat bottom and of ship's lengthwise (fore and aft) and athwartship (port side or starboard side) direction.~~
Markings indicating the position of longitudinal and transverse bulkheads and the names of interior spaces on the hull below the load water line, so that the diver or Remotely Operated Vehicle is able to orient his/her/its position relative to the ship.

Paragraphs 2.2.2(d)&(e) have been deleted as follows:

~~(d) Performance of In-Water Survey~~

~~(i) The In-Water Survey is to be carried out in sufficiently clear and calm waters. The ship is to be as light as possible. The shell side below the waterline and the bottom are to be sufficiently clean.~~

~~(ii) The underwater pictures on the surface monitor screen are to offer reliable technical information such as to enable the Surveyor to judge the parts surveyed.~~

~~(iii) The In-Water Survey is to provide the information normally obtained from a Bottom Survey in dry dock. It at least covers an examination of the bottom and side plates of the shell plating, including any attachments and the rudder, an external examination of propellers as well as propeller shafts, and the cleaning condition of sea chests.~~

~~(e) Firms engaged in In-Water Survey of ships are to comply with the requirements of "Guidelines for Approval of Service Suppliers."2.3 Surveys of Propeller Shafts and Tube Shafts~~

Paragraph 2.2.3 has been added as follows:

2.2.3 Extensions

(a) Extensions up to 1 month

General examination afloat to determine the ship's fitness for continued service during the extension period is to include:

(i) Examination and testing of the steering machinery as considered necessary

(ii) Review of on board records to confirm satisfactory operation of the propulsion machinery

(iii) Confirmation that no damages and/or grounding have occurred since the last attendance by the CR surveyor.

(iv) External examination of the saltwater systems with particular attention to nonmetallic expansion pieces (if fitted), sea valves and their attachments to the sea chests/side shell

(v) Re-examination of any condition of class with a view to confirm condition satisfactory for service through the subject extension period

(vi) All class surveys are current

In addition, when the requested extension date exceeds 36 months from the previous drydocking survey, an examination of the underwater body by an In-Water Survey company approved by the Society is required (with the underwater body sufficiently clean and water clear enough for a meaningful examination) including rudder, propeller, visible parts of the stern bearing assembly and sea chests.

(b) Extensions up to 3 months

General examination afloat to determine the ship's fitness for continued service during the extension period is to include:

(i) Examination and testing of the steering machinery as considered necessary

(ii) Review of on board records to confirm satisfactory operation of the propulsion machinery

(iii) Confirmation that no damages and/or grounding have occurred since the last attendance by CR surveyor.

(iv) External examination of the saltwater systems with particular attention to nonmetallic expansion pieces (if fitted), sea valves and their attachments to the sea chests/side shell

(v) Re-examination of any condition of class to confirm condition satisfactory for service through the subject extension period

(vi) All class Surveys are current.

In addition, when the requested extension date exceeds 36 months from the previous drydocking survey, the following examinations are required:

(vii) An examination of the underwater body by an In-Water Survey company approved by the Society, (with the underwater body sufficiently clean and water clear enough for a meaningful examination), including rudder, propeller, visible parts of the stern bearing assembly and sea chests

(viii) Strut/stern bearing and rudder clearances to be determined as possible and confirmed satisfactory for continued service during subject deferral period. Where not practical, rudder pintle clearances may be dispensed with if the attending Surveyor is satisfied with the physical and securing arrangements of the pintle.

(ix) Oil-lubricated stern bearings to be visually checked for oil leaks

Paragraph 2.3.5(a) has been amended as follows:

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

(a) Where oil lubricated shaft with approved oil glands are fitted, a class notation **PCM** may be assigned, ~~if its monitoring manuals or maintenance manuals of preventive maintenance system together with relative diagrams,~~ if it's the relevant drawing(s) and data are submitted and approved by the Society. The management systems are to comply with the following:

Paragraph 2.3.5(e) has been amended as follows:

(e) Initial survey for existing ships ~~vessels~~ obtaining **PCM** notation

Paragraphs 2.5.1(o)&(p) have been added as follows:

2.5.1 Annual surveys - hull

(o) Where the special equipment notation **CSS** is assigned, the Surveyor is to examine the securing arrangements including loose fittings so far as necessary and practicable in order to be satisfied as to their general condition, see chapter 9 of Guidelines for container securing systems.

(p) The Surveyor is to confirm that, for container ships which have the special equipment notation **CSP**, the onboard lashing program, together with its operation manual, is available on board, see Appendix 2 of Guidelines for container securing systems.

Paragraph 2.6.4(h) has been added as follows:

2.6.4 Additional hull requirements for ships other than tankers, combination carriers and bulk carriers

(h) For fishing ships over 15 years of age, an overall survey of at least 2 fish holds, where applicable, is to be carried out.

Paragraph 2.7.1(m) has been amended as follows:

2.7.1 Special Survey - hull

(m) ~~When spaces are insulated in connection with refrigeration, hatches and limbers are to be removed and the condition of the structural members examined.~~ In refrigerated cargo spaces, the condition of the coating and structure behind the insulation is to be examined at representative locations. The surveyors may limit the examination to the verification that the protective coating remains effective and that there are no visible structural defects. Where POOR coating condition is found, or structural defects are identified, then sufficient insulation is to be removed in each of the chambers in order to assess the condition of the remaining structure, as deemed necessary by the Surveyor. Additionally, where indents, scratches or other defects are identified during the survey of the shell plating from the outside, insulations in way are to be removed to enable further examination of the plating and adjacent frames, as required by the Surveyor.

Paragraph 2.7.1(p) has been added as follows:

(p) Where the special equipment notation **CSS** is assigned, the Surveyor is to be satisfied as to the efficient condition of:

(i) Cell guide structure including the connections between vertical cell guides and cross ties.

(ii) Cell guide entry devices.

(iii) Portable frameworks or other forms of structural restraints.

(iv) Fittings attached to the ship structure, with special attention to any signs of leakage in way of tanks or deck and shell plating.

(v) End connecting pieces for lashings, twist locks and other loose fittings, which are to be examined and verified with the Register, see chapter 9 of Guidelines for of container securing systems.

(vi) Lashings, rods, wire ropes, and chains together with turn buckles and other tightening devices are to be examined and verified with the records prepared by crew as far as necessary and practicable in order to be satisfied as to their general condition, see chapter 9 of "Guidelines for Container Securing Systems".

(vii) Lashing wire ropes, which are to be renewed where more than 5 percent of the wires are broken, worn or corroded in any length of 10 diameters of the wire rope.

(viii) Chains, which are to be renewed where worn or damaged.

Where renewals are required, the new item is to be of approved type and manufacture. Where test certificates are not available,the item is to be tested in accordance with charpter 7 of "Guidelines for Container Securing Systems".

Paragraph 2.7.2(e) has been amended as follows:

2.7.2 Special Survey–machinery

(e) All air ships ~~vessels~~ for essential services, together with their mountings, valves and safety devices, are to be cleaned internally, and examined internally and externally. If internal examination of the air ships ~~vessels~~ is not practicable, they are to be tested hydraulically to at 1.25 times the working pressure. Safety valves setting are to be checked.

Paragraphs 2.7.2(k)&(n) have been amended as follows:

(k) Air compressors of essential services ~~is~~ are to be examined visually without dismantling. Performance test shall be carried out. They are to be opened up for examination if deemed necessary by the sureveyor. Verify last overhaul records.~~opened up for examination.~~ Safety valve setting is to be checked.

(n) Engine room remote control quick closing valves are to be examined visually without dismantling. Performance test shall be carried out. They are to be opened up for examiniation if deemed necessary by the sureveyor. Verify last overhaul records. ~~opened up, examined and tested in working condition.~~

Paragraphs 2.7.2(r)(vi)&(vii) have been amended as follows:

(r) Electrical installations.

(vi) ~~For the main electric propelling machinery, windings, commutators and slip-rings, all air ducts in stator coil and ventilating holes in rotors are to be examined.~~
Where the ship is electrically propelled, the propulsion motors, generators, propulsion transformers, propulsion conversion equipment, cables, harmonic filters, neutral earthing resistors, dynamic braking resistors and all ancillary electrical equipment that forms part of the propulsion drive and control system, exciters and ventilating plant (including coolers) associated therewith are to be surveyed , and the insulation resistance to earth is to be tested. Special attention is to be given to windings, commutators and slip-rings. Where practicable, the low voltage and high voltage windings of cast resin propulsion transformers are to be subjected to boroscopic inspection, to assess the physical condition of their insulation and for signs of mechanical and thermal damage. The operation of protective gear and alarm devices is to be checked, so far as practicable. Insulating oil, if used, is to be tested in accordance with 2.7.2 (r) (vii). Interlocks intended to prevent unsafe operations or unauthorised access are to be checked to verify that they are functioning correctly. Emergency overspeed governors are to be tested.

(vii) Where transformers associated with supplies to essential services are liquid-immersed, the Owner is to arrange for samples of the liquid to be taken and tested for dissolved gases, breakdown voltage, acidity and moisture by a competent testing authority, in accordance with the equipment manufacturer’s requirements, and a certificate giving the test results is to be made available to the Surveyor on request.

Paragraph 2.8.3 has been amended as follows:

2.8 Classification Survey of Ships not Built under Survey

2.8.3 Ships with classification

If the ship keeps the Class of another recognized Classification Society with sufficient status, in general, a survey to the extent of the Special Survey corresponding to the ship’s age is to be conducted ~~except the ship being within 3 months of the due date of Special Survey~~. Some Special Survey items may be omitted by the Surveyor in view of the ship's condition. In such case, the period of class is to remain as assigned by the previous Classification Society.

Paragraph 2.10.3(a)(viii) has been amended as follows:

2.10 Hull Surveys of Liquefied Gas Carriers

2.10.3 Special Survey

(a) The cargo containment systems is to be examined as follows:

(viii) Extended tests

On the occasion of Special Surveys No. ~~2~~3, 4, 5, etc., all independent type C tanks are to be either

Paragraph 2.14.3(a)(ii) has been amended as follows:

2.14 Hull Surveys of Double Hull Oil Tankers

2.14.3 Special Survey

(a) General

(ii) All cargo tanks, ballast tanks, including double bottom tanks, pump rooms, pipe tunnels, cofferdams and void spaces bounding cargo tanks, decks and outer hull are to be examined, and this examination is to be supplemented by thickness measurement and pressure testing as required in 2.14.3(d) and 2.14.3(e), to ensure that the structural integrity remains effective. The aim of the examination is to be sufficient to discover Substantial Corrosion, significant deformation, fractures, damages or other structural deterioration that may be present.

Paragraph 2.14.3(d)(ii) has been amended as follows:

(d) Extent of thickness measurement

(i) The minimum requirements for thickness measurements at Special Survey are given in Table I 2-14.

(ii) Provisions for extended measurements for areas with Substantial Corrosion are given in Table I 2-15, and as may be additionally specified in the survey programme as required in 2.1.6(a). These extended thickness measurements are to be carried out before the survey is credited as completed. Suspect Areas identified at previous Special Surveys are to be examined. Areas of Substantial Corrosion identified at previous Special or Intermediate Survey are to have thickness measurements taken.

For ships ~~vessels~~ 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 at annual and Intermediate Surveys.

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

(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 ships's ~~vessels'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) there is no record of leakage, distortion or substantial corrosion that would affect the structural integrity of the tank;

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

(4) the satisfactory results of the testing is recorded in the ships's ~~vessels's~~ logbook;

(5) 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.

Paragraph 2.16.2(a)(ii) has been amended as follows:

2.16 Hull Surveys of Craft for FRP and Aluminum Alloys Construction

2.16.2 Special Survey

In addition to the Annual Survey in 2.16.1 above and the applicable requirements of Special Survey in 2.7 of this Part, the Special Survey is to include the following:

(a) Requirements for Craft of Fiber Reinforced Plastic (FRP) Construction

(i) Engine foundations and their attachments to the hull are to be examined.

(ii) If considered necessary by the attending surveyor, a ~~A~~ minimum of five plugs, each 50~~.8~~ mm in diameter, are to be removed from the hull bottom and topsides from locations deemed appropriate from the attending Surveyor and examined for core to skin adhesion and water permeation.

Paragraph 2.17.2(a)(i) has been amended as follows:

2.17 Surveys of Passenger Ships

2.17.2 Annual Survey:

In addition to the requirements of Annual Survey in 2.5, following items are also to be carried out:

(a) Hull:

(i) Bottom Survey in 2.2 of this chapter ~~dry dock or in water~~.

Paragraph 2.17.3(b) has been deleted as follows:

2.17.3 Intermediate and Special Survey

(b) Bottom Survey in dry dock is to be a part of ~~Intermediate or~~ Special Survey.

While the thickness measurements is carried out, if substantial corrosion is found, the extent of thickness measurements is to be increased in accordance with the requirements of Table I 2-4A. Tanks or areas where coating was found to be in GOOD condition at the previous intermediate or periodical survey may be specially considered by the Society.

Section 2.19 has been added as follows:

2.19 Hull and Special Equipment Survey of Mobile Offshore Unit

2.19.1 General

(a) Definition

(i) Preload Tank

A Preload Tank is a tank within the hull of a self-elevating unit. These tanks are periodically filled with salt water ballast and used to preload the footings of the unit prior to commencing drilling operations. Preload Tanks are considered equivalent to Ballast Tanks.

(ii) Excessive Diminution

Excessive Diminution is an extent of corrosion beyond allowable limits.

(iii) Propulsion Assist

Propulsion Assist are non-self-propelled Units fitted with thrusters intended to assist in manoeuvring or propelling while under tow.

2.19.2 Annual Survey

In addition to the applicable requirements of the Annual Survey in 2.5, those items herein are to be carried out.

(a) Hull, Structure and Equipment

(i) At each Annual Survey the exposed parts of the hull, deck, deck house, structures attached to the deck, derrick substructure, including supporting structure, accessible internal spaces, and the applicable parts listed below (iv)~(vii) are to be generally examined and placed in satisfactory condition as found necessary.

(ii) The Surveyors are to be satisfied at each Annual Survey that no material alterations have been made to the unit, its structural arrangements, subdivision, superstructure, fittings, and closing appliances upon which the stability calculations or the load line assignment is based.

(iii) Suspect Areas identified at previous surveys are to be examined. Thickness measurements are to be taken of the areas of substantial corrosion and the extent of thickness measurements is to be increased to determine areas of substantial corrosion. Table I 2-4A may be used as guidance for these additional thickness measurements. These extended thickness measurements are to be carried out before the annual survey is credited as completed.

(iv) All Units

The following items are to be examined:

(1) Accessible hatchways, manholes and other openings.

(2) Machinery casings and covers, companionways, and deck houses protecting openings.

(3) Portlights together with deadcovers, cargo ports and similar openings in hull sides, ends, or in enclosed superstructures.

(4) Ventilators, tank vent pipes together with flame screens, and overboard discharges from enclosed spaces.

(5) Watertight bulkheads and end bulkheads of enclosed superstructures.

(6) Closing appliances for all the above, including hatchcovers, doors, together with their respective securing devices, dogs, sill, coamings and supports.

(7) Freeing ports together with bars, shutters and hinges.

(8) Windlass and attachment of anchor racks and anchor cables.

(9) Protection of the crew, guard rails, lifelines, gangways, and deck houses accommodating crew.

(v) Surface-Type Units

In addition to the requirements of 2.19.2 (a) (iv) the following items are to be examined:

The hull and deck structure around the drilling well (moon-pool) and in vicinity of any other structural changes in section, slots, steps, or openings in the deck or hull and the back-up structure in way of structural members or sponsons connecting to the hull.

(vi) Self-Elevating Units

In addition to the requirements of 2.19.2 (a) (iv) the following items are to be examined:
Jack-house structures and attachments to upper hull or platform. Jacking or other elevating systems and leg guides, externally. Legs as accessible above the waterline, Plating and supporting structure in way of leg wells.

(vii) Column-Stabilized Units

In addition to the requirements of 2.19.2 (a) (iv) the following items are to be examined:

Columns, diagonal and horizontal braces together with any other parts of the upper hull supporting structure as accessible above the waterline.

Note: At the 1st Annual Survey after construction, Column-Stabilized and Self -Elevating Units may be subject to examination of major structural components including non-destructive testing, as deemed necessary by the Society. If the Society deems such survey to be necessary, the extent should be agreed to by the Society and the Owner or operator prior to commencement of the Survey.

(b) Special Equipment

A general examination of hazardous areas, remote shutdown arrangements, fire fighting systems where included in the Society's Rules, self-elevating systems, piping systems, and bilge systems is to be made.

2.19.3 Special Survey

(a) Special Survey No. 1 - Hull, Structure and Equipment

(i) All Units

The following parts are to be examined:

(1) The hull or platform structure including tanks, watertight bulkheads and deck, cofferdams, void spaces, sponsons, chain lockers, duct keels, helicopter deck and its supporting structure, machinery spaces, peak spaces, steering gear spaces, and all other internal spaces are to be examined externally and internally for damage, fractures, or excessive diminution. Thickness gauging of plating and framing may be required where wastage is evident or suspected.

(2) All tanks, compartments and free-flooding spaces throughout the drilling unit are to be examined externally and internally for excess wastage or damage.

(3) Internal examinations of spud cans and mats may be specially considered.

(4) Watertight integrity of tanks, bulkheads, hull, decks and other compartments is to be verified by visual inspection.

(5) Suspect areas and critical structural areas should be examined and may be required to be tested for tightness, non-destructive tested or thickness gauged.

(6) All special and primary application structures and identified critical structural areas are to be subjected to Close up survey.

(7) Tanks and other normally closed compartments are to be ventilated, gas freed and cleaned as necessary to expose damages and allow meaningful examination and thickness gauged in case of excessive diminution.

(8) Internal examination and testing of void spaces, compartments filled with foam or corrosion inhibitors, and tanks used only for lube oil, light fuel oil, diesel oil, fresh water, drinking water or other non-corrosive products may be waived provided that upon a general examination the Surveyor considers their condition to be satisfactory. External thickness gauging may be required to confirm corrosion control.

(9) Structures such as derrick substructure and supporting structure, jack-houses, deck houses, superstructures, helicopter landing areas, raw water (sea water intake) towers and their respective attachments to the deck or hull.

(10) Windlass and attachments of anchor racks and anchor cable fairleads.

(11) Foundations and supporting headers, brackets, and stiffeners for drilling related apparatus, where attached to hull, deck, superstructure or deck house.

(12) Thickness gaugings are to be carried out where wastage is evident or suspect.

(13) Where provided, the condition of corrosion prevention system of ballast tanks is to be examined. Where a hard protective coating is found in POOR condition and it is not renewed, where soft or semi-hard coating has been applied, or where a hard protective coating was not applied from time of construction, the tanks in question are to be examined at a frequency determined by the Society. Thickness measurements are to be carried out as deemed necessary by the Surveyor.

(14) Thickness measurements are to be carried out in accordance with Table I 2-27~ Table I 2-29 as applicable. The Surveyor may extend the thickness measurements as deemed necessary. When thickness measurements indicate substantial corrosion, the extent of thickness measurements is to be increased to determine areas of substantial corrosion. Table I 2-4A may be used as guidance for these additional thickness measurements. These extended thickness measurements are to be carried out before the survey is credited as completed.

(ii) Surface-type Units

In addition to the requirements of 2.19.3 (a)(i) the following items are to be examined:

Structural appendages and ducts for positioning units.

(iii) Self-Elevating Units

In addition to the requirements of 2.19.3 (a)(i) the following items are to be examined:

(1) All legs, including chords, diagonal and horizontal braces, gussets, racks, joints, together with leg guides. Tubular or similar type legs are to be examined externally and internally, together with internal stiffeners and pinholes as applicable.

(2) Structure in, around and under jack-house and leg wells. Non-destructive testing of these areas may be required.

(3) Leg jacking or other elevating systems externally.

(4) Leg connections to bottom mats or spud cans, including non-destructive testing of leg connections to mats or spud cans.

(5) Jetting piping systems or other external piping, particularly where penetrating mats or spud cans.

(6) Spud cans or mats. Where the spud cans or mat are partly or entirely obscured below the mud line where the Special Survey is otherwise being completed, consideration may be given to postponement of the examinations until the next Rig move.

(iv) Column-Stabilized Units

In addition to the requirements of 2.19.3 (a) (i) the following items are to be examined:

Connections of columns and diagonals to upper hull, structure or platform and lower hull, structure or pontoons. Joints of supporting structure including diagonals, braces and horizontals, together with gussets and brackets. Internal continuation or back-up structure for the above. Non-destructive examination may be required of these areas.

(b) Special Survey No. 2 and Subsequent Special Surveys - Hull, Structure and Equipment

These Surveys are to be at least as comprehensive as Special Survey No. 1, with special attention being given to the condition and thickness of material in high corrosion areas.

Representative gaugings will be required as Table I 2-27~ Table I 2-29 and Table I 2-4A. Special attention should be paid to splash zones on structure, legs or related structure, and in ballast tanks, pre-load tanks, free-flooding spaces, spud cans and mats.

(c) Special Equipment

Mobile Offshore Drilling Units may have many items of machinery and electrical equipment not found on conventional ships. Certain of these items are required for classification even if the unit is without propulsion machinery. Items to be especially examined and reported upon at all Special Surveys are as follows:

(i) Hazardous Areas - Enclosed hazardous areas such as those containing open active mud tanks, shale shakers, degassers and desanders are to be examined and doors and closures in boundary bulkheads verified as effective. Electric lighting, electrical fixtures, and instrumentation are to be examined,

proven satisfactory and verified as explosion-proof or intrinsically safe. Ventilating systems including ductwork, fans, intake and exhaust locations for enclosed restricted areas are to be examined, tested and proven satisfactory. Ventilating air alarm systems to be proven satisfactory. Electrical motors are to be examined including closed-loop ventilating systems for large D-C motors. Automatic power disconnect to motors in case of loss of ventilating air is to be proved satisfactory.

(ii) Remote Shutdown Arrangements - Remote shutdown for fuel-oil transfer service pumps and ventilating equipment, together with oil tank outlet valves where required to be capable of being remotely closed are to be proved satisfactory. Emergency switch(s) for all electrical equipment including main and emergency generators, except alarm and communication systems and lighting in vital areas such as escape routes and landing platforms, are to be proved satisfactory.

(iii) Fire Fighting Systems where included in the Society's Rules - A general examination of the fire detection and extinguishing systems is to be made in order that the Surveyor may be satisfied with its efficient state. The following items are to be especially examined:

(1) Fire hoses, nozzles, and spanners at each fire station.

(2) Servicing of all portable extinguishers.

(3) Weighing and re-charging as necessary of all dry chemical and CO^2 extinguishers.

(4) Fire pumps and piping including operation and capacity.

(5) Alarm systems including fire and gas detection.

(iv) Self Elevating Systems - On self elevating type Mobile Offshore Drilling Units, the elevating systems are to be examined and reported on. Pinions and gears of the climbing pinion gear train of rack and pinion systems are to be examined, as far as practicable, to the Surveyor's satisfaction by an effective crack detection method.

(v) Piping Systems - Piping systems used solely for drilling operations and complying either with the Society's requirements or a recognized standard are to be examined, as far as practical, operationally or hydrostatically tested to working pressure, to the satisfaction of the Surveyor.

(vi) Miscellaneous - Bilge alarm systems, if fitted, to be tested.

Table I 2-5A has been amended as follows:

Table I 2-5A
Minimum Requirements for Close-up Surveys
at Hull Special Survey of Oil Tankers, Ore/Oil Carriers and etc.

SS No. 1 (Age ≤ 5)	SS No. 2 (5 < Age ≤ 10)	SS No. 3 (10 < Age ≤ 15)	SS No. 4 and Subsequent (15 < Age)
A) 1 web frame ring in a ballast wing tank, if any, or a cargo wing tank used primarily for water ballast B) 1 deck transverse in a cargo oil tank D) 1 transverse bulkhead in a ballast tank D) 1 transverse bulkhead in a cargo oil wing tank D) 1 transverse bulkhead in a cargo oil center tank	A) All web frame rings in a ballast wing tank, if any, or a cargo wing tank used primarily for water ballast B) 1 deck transverse in each of the remaining ballast tanks, if any B) 1 deck transverse in a cargo wing tank B) 1 deck transverse in 2 cargo center tanks C) Both transverse bulkheads in a wing ballast tank, if any, or a cargo wing tank used primarily for water ballast D) 1 transverse bulkhead in each remaining ballast tank D) 1 transverse bulkhead in a cargo oil wing tank D) 1 transverse bulkhead in 2 cargo center tanks	A) All web frame rings in all ballast tanks A) All web frame rings in a cargo wing tank A) A minimum of 30% of all web frame rings in each remaining cargo wing tank(1) C) All transverse bulkheads in all cargo and ballast tanks E) A minimum of 30% of deck and bottom transverses including adjacent structural members in each cargo center tank(1) F) As considered necessary by the Surveyor	1. As Special Survey No. 3 2. Additional transverses included as deemed necessary by the Society

A) ~ F) are areas to be subjected to close-up surveys.

A) Complete transverse web frame ring including adjacent structural members

B) Deck transverse including adjacent deck structural members

C) Transverse bulkhead complete - including girder system and adjacent members

D) Transverse bulkhead lower part - including girder system and adjacent structural members

E) Deck and bottom transverse including adjacent structural members

F) Additional complete transverse web frame ring

Notes:

(1) The 30% is to be rounded up to the next whole integer.

Table I 2-18 has been amended as follows:

Table I 2-18
Minimum Requirements for Close-Up Survey at Hull Special Survey of Double Skin Bulk Carriers, Excluding Ore Carriers

SS No. 1 (Age ≤ 5)	SS No. 2 (5 < Age ≤ 10)	SS No. 3 (10 < Age ≤ 15)	SS No. 4 and Subsequent (15 < Age)
(A) 1 transverse web with associated plating and longitudinals in ~~two~~ 2 representative water ballast tanks of each type. (This is to include the foremost topside and double side water ballast tanks on either side)	(A) 1 transverse web with associated plating and longitudinals as applicable in each water ballast tank. (A) Forward and aft transverse bulkheads including stiffening system in a transverse section including topside, hopper side and double side ballast tanks on one side of the ship (i.e. port or starboard). (B) 25% of ordinary transverse frames for transverse framing system or 25% of longitudinals for longitudinal framing system on side shell and inner side plating at forward, middle and aft parts, in the foremost double side tanks.	(A) All transverse webs with associated plating and longitudinals as applicable in each water ballast tank. (A) All transverse bulkheads including stiffening system in each water ballast tank. (B) 25% of ordinary transverse frames for transverse framing systems or 25% of longitudinals for longitudinal framing systems on side shell and inner side plating at forward, middle and aft parts in all double side tanks.	(A) All transverse webs with associated plating and longitudinals as applicable in each water ballast tank. (A) All transverse bulkheads including stiffening system in each water ballast tank. (B) All ordinary transverse frames for transverse framing systems or all longitudinals for longitudinal framing systems on side shell and inner side plating at forward, middle and aft parts in all double side tanks. ~~Areas (C) ~ (E) as for age interval 10 to 15 years.~~
(C) 2 selected cargo hold transverse bulkheads, including internal structure of upper and lower stools, where fitted.	(C) 1 transverse bulkhead in each cargo hold, including internal structure of upper and lower stools, where fitted.	(C) All cargo hold transverse bulkheads, including internal structure of upper and lower stools, where fitted.	Areas (C) ~ (E) as for age interval 10 to 15 years.
(D) All cargo hold hatch covers and coamings (platings and stiffeners).	(D) All cargo hold hatch covers and coamings (platings and stiffeners).	(D) All cargo hold hatch covers and coamings (platings and stiffeners).	
	(E) All deck plating and under deck structure, inside line of hatch openings between all cargo hold hatches.	(E) All deck plating and under deck structure inside line of hatch openings between all cargo hold hatches	

(A) ~ (E) are areas to be subjected to Close-up Surveys and thickness measurements (See IACS URZ10.5, Figure 10 and 11).

(A) Transverse web frame or watertight transverse bulkhead in topside, hopper side and double side ballast tanks. In fore and aft peak tanks transverse web frame means a complete transverse web frame ring including adjacent structural members.

(B) Ordinary transverse frame or longitudinal frame in double side tanks.

(C) Cargo hold transverse bulkheads plating, stiffeners and girders.

(D) Cargo hold hatch covers and coamings. For cargo hold hatch covers of approved design which structurally have no access to the internals, close-up survey/ thickness measurement shall be done of accessible parts of hatch covers' structures.

(E) Deck plating and under deck structure inside line of hatch openings between cargo hold hatches.

Note: Close-up survey of transverse bulkheads to be carried out at 4 levels:
Level (a): Immediately above the inner bottom and immediately above the line of gussets (if fitted) and shedders for ships without lower stool.
Level (b): Immediately above and below the lower stool shelf plate (for those ships fitted with lower stools), and immediately above the line of the shedder plates.
Level (c): Above mid-height of the bulkhead.
Level (d): Immediately below the upper deck plating and immediately adjacent to the upper wing tank, and immediately below the upper stool shelf plate for those ships fitted with upper stools, or immediately below the topside tanks.

Table I 2-27~2-31 has been deleted as follows:

~~Table I 2-27~~

~~Individual Wastage Allowances, Non-CSR Tankers 90 m ≤ L~~[(5), (6), (7) and (8)]

~~Ordinary and High Strength Steel~~	~~Built 2005 or later~~	~~Built between 1962 and 2005~~	~~Built 1962 Or later~~
	~~Double Bottom Tankers~~	~~Double Bottom Tankers~~	~~Single Bottom Tankers~~
~~Strength Deck Plating~~	~~20%~~	~~20%~~	~~20%~~
~~Forecastle, Poop and Bridge Deck Plates; Superstructure End Bulkheads~~	~~30%~~	~~30%~~	~~30%~~
~~Sheer Strake Plates~~	~~20%~~	~~20%~~	~~20%~~
~~Side Shell Plates~~	~~20%~~	~~25%~~	~~25%~~
~~Bilge Strake Plates~~	~~20%~~	~~25%~~	~~20%~~
~~Bottom Plates~~	~~20%~~	~~25%~~	~~20%~~
~~Keel Plates~~[(4)]			
~~Outermost Strake of Inner Bottom~~	~~20%~~	~~20%~~	~~—~~
~~Other Plates of Inner Bottom~~	~~20%~~	~~25%~~	~~—~~
~~Top Strake of Longitudinal Bulkheads and Top Strake of Topside Tank Sloping Plating~~	~~20%~~	~~20%~~	~~20%~~
~~Bottom Strake of Longitudinal Bulkheads~~	~~20%~~	~~25%~~	~~20%~~
~~Other Plates of Longitudinal Bulkheads, Topside tank Sloping Plating, Hopper Tank Sloping Plating and Transverse Bulkheads~~	~~20%~~	~~25%~~	~~25%~~
~~Internals including Longitudinals, Girders, Transverses, Struts, Bulkhead Webs and Stringers, and Brackets~~	~~20%~~	~~25%~~	~~25%~~
~~Plates in way of Top of Tanks~~	~~25%~~	~~30%~~	~~30%~~

~~Notes:~~

~~(1) Internals included in longitudinal strength must be continuous or be effectively developed at ends, throughout amidships 0.4L.~~

~~(2) Structure must meet individual member thickness and average wastage.~~

~~(3) If design was originally approved on basis of engineering analysis (such as car carriers and other specialized vessels), or if owner specially request, the wastage may be assessed on engineering basis (i.e., acceptable stress levels and structural stability).~~

~~(4) Keel plates are to be renewed when they reach the minimum allowed thickness for adjacent bottom plating.~~

~~(5) The individual wastage allowances are acceptable, provided the Section Modulus is not less than 90% of the greater Section Modulus required: a) at the time of new construction or b) Z_{min} by 3.2.2 of Part II.~~

~~(6) For tankers 130 m in length and above and over 10 years of age, sectional area calculations are to be carried out by the Head Office of the Society.~~

~~(7) For vessels built to other society rules, the Head Office of the Society carrying out the initial plan review is to be contacted for wastage allowances.~~

~~(8) For CSR vessels type, the individual wastage allowance is defined in accordance with Part 1, Chapter 13 of IACS CSR for double hull oil tankers and for bulk carriers.~~

~~Table I 2-28~~

~~Individual Wastage Allowances, Liquefied Gas Carriers, 90 m ≤ L~~ ~~(5) & (6)~~

~~Ordinary and High Strength Steel~~	~~Built 2008 or later~~	~~Built between 1962 and 2008~~	~~Built 1962 or later~~
	~~Membrane LNG Carriers~~	~~Membrane LNG Carriers~~	~~Liquefied Gas Carriers with Independent Tanks~~
~~Strength Deck Plating~~	~~20%~~	~~20%~~	~~20%~~
~~Continuous Long'l Hatch Coamings & Above Deck Box Girders~~	~~20%~~	~~20%~~	~~20%~~
~~Forecastle, Poop and Bridge Deck Plates; Superstructure End Bulkheads~~	~~30%~~	~~30%~~	~~30%~~
~~Sheer Strake Plates~~	~~20%~~	~~20%~~	~~20%~~
~~Side Shell Plates~~	~~20%~~	~~25%~~	~~25%~~
~~Bilge Strake Plates~~	~~20%~~	~~25%~~	~~25%~~
~~Bottom Plates~~	~~20%~~	~~25%~~	~~25%~~
~~Keel Plates~~ ~~(4)~~			
~~Outermost Strake of Inner Bottom~~	~~20%~~	~~20%~~	~~20%~~
~~Other Plates of Inner Bottom~~	~~20%~~	~~25%~~	~~25%~~
~~Top Strake of Longitudinal Bulkheads and Top Strake of Topside Tank Sloping Plating~~	~~20%~~	~~20%~~	~~20%~~
~~Bottom Strake of Longitudinal Bulkheads~~	~~20%~~	~~25%~~	~~25%~~
~~Other Plates of Longitudinal Bulkheads, Topside Tank Sloping Plating, Hopper Tank Sloping Plating and Transverse Bulkheads~~	~~20%~~	~~25%~~	~~25%~~
~~Internals including Longitudinals, Girders, Transverses, Struts, Bulkhead Webs and Stringers and Brackets~~	~~20%~~	~~25%~~	~~25%~~
~~Plates in way of Top of Tanks~~	~~25%~~	~~30%~~	~~30%~~
~~Underdeck Box Girders (Long'l or Transverse)~~	~~20%~~	~~20%~~	~~20%~~

~~Notes:~~

~~(1) Internals included in longitudinal strength must be continuous or be effectively developed at ends, throughout amidships 0.4L.~~

~~(2) Structure must meet individual member thickness and average wastage.~~

~~(3) If design was originally approved on basis of engineering analysis (such as car carriers and other specialized vessels), or if owner specially request, the wastage may be assessed on engineering basis (i.e., acceptable stress levels and structural stability).~~

~~(4) Keel plates are to be renewed when they reach the minimum allowed thickness for adjacent bottom plating.~~

~~(5) The individual wastage allowances are acceptable, provided the Section Modulus is not less than 90% of the greater Section Modulus required: a) at the time of new construction or b) Z_{min} by 3.2.2 of Part II.~~

~~(6) For vessels built to other society rules, the Head Office of the Society carrying out the initial plan review is to be contacted for wastage allowances.~~

~~Table I 2-29~~

~~Individual Wastage Allowances, Ships, 90 m ≤ L~~ ~~(9), (10) and (11)~~

~~Ordinary and High Strength Steel~~	~~Built 2018 or later~~	~~Built between 1962 and 2018~~	~~Built 1962 or later~~	~~Long'ly framed vessels built prior to 1962. Transv'ly framed vessels of all ages. Dry cargo barges 90 m ≤ L. Tank Barges 90 to 122 m~~[8]	~~Vessels of all ages with a combination of transverse and longitudinal framing.~~
	~~Non-CSR Bulk Carriers, Ore Carriers and OBOs~~		~~Container ships~~		
~~Strength Deck Plating~~	~~20%~~	~~20%~~	~~20%~~	~~25%~~	~~20%~~
~~Continuous Long'l Hatch Coamings & Above Deck Box-Girders~~	~~20%~~	~~20%~~	~~20%~~	~~25%~~	~~20%~~
~~Deck Plates within Line of Hatches and at Ends.~~	~~30%~~	~~30%~~	~~30%~~	~~30%~~	~~30%~~
~~Forecastle, Poop and Bridge Deck Plates; Superstructure End Bulkheads~~	~~30%~~	~~30%~~	~~30%~~	~~30%~~	~~30%~~
~~Tween Deck Plates~~	~~--~~	~~--~~	~~--~~	~~30%~~	~~--~~
~~Sheer Strake Plates~~	~~20%~~	~~20%~~	~~20%~~	~~25%~~	~~20%~~
~~Side Shell Plates~~	~~20%~~	~~25%~~	~~25%~~	~~25%~~	~~25%~~
~~Bilge Strake Plates~~	~~20%~~	~~25%~~	~~25%~~	~~25%~~	~~25%~~
~~Bottom Plates~~	~~20%~~	~~25%~~	~~25%~~	~~25%~~	~~25%~~
~~Keel Plates~~[4]					
~~Outermost Strake of Inner Bottom~~	~~25%~~	~~30%~~	~~20%~~	~~30%~~	~~30%~~
~~Other Plates of Inner Bottom~~	~~25%~~	~~30%~~	~~25%~~	~~30%~~	~~30%~~
~~Top Strake of Longitudinal Bulkheads and Top Strake of Topside Tank Sloping Plating~~	~~20%~~	~~20%~~	~~20%~~	~~25%~~	~~25%~~
~~Bottom Strake of Longitudinal Bulkheads~~	~~20%~~	~~25%~~	~~25%~~	~~25%~~	~~25%~~
~~Other Plates of Longitudinal Bulkheads, Topside Tank Sloping Plating, Hopper Tank Sloping Plating and Transverse Bulkheads.~~[5] ~~&~~ [6]	~~20%~~	~~25%~~	~~25%~~	~~25%~~	~~25%~~
~~Internals including Longitudinals, Girders, Transverses, Struts, Bulkhead Webs and Stringers, Brackets and Hatch Side Girders~~	~~20%~~	~~25%~~	~~25%~~	~~25%~~	~~25%~~
~~Plates in way of Top of Tanks~~	~~25%~~	~~30%~~	~~30%~~	~~30%~~	~~30%~~
~~Underdeck Box Girders (Long'l or Transverse)~~	~~20%~~	~~20%~~	~~20%~~	~~20%~~	~~20%~~
~~Hatch Covers~~[7]~~, Hatch coamings and brackets~~	~~30%~~	~~30%~~	~~30%~~	~~30%~~	~~30%~~

~~Notes:~~

~~(1) Internals included in longitudinal strength must be continuous or be effectively developed at ends, throughout amidships 0.4L.~~

~~(2) Structure must meet individual member thickness and average wastage.~~

~~(3) If design was originally approved on basis of engineering analysis (such as car carriers and other specialized vessels), or if owner specially request, the wastage may be assessed on engineering basis (i.e., acceptable stress levels and structural stability).~~

~~(4) Keel plates are to be renewed when they reach the minimum allowed thickness for adjacent bottom plating.~~

~~(5) Bulk Carriers for which IACS UR S19 applies to the corrugated transverse watertight bulkhead between cargo holds 1 and 2 are to be assessed in accordance with S19 for initial compliance and subsequent continued compliance at each Intermediate Survey and Special Periodical Survey – Hull.~~

~~(6) Bulk carriers for which UR S18 applies to the corrugated transverse W.T. bulkheads are to comply with the steel renewal provisions of S18.~~

~~(7) The hatch covers of bulk carriers to which IACS UR S21 applies are to comply with the steel renewal provisions of UR S21.6.~~

~~(8) Wastage allowances in columns 1, 2 or 3 of Table I 2-27, depending on the barge's construction, apply to tank barges over 122 m in length.~~

~~(9) The individual wastage allowances are acceptable, provided the hull girder Section Modulus is not less than 90% of the greater Section Modulus required: a) at the time of new construction or b) Z_{min} by 3.2.2 of Part II.~~

~~(10) For vessels built to other society rules, the Head Office of the Society carrying out the initial plan review is to be contacted for wastage allowances.~~

~~(11) For CSR vessels type, the individual wastage allowance is defined in accordance with Part 1, Chapter 13 of IACS CSR for double hull oil tankers and for bulk carriers.~~

~~Table I 2-30~~
~~Individual Wastage Allowances, Ships, L < 90 m~~

~~Main Deck Plating~~	~~25%~~
~~Bottom Plating~~	~~25%~~
~~Keel Plating~~	~~25%~~
~~Sheer Strake~~	~~25%~~
~~Bilge Strake~~	~~25%~~
~~Side Shell Plating~~	~~30%~~
~~Forecastle~~	~~30%~~
~~Internals and Bulkheads~~	~~30%~~

~~For vessels built to other society rules, the Head Office of the Society carrying out the initial plan review is to be contacted for wastage allowances.~~

~~Notes:~~

~~(1) Internals included in longitudinal strength must be continuous or be effectively developed at ends, throughout amidships 0.4L.~~

~~(2) The values shown in the table are the minimum requirements for individual members and plates.~~

~~(3) In addition to satisfying the individual member and plate requirements, it should be verified that the hull girder section modulus is not less than 90% of the greater Hull Girder Section Modulus required either:~~

~~a) At the time of new construction~~

~~b) Z_e as specified in 3.2.1 of Part XV~~

~~(4) For vessels less than 60 m only, maximum loss of deck or bottom area is 20 percent of Rule required area.~~

~~(5) For vessels built to other society rules, wastage allowance based on the previous society requirements may apply.~~

~~Table I 2-31~~
~~Aluminum Wastage Allowances, Ships, L < 90 m~~

~~Main Deck Plating~~	~~15%~~
~~Bottom Plating~~	~~15%~~
~~Keel Plating~~	~~15%~~
~~Sheer Strake~~	~~15%~~
~~Bilge Strake~~	~~15%~~
~~Side Shell Plating~~	~~20%~~
~~Forecastle~~	~~20%~~
~~Internals and Bulkheads~~	~~20%~~

~~For Ships built to other society rules, the Head Office of the Society carrying out the initial plan review is to be contacted for wastage allowances.~~

Table I 2-27~2-29 has been added as follows:

Table I 2-27
Minimum Requirements for Thickness Measurements for Surface-Type Units at Special Survey

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. Suspect areas throughout the unit.	1. Suspect areas throughout the unit.	1. Suspect areas throughout the unit.	1. Suspect areas throughout the unit
	2. 1 transverse section of deck plating abreast the moon pool opening within the amidships 0.6L, together with internals in way as deemed necessary. Where unit is configured with side ballast tanks, the plating and internals of the tanks are also to be gauged in way of the section chosen.	2. 2 Transverse Sections (Girth Belts) of deck, bottom and side plating abreast the moon pool and 1 hatch opening within the amidships 0.6L together with internals in way as deemed necessary. Where unit is configured with side ballast tanks, the plating and internals of the tanks to be gauged in way of the required belts, Remaining internals in ballast tanks to be gauged as deemed necessary.	2. A minimum of 3 Transverse Sections (Girth Belts) of deck, bottom, side, and longitudinal-bulkhead plating in way of the moon pool and other areas within the amidships 0.6L, together with internals in way (including in perimeter ballast tanks, where fitted in way of belts).
	3. Moon pool boundary bulkhead plating.	3. Moon pool boundary bulkhead plating.	3. Moon pool boundary bulkhead plating.
		4. Internals in forepeak tank and aft peak tank as deemed necessary.	4. Internals in forepeak and after peak tanks as deemed necessary.
			5. Lowest strake of all transverse bulkheads in hold spaces. Remaining bulkhead plating to be gauged as deemed necessary.
			6. All plates in 2 wind and water strakes, port and starboard, full length.
			7. All exposed main deck plating full length and all exposed first-tier super-structure deck plating (poop, bridge and forecastle decks).
			8. All keel plates full length plus additional bottom plating as deemed necessary by the Surveyor, particularly in way of cofferdams and machinery spaces.
			9. Duct keel or pipe tunnel plating or pipe tunnel plating and internals as deemed necessary.
			10. Plating of sea chests. Shell plating in way of overboard discharges as considered necessary by the attending surveyor.

Notes:

1. Thickness measurement locations are to be selected to provide the best representative sampling of areas likely to be most exposed to corrosion, considering ballast history and arrangement and condition of protective coatings.
2. Thickness measurements of internals may be specially considered by the Surveyor if the hard protective coating is in GOOD condition.
3. For units less than 100 meters in length, the number of transverse sections required at Special Survey No. 3 may be reduced to 1, and the number of transverse sections required at subsequent Special Surveys may be reduced to 2.
4. For units more than 100 meters in length, at Special Survey No. 3, thickness measurements of exposed deck plating within amidship 0.5L may be required.

Table I 2-28
Minimum Requirements for Thickness Measurements for Self-Elevating Units at Special Survey

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. Suspect areas throughout the unit (particular attention to be paid to the legs in way of the Splash Zone).	1. Suspect areas throughout the unit.	1. Suspect areas throughout the unit.	1. Suspect areas throughout the unit.
	2. Legs in way of Splash Zone.	2. Legs in way of Splash Zone.	2. Legs in way of Splash Zone.
	3. Primary application structures where wastage is evident.	3. Representative gaugings, throughout, of special and primary application structures.	3. Comprehensive gaugings, throughout, of special and primary application structures.
	4. Representative gaugings of upper hull deck and bottom plating and internals of one preload (ballast) tank.	4. Leg well structure.	4. Leg well structure.
		5. Representative gaugings of deck, bottom, and side shell plating of hull and mat.	5. Representative gaugings of deck, bottom, and side shell plating of hull and mat.
		6. Representative gaugings of upper hull deck and bottom plating and internals of at least 2 preload (ballast) tanks.	6. Substructure of derrick as deemed necessary.
			7. Representative gaugings of internals of all preload (ballast) tanks.

Note:
Structural application designation (Special, Primary, Secondary) are defined in IACS Recommendation No. 11

Table I 2-29
Minimum Requirements for Thickness Measurements for Column-Stabilized Units at Special Survey

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. Suspect areas throughout the unit.	1. Suspect areas throughout the unit.	1. Suspect areas throughout the unit.	1. Suspect areas throughout the unit.
2. Columns and bracings where wastage is evident in Splash Zone.	2. Representative gaugings of columns and bracings in Splash Zone together with internals in way as deemed necessary.	2. Representative gaugings, throughout, of special and primary application structures.	2. Comprehensive gaugings, throughout, of special and primary application structures.
	3. Special and primary application structure where wastage is evident.	3. 1 Transverse Section (Girth Belt) of each of 2 columns and 2 bracings in Splash Zone together with internals in way as deemed necessary.	3. 1 Transverse Section (Girth Belt) of each of one-half of the columns and bracings in Splash Zone and internals in way as deemed necessary (i.e., gauge half of the unit's columns and bracings in Splash Zone).
		4. Lower hulls in way of mooring lines where wastage is evident.	4. Lower hulls in way of mooring lines where wastage is evident.
		5. 1 Transverse Section (Girth Belt) of each lower hull between one set of columns.	5. 1 Transverse Section (Girth Belt) of each lower hull between 1 set of columns.
			6. Representative gaugings of substructure of drilling derrick.

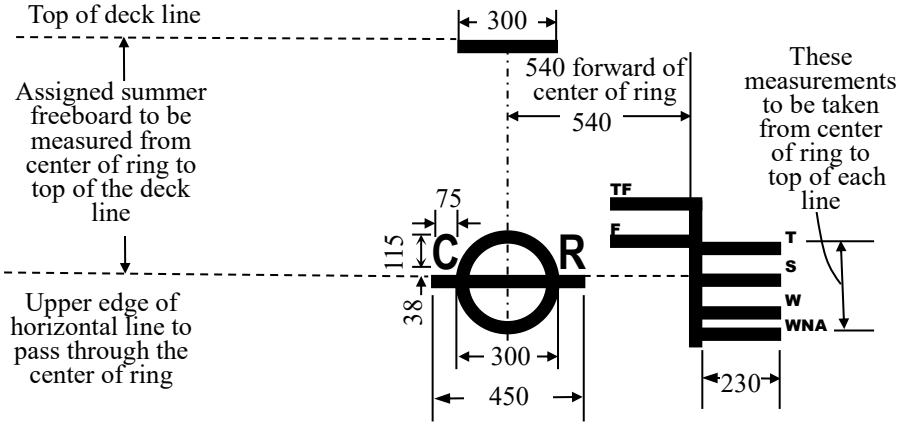
Note:

Structural application designation (Special, Primary, Secondary) are defined in IACS Recommendation No. 11

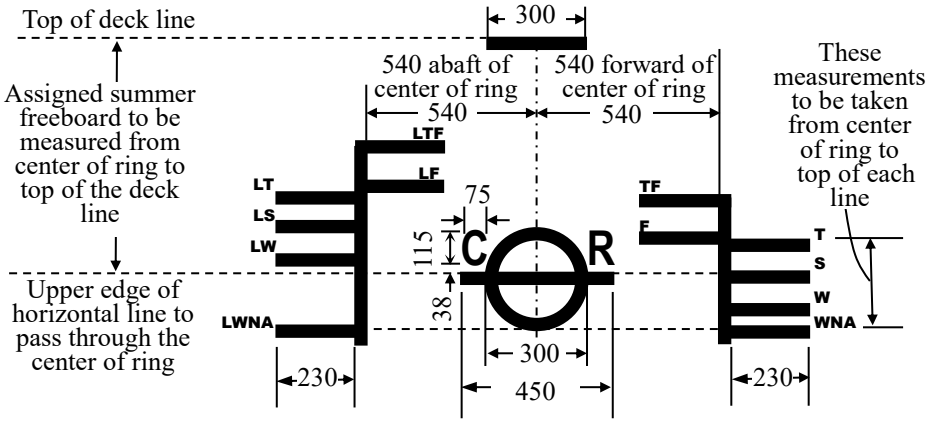
Appendix 3 Load-Line Markings

Appendix 3 has been amended as follows:

For Ocean-going Ships



For Ocean-going Ships with Timber Freeboards



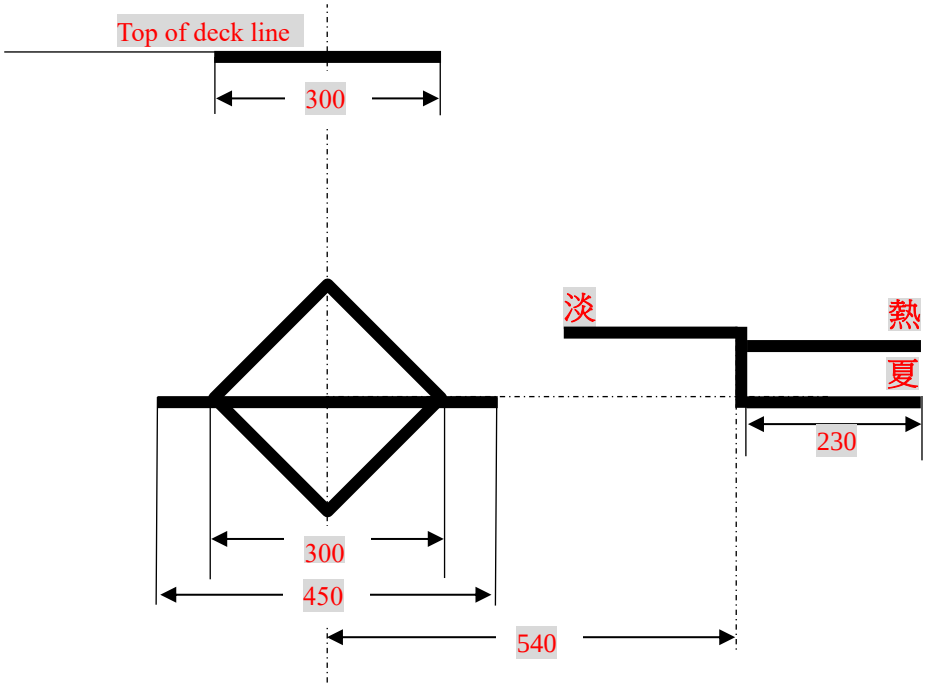
Notes:

(1) The center of the ring is to be placed on each side of the ships ~~vessels~~ at the middle of the length as defined in the Load Line Regulations. The ring and lines are to be permanently marked, as by center punch, chisel cut or bead of weld.

(2) The breadth ~~thickness~~ of all lines is ~~are~~ 25 mm.

(3) The size of all letterings are 50 × 32 mm. except W 50 × 45 mm, unless otherwise noted.

For domestic voyages ships



Notes:

(1) The center of the square is to be placed on each side of the ship at the middle of the length as defined in the Load Line Regulations. The square and lines are to be permanently marked, as by center punch, chisel cut or bead of weld.

(2) The breadth of all lines is 25 mm.

(3) The size of the Chinese characters 「淡」,「夏」,「熱」are 50 × 45 mm.

Appendix 4 Additional Information on Hull Thickness Measurement

Appendix 4 has been added as follows:

A4.1 Thickness Measurements Acceptance Criteria

A4.1.1 For ship built before 2020, the acceptance criteria for thickness measurements are according to CR Notice No. CRN-08-001(T).

A4.1.2 For ship built 2020 or later, the acceptance criteria for thickness measurements are according to Table I A4-1 to Table I A4-5.

Table I A4-1
Individual Wastage Allowances, Non-CSR Tankers 90 m ≤ L[(5), (6), (7) and (8)]

Ordinary and High Strength Steel	Double Bottom Tankers
Strength Deck Plating	20%
Forecastle, Poop and Bridge Deck Plates; Superstructure End Bulkheads	30%
Sheer Strake Plates	20%
Side Shell Plates	20%
Bilge Strake Plates	20%
Bottom Plates	20%
Keel Plates[(4)]	
Outermost Strake of Inner Bottom	20%
Other Plates of Inner Bottom	20%
Top Strake of Longitudinal Bulkheads and Top Strake of Topside Tank Sloping Plating	20%
Bottom Strake of Longitudinal Bulkheads	20%
Other Plates of Longitudinal Bulkheads, Topside tank Sloping Plating, Hopper Tank Sloping Plating and Transverse Bulkheads	20%
Internals including Longitudinals, Girders, Transverses, Struts, Bulkhead Webs and Stringers, and Brackets	20%
Plates in way of Top of Tanks	25%

Notes:

(1) Internals included in longitudinal strength must be continuous or be effectively developed at ends, throughout amidships 0.4L.

(2) Structure must meet individual member thickness and average wastage.

(3) If design was originally approved on basis of engineering analysis (such as car carriers and other specialized ships), or if owner specially request, the wastage may be assessed on engineering basis (i.e., acceptable stress levels and structural stability).

(4) Keel plates are to be renewed when they reach the minimum allowed thickness for adjacent bottom plating.

(5) The individual wastage allowances are acceptable, provided the Section Modulus is not less than 90% of the greater Section Modulus required: a) at the time of new construction or b) Z_{min} by 3.2.2 of Part II.

(6) For tankers 130 m in length and above and over 10 years of age, sectional area calculations are to be carried out by the Society.

(7) For ships built to other society rules, the Society carrying out the initial plan review is to be contacted for wastage allowances.

(8) For CSR ships type, the individual wastage allowance is defined in accordance with Part 1, Chapter 13 of IACS CSR for double hull oil tankers and for bulk carriers.

Table I A4-2
Individual Wastage Allowances, Liquefied Gas Carriers, 90 m ≤ L (5) & (6)

Ordinary and High Strength Steel	Membrane LNG Carriers	Liquefied Gas Carriers with Independent Tanks
Strength Deck Plating	20%	20%
Continuous Long'l Hatch Coamings & Above Deck Box-Girders	20%	20%
Forecastle, Poop and Bridge Deck Plates; Superstructure End Bulkheads	30%	30%
Sheer Strake Plates	20%	20%
Side Shell Plates	20%	25%
Bilge Strake Plates	20%	25%
Bottom Plates	20%	25%
Keel Plates(4)		
Outermost Strake of Inner Bottom	20%	20%
Other Plates of Inner Bottom	20%	25%
Top Strake of Longitudinal Bulkheads and Top Strake of Topside Tank Sloping Plating	20%	20%
Bottom Strake of Longitudinal Bulkheads	20%	25%
Other Plates of Longitudinal Bulkheads, Topside Tank Sloping Plating, Hopper Tank Sloping Plating and Transverse Bulkheads	20%	25%
Internals including Longitudinals, Girders, Transverses, Struts, Bulkhead Webs and Stringers and Brackets	20%	25%
Plates in way of Top of Tanks	25%	30%
Underdeck Box Girders (Long'l or Transverse)	20%	20%

Notes:

(1) Internals included in longitudinal strength must be continuous or be effectively developed at ends, throughout amidships 0.4L.

(2) Structure must meet individual member thickness and average wastage.

(3) If design was originally approved on basis of engineering analysis (such as car carriers and other specialized ships), or if owner specially request, the wastage may be assessed on engineering basis (i.e., acceptable stress levels and structural stability).

(4) Keel plates are to be renewed when they reach the minimum allowed thickness for adjacent bottom plating.

(5) The individual wastage allowances are acceptable, provided the Section Modulus is not less than 90% of the greater Section Modulus required: a) at the time of new construction or b) Z_{min} by 3.2.2 of Part II.

(6) For ships built to other society rules, the Society carrying out the initial plan review is to be contacted for wastage allowances.

Table I A4-3
Individual Wastage Allowances, Ships, 90 m ≤ L [(9), (10) and (11)]

Ordinary and High Strength Steel	Non-CSR Bulk Carriers, Ore Carriers and OBOs	Container ships	Transv'ly framed ships Dry cargo barges 90 m ≤ L Tank Barges 90 to 122 m[(8)]	Ships with a combination of transverse and longitudinal framing.
Strength Deck Plating	20%	20%	25%	20%
Continuous Long'l Hatch Coamings & Above Deck Box-Girders	20%	20%	25%	20%
Deck Plates within Line of Hatches and at Ends.	30%	30%	30%	30%
Forecastle, Poop and Bridge Deck Plates; Superstructure End Bulkheads	30%	30%	30%	30%
Tween Deck Plates	--	--	30%	--
Sheer Strake Plates	20%	20%	25%	20%
Side Shell Plates	20%	25%	25%	25%
Bilge Strake Plates	20%	25%	25%	25%
Bottom Plates	20%	25%	25%	25%
Keel Plates[(4)]				
Outermost Strake of Inner Bottom	25%	20%	30%	30%
Other Plates of Inner Bottom	25%	25%	30%	30%
Top Strake of Longitudinal Bulkheads and Top Strake of Topside Tank Sloping Plating	20%	20%	25%	25%
Bottom Strake of Longitudinal Bulkheads	20%	25%	25%	25%
Other Plates of Longitudinal Bulkheads, Topside Tank Sloping Plating, Hopper Tank Sloping Plating and Transverse Bulkheads [(5) & (6)]	20%	25%	25%	25%
Internals including Longitudinals, Girders, Transverses, Struts, Bulkhead Webs and Stringers, Brackets and Hatch Side Girders	20%	25%	25%	25%
Plates in way of Top of Tanks	25%	30%	30%	30%
Underdeck Box Girders (Long'l or Transverse)	20%	20%	20%	20%
Hatch Covers[(7)], Hatch coamings and brackets	30%	30%	30%	30%

Notes:

(1) Internals included in longitudinal strength must be continuous or be effectively developed at ends, throughout amidships 0.4L.

(2) Structure must meet individual member thickness and average wastage.

(3) If design was originally approved on basis of engineering analysis (such as car carriers and other specialized ships), or if owner specially request, the wastage may be assessed on engineering basis (i.e., acceptable stress levels and structural stability).

(4) Keel plates are to be renewed when they reach the minimum allowed thickness for adjacent bottom plating.

(5) Bulk Carriers for which IACS UR S19 applies to the corrugated transverse watertight bulkhead between cargo holds 1 and 2 are to be assessed in accordance with S19 for initial compliance and subsequent continued compliance at each Intermediate Survey and Special Periodical Survey – Hull.

(6) Bulk carriers for which UR S18 applies to the corrugated transverse W.T. bulkheads are to comply with the steel renewal provisions of S18.

(7) The hatch covers of bulk carriers to which IACS UR S21 applies are to comply with the steel renewal provisions of UR S21.6.

(8) Wastage allowances in Table I A4-1, depending on the barge's construction, apply to tank barges over 122 m in length.

(9) The individual wastage allowances are acceptable, provided the hull girder Section Modulus is not less than 90% of the greater Section Modulus required: a) at the time of new construction or b) Z_{min} by 3.2.2 of Part II.

(10) For ships built to other society rules, the Society carrying out the initial plan review is to be contacted for wastage allowances.

(11) For CSR ships type, the individual wastage allowance is defined in accordance with Part 1, Chapter 13 of IACS CSR for double hull oil tankers and for bulk carriers.

Table I A4-4
Individual Wastage Allowances, Ships, L < 90 m

Main Deck Plating	25%
Bottom Plating	25%
Keel Plating	25%
Sheer Strake	25%
Bilge Strake	25%
Side Shell Plating	30%
Forecastle	30%
Internals and Bulkheads	30%

For ships built to other society rules, the Society carrying out the initial plan review is to be contacted for wastage allowances.

Notes:

(1) Internals included in longitudinal strength must be continuous or be effectively developed at ends, throughout amidships 0.4L.

(2) The values shown in the table are the minimum requirements for individual members and plates.

(3) In addition to satisfying the individual member and plate requirements, it should be verified that the hull girder section modulus is not less than 90% of the greater Hull Girder Section Modulus required either:

a) At the time of new construction

b) Z_σ as specified in 3.2.1 of Part XV

(4) For ships less than 60 m only, maximum loss of deck or bottom area is 20 percent of Rule required area.

(5) For ships built to other society rules, wastage allowance based on the previous society requirements may apply.

Table I A4-5
Aluminum Wastage Allowances, Ships, L < 90 m

Main Deck Plating	15%
Bottom Plating	15%
Keel Plating	15%
Sheer Strake	15%
Bilge Strake	15%
Side Shell Plating	20%
Forecastle	20%
Internals and Bulkheads	20%

For Ships built to other society rules, the Society carrying out the initial plan review is to be contacted for wastage allowances.

AMENDMENT TO "THE RULES FOR THE CONSTRUCTION AND CLASSIFICATION OF STEEL SHIPS 2019 AND AMENDMENTS THEREOF "

PART II HULL CONSTRUCTION AND EQUIPMENT

List of major changes in Part II from 2019 edition

1.5.4~1.5.5	Revised
1.5.8	New
1.12.1	New
1.13.4(a)	Revised
Table II 1-6	New
Table II 1-6~1-9	Renumbered
Table II 1-10	Renumbered and Revised
Table II 1-11~13	Revised
Table II 1-14	Renumbered
12.5	New
23.1.7	Revised
25.1.6	New
25.2.1(c) & (d)	New
25.3.6	Revised
25.4.6~25.4.7	New
25.9.3(b)(i)	Revised
25.9.3(b)(viii) & (ix)	New
25.11	New
Table II 25-2	New
30.6.1(c)	New
31.5.3(b)	Deleted

Rules for the Construction and Classification of Steel Ships 2019 and amendments thereof have been partly amended as follows:

Chapter 1 General

Paragraphs 1.5.4~1.5.5 have been amended as follows:

1.5 Materials

1.5.4 Use of steel grades for ships

(a) Materials in the various strength members are not to be of lower grade than those corresponding to the material classes and grades specified in Table II 1-4 to Table II 1-~~9~~10. General requirements are given in Table II 1-4, while additional minimum requirements for ships with length exceeding 150 m and 250 m, bulk carriers subject to the requirements of SOLAS regulation XII/6.4.3, and ships with ice strengthening are given in Table II 1-~~7~~5 to Table II 1-~~8~~9. The material grade requirements for hull members of each class depending on the thickness are defined in Table II 1-~~9~~10.

(b) For strength members not mentioned in Table II 1-4 to Table II 1-~~8~~9, Grade A/AH may generally be used. The steel grade is to correspond to the as-built plate thickness when this is greater than the rule requirement.

(c) Plating materials for stern frames, rudders, rudder horns and shaft brackets are in general not to be of lower grades than corresponding to Class II. For rudder and rudder body plates subjected to stress concentrations (e.g. in way of lower support of semi-spade rudders or at upper part of spade rudders) Class III is to be applied.

1.5.5 Structures exposed to low air temperatures

(a) For ships intended to operate in areas with low air temperatures (below and including -20ºC), e.g. regular service during winter seasons to Arctic or Antarctic waters, the materials in exposed structures are to be selected based on the design temperature t_D, to be taken as defined in 1.5.6.

(b) Materials in the various strength members above the lowest ballast water line (BWL) exposed to air are not to be of lower grades than those corresponding to Classes I, II and III, as given in Table II 1-1~~0~~ of this Chapter, depending on the categories of structural members (SECONDARY, PRIMARY and SPECIAL). For non-exposed structures (except as indicated in Note (5) of Table II 1-1~~0~~ of this Chapter) and structures below the lowest ballast water line, see 1.5.4 of this Chapter.

(c) The material grade requirements for hull members of each class depending on thickness and design temperature are defined in Table II 1-12~~1~~ to Table II 1-14~~2~~. For design temperatures t_D < -55ºC, materials are to be specially considered by the Society.

(d) Single strakes required to be of Class III or of Grade E/EH or FH are to have breadths not less than 800+ 5L mm, maximum 1800 mm.

(e) Plating materials for stern frames, rudder horns, rudders and shaft brackets are not to be of lower grades than those corresponding to the material classes given in 1.5.4.

Paragraph 1.5.8 has been added as follows:

1.5.8 Cold cargo for ships other than liquefied gas carriers

For ships other than liquefied gas carriers, intended to be loaded with liquid cargo having a temperature below −10 °C, e.g. loading from cold onshore storage tanks during winter conditions, the material grade of cargo tank boundary plating is defined in Table II 1-12 to Table II 1-14 based on the following:

(a) t_c = design minimum cargo temperature in °C

(b) steel grade corresponding to Class I as given in Table II 1-12

The design minimum cargo temperature, t_c is to be specified in the loading manual.

Paragraph 1.12.1 has been amended as follows:

1.12 Direct Calculations

1.12.1 Where approved by the Society, direct calculations may be used to determine the scantlings of primary members. Where direct calculations are used, the data necessary for the calculations are to be submitted to the Society including but not limited to as follows:

(a) The direct calculation procedures are to be agreed by the Society.

(b) The technical program(s) used.

(c) A description of the structural modelling.

(d) A summary of analysis parameters including properties and boundary conditions.

(e) Details of the loading conditions and the means of applying loads.

(f) A comprehensive summary of calculation results. Sample calculations should be submitted where appropriate.

In general, submission of large volumes of input and output data associated with such programs as finite element analysis will not be necessary.

Paragraph 1.13.4(a) has been amended as follows:

1.13 Structural Details

1.13.4 Sheerstrake and bulwarks

(a) Where an angled gunwale is fitted, the top edge of the sheerstrake is to be kept free of all notches and isolated welded fittings. Fixtures of deck fittings such as bulwarks and eye plates ~~Bulwarks~~ are not to be welded to the top of the sheerstrake ~~within the 0.5L amidships~~ except within 0.1 L from A.E. and F.E. Drainage openings with a smooth transition in the longitudinal direction may be permitted. The design of the fittings shall be such as to minimise stress concentrations, with a smooth transition towards deck level. For ships with low/moderate hull girder stress, such details will be considered on a case-by-case basis.

Table II 1-6 has been added as follows:

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

Structural member category		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.

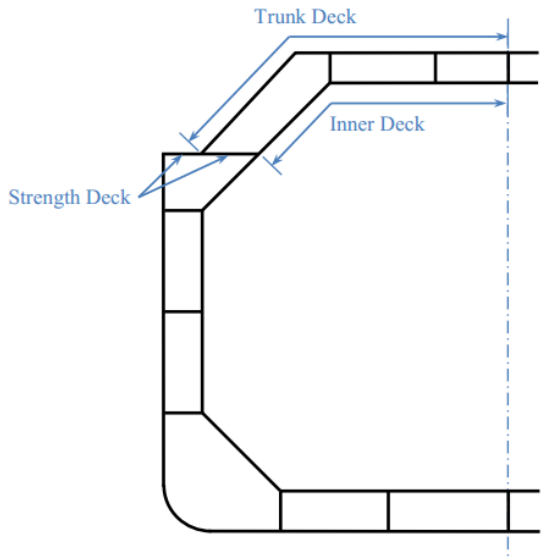


Figure: Typical deck arrangement for membrane type Liquefied Natural Gas Carriers

Table II 1-6~1-9 have been renumbered as follows:

Table II 1-~~6~~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

Single strakes required to be of 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.

Table II 1-~~7~~8
Minimum Material Grades for Single-side Skin Bulk Carriers Subjected to SOLAS Regulation XII/6.4.3

Structural member category	Material grade
Lower bracket of ordinary side frame(1), (2)	Grade D/DH
Side shell strakes included totally or partially between the two points located to 0.125h above and below the intersection of side shell and bilge hopper sloping plate or inner bottom plate(2)	Grade D/DH

(1) The term "lower bracket" means webs of lower brackets and webs of the lower part of side frames up to the point of 0.125h above the intersection of side shell and bilge hopper sloping plate or inner bottom plate.

(2) The span of the side frame, h, is defined as the distance between the supporting structures.

Table II 1-~~8~~9
Minimum Material Grades for Ships with Ice Strengthening

Structural member category	Material grade
Shell strakes in way of ice strengthening area for plates	Grade B/AH

Table II 1-~~9~~10
Material Grade Requirements for Classes I, II and III

Class	I		II		III	
As-built thickness, in mm	NSS	HSS	NSS	HSS	NSS	HSS
$t \leq 15$	A	AH	A	AH	A	AH
$15 < t \leq 20$	A	AH	A	AH	B	AH
$20 < t \leq 25$	A	AH	B	AH	D	DH
$25 < t \leq 30$	A	AH	D	DH	D	DH
$30 < t \leq 35$	B	AH	D	DH	E	EH
$35 < t \leq 40$	B	AH	D	DH	E	EH
$40 < t \leq 50$	D	DH	E	EH	E	EH

Note :
NSS : Normal strength steel
HSS : Higher strength steel

Table II 1-10 have been renumbered and amended as follows:

Table II 1-~~10~~11
Application of Material Classes and Grades – Structures Exposed at Low Temperatures

Structural member category	Material class	
	Within 0.4L amidships	Outside 0.4L amidships
SECONDARY: Deck plating exposed to weather, in general Side plating above BWL Transverse bulkheads above BWL(5) Cargo tank boundary plating exposed to cold cargo(6)	I	I
PRIMARY: Strength deck plating(1) Continuous longitudinal members above strength deck, excluding longitudinal hatch coamings Longitudinal bulkhead above BWL(5) Top wing tank bulkhead above BWL(5)	II	I
SPECIAL: Sheer strake at strength deck(2) Stringer plate in strength deck(2) Deck strake at longitudinal bulkhead(3) Continuous longitudinal hatch coamings(4)	III	II

Note:

(1) Plating at corners of large hatch openings to be specially considered. Class III or Grade E/EH to be applied in positions where high local stresses may occur.

(2) Not to be less than Grade E/EH within 0.4L amidships in ships with length exceeding 250 m.

(3) In ships with breadth exceeding 70 m at least three deck strakes to be Class III.

(4) Not to be less than Grade D/DH.

(5) Applicable to plating attached to hull envelope plating exposed to low air temperature. At least one strake is to be considered in the same way as exposed plating and the strake width is to be at least 600 mm.

(6) For cargo tank boundary plating exposed to cold cargo for ships other than liquefied gas carriers, see 1.5.8.

The material grade requirements for hull members of each class depending on thickness and design temperature are defined in Table II 1-11 to Table II 1-13. For design temperatures $t_D < -55$ºC, materials are to be specially considered by each Classification Society.

[PART II]

Table II 1-11~1-13 have been amended as follows:

~~**Table II 1-11**~~

~~**Material Grade Requirements for Classes I at Low Temperature**~~

~~Temperature~~	~~-20 / -25 ℃~~		~~-26 / -35 ℃~~		~~-36 / -45 ℃~~		~~-45 / -55 ℃~~	
~~As-built thickness, in mm~~	~~NSS~~	~~HSS~~	~~NSS~~	~~HSS~~	~~NSS~~	~~HSS~~	~~NSS~~	~~HSS~~
~~t ≤ 10~~	~~A~~	~~AH~~	~~B~~	~~AH~~	~~D~~	~~DH~~	~~D~~	~~DH~~
~~10 < t ≤ 15~~	~~B~~	~~AH~~	~~D~~	~~DH~~	~~D~~	~~DH~~	~~D~~	~~DH~~
~~15 < t ≤ 20~~	~~B~~	~~AH~~	~~D~~	~~DH~~	~~D~~	~~DH~~	~~E~~	~~EH~~
~~20 < t ≤ 25~~	~~D~~	~~DH~~	~~D~~	~~DH~~	~~D~~	~~DH~~	~~E~~	~~EH~~
~~25 < t ≤ 30~~	~~D~~	~~DH~~	~~D~~	~~DH~~	~~E~~	~~EH~~	~~E~~	~~EH~~
~~30 < t ≤ 35~~	~~D~~	~~DH~~	~~D~~	~~DH~~	~~E~~	~~EH~~	~~E~~	~~EH~~
~~35 < t ≤ 45~~	~~D~~	~~DH~~	~~E~~	~~EH~~	~~E~~	~~EH~~	~~-~~	~~FH~~
~~45 < t ≤ 50~~	~~E~~	~~EH~~	~~E~~	~~EH~~	~~-~~	~~FH~~	~~-~~	~~FH~~
~~Note :~~ ~~NSS : Normal strength steel~~ ~~HSS : Higher strength steel~~								

Table II 1-12

Material Grade Requirements for Class I at Low Temperatures

Temperature	-11 / -15 ℃		-16 / -25 ℃		-26 / -35 ℃		-36 / -45 ℃		-46 / -55 ℃	
Plate thickness, in mm	MS	HT	MS	HT	MS	HT	MS	HT	MS	HT
t ≤ 10	A	AH	A	AH	B	AH	D	DH	D	DH
10 < t ≤ 15	A	AH	B	AH	D	DH	D	DH	D	DH
15 < t ≤ 20	A	AH	B	AH	D	DH	D	DH	E	EH
20 < t ≤ 25	B	AH	D	DH	D	DH	D	DH	E	EH
25 < t ≤ 30	B	AH	D	DH	D	DH	E	EH	E	EH
30 < t ≤ 35	D	DH	D	DH	D	DH	E	EH	E	EH
35 < t ≤ 45	D	DH	D	DH	E	EH	E	EH	-	FH
45 < t ≤ 50	D	DH	E	EH	E	EH	-	FH	-	FH

~~**Table II 1-12**~~
~~**Material Grade Requirements for Classes II at Low Temperature**~~

~~Temperature~~	~~-20 / -25 ºC~~		~~-26 / -35 ºC~~		~~-36 / -45 ºC~~		~~-45 / -55 ºC~~	
~~As-built thickness, in mm~~	~~NSS~~	~~HSS~~	~~NSS~~	~~HSS~~	~~NSS~~	~~HSS~~	~~NSS~~	~~HSS~~
~~t ≤ 10~~	~~B~~	~~AH~~	~~D~~	~~DH~~	~~D~~	~~DH~~	~~E~~	~~EH~~
~~10 < t ≤ 20~~	~~D~~	~~DH~~	~~D~~	~~DH~~	~~E~~	~~EH~~	~~E~~	~~EH~~
~~20 < t ≤ 30~~	~~D~~	~~DH~~	~~E~~	~~EH~~	~~E~~	~~EH~~	~~-~~	~~FH~~
~~30 < t ≤ 40~~	~~E~~	~~EH~~	~~E~~	~~EH~~	~~-~~	~~FH~~	~~-~~	~~FH~~
~~40 < t ≤ 45~~	~~E~~	~~EH~~	~~-~~	~~FH~~	~~-~~	~~FH~~	~~-~~	~~-~~
~~45 < t ≤ 50~~	~~E~~	~~EH~~	~~-~~	~~FH~~	~~-~~	~~FH~~	~~-~~	~~-~~
~~Note :~~ ~~NSS : Normal strength steel~~ ~~HSS : Higher strength steel~~								

Table II 1-13
Material Grade Requirements for Class II at Low Temperatures

Temperature	-11 / -15 ºC		-16 / -25 ºC		-26 / -35 ºC		-36 / -45 ºC		-46 / -55 ºC	
Plate thickness, in mm	MS	HT	MS	HT	MS	HT	MS	HT	MS	HT
t ≤ 10	A	AH	B	AH	D	DH	D	DH	E	EH
10 < t ≤ 20	B	AH	D	DH	D	DH	E	EH	E	EH
20 < t ≤ 30	D	DH	D	DH	E	EH	E	EH	-	FH
30 < t ≤ 40	D	DH	E	EH	E	EH	-	FH	-	FH
40 < t ≤ 45	E	EH	E	EH	-	FH	-	FH	-	-
45 < t ≤ 50	E	EH	E	EH	-	FH	-	FH	-	-

~~**Table II 1-13**~~
~~**Material Grade Requirements for Classes III at Low Temperature**~~

~~Temperature~~	~~-20 / -25 ºC~~		~~-26 / -35 ºC~~		~~-36 / -45 ºC~~		~~-45 / -55 ºC~~	
~~As-built thickness, in mm~~	~~NSS~~	~~HSS~~	~~NSS~~	~~HSS~~	~~NSS~~	~~HSS~~	~~NSS~~	~~HSS~~
~~t ≤ 10~~	~~D~~	~~DH~~	~~D~~	~~DH~~	~~E~~	~~EH~~	~~E~~	~~EH~~
~~10 < t ≤ 20~~	~~D~~	~~DH~~	~~E~~	~~EH~~	~~E~~	~~EH~~	~~-~~	~~FH~~
~~20 < t ≤ 25~~	~~E~~	~~EH~~	~~E~~	~~EH~~	~~E~~	~~FH~~	~~-~~	~~FH~~
~~25 < t ≤ 30~~	~~E~~	~~EH~~	~~E~~	~~EH~~	~~-~~	~~FH~~	~~-~~	~~FH~~
~~30 < t ≤ 35~~	~~E~~	~~EH~~	~~-~~	~~FH~~	~~-~~	~~FH~~	~~-~~	~~-~~
~~35 < t ≤ 40~~	~~E~~	~~EH~~	~~-~~	~~FH~~	~~-~~	~~FH~~	~~-~~	~~-~~
~~40 < t ≤ 50~~	~~-~~	~~FH~~	~~-~~	~~FH~~	~~-~~	~~-~~	~~-~~	~~-~~

~~Note :~~
~~NSS : Normal strength steel~~
~~HSS : Higher strength steel~~

Table II 1-14
Material Grade Requirements for Class III at Low Temperatures

Temperature	-11 / -15 ºC		-16 / -25 ºC		-26 / -35 ºC		-36 / -45 ºC		-46 / -55 ºC	
Plate thickness, in mm	MS	HT	MS	HT	MS	HT	MS	HT	MS	HT
t ≤ 10	B	AH	D	DH	D	DH	E	EH	E	EH
10 < t ≤ 20	D	DH	D	DH	E	EH	E	EH	-	FH
20 < t ≤ 25	D	DH	E	EH	E	EH	E	FH	-	FH
25 < t ≤ 30	D	DH	E	EH	E	EH	-	FH	-	FH
30 < t ≤ 35	E	EH	E	EH	-	FH	-	FH	-	-
35 < t ≤ 40	E	EH	E	EH	-	FH	-	FH	-	-
40 < t ≤ 50	E	EH	-	FH	-	FH	-	-	-	-

Table II 1-14 has been renumbered as follows:

Table II 1-~~14~~15
Brackets (Unit: mm)

Length of longer arm	Thickness		Breadth of flange	Length of longer arm	Thickness		Breadth of flange
	Plane	Flanged			Plane	Flanged	
150	6.5	-	-	700	14.0	9.5	70
200	7.0	6.5	30	750	14.5	10.0	70
250	8.0	6.5	30	800	-	10.5	80
300	8.5	7.0	40	850	-	11.0	85
350	9.0	7.0	40	900	-	11.0	90
400	10.0	8.0	50	950	-	11.5	90
450	10.5	8.0	50	1000	-	11.5	95
500	11.0	8.5	55	1050	-	12.0	100
550	12.0	8.5	55	1100	-	12.5	105
600	12.5	9.0	65	1150	-	12.5	110
650	13.0	9.0	65				

Chapter 12 Superstructures and Deckhouses

Section 12.5 has been added as follows:

12.5 Aluminum Superstructures and Deckhouses

12.5.1 Scantlings

Where deckhouses are constructed of aluminum alloys, the required plate thickness and stiffener section modulus, SM, are first to be determined as required for mild steel superstructures and deckhouses, and are then to be increased by the material factor, $(235/ Y_{aw})^{0.50}$ or $235/Y_{aw}$, as indicated below.

For all deck and bulkhead plating and stiffeners, the required thickness and section modulus for aluminum alloy plate and shapes are obtained from the following equations:

Plating:

$$t_{al} = t_s \left(\frac{Y_S}{Y_{aw}}\right)^{0.5} \quad \text{mm}$$

Stiffeners:

$$SM_{al} = \frac{Y_S}{Y_{aw}} SM_S \quad \text{cm}^3$$

Where:

t_{al}	=	minimum thickness of aluminum plate.
t_s	=	required plate thickness for steel obtained from 12.2.2 and 12.3.2
SM_{al}	=	minimum section modulus of aluminum stiffeners.
SM_S	=	minimum section modulus of steel stiffeners, as determined from Chapter 9 and Chapter 10 for deck stiffeners and 12.3.1 for bulkhead stiffeners.
Y_S	=	235 N/mm^2
Y_{aw}	=	minimum yield strength of the welded aluminum alloy under consideration at 0.20% offset in N/mm^2

In addition, the aluminum stiffeners are to have a depth not less than that given below:

$$d_{al} = 3SM_S \frac{d_S}{SM_{al}}$$

where

d_{al}	=	minimum required depth for aluminum stiffeners.
d_S	=	minimum required depth for steel stiffeners; not to be less than 100 mm depth for fronts and 80 mm for sides and ends.

Chapter 23 Painting

Paragraph 23.1.7 has been amended as follows:

23.1 Painting

23.1.7 For cargo holds on bulk carriers including combination carriers intended for the carriage of dry bulk cargoes, at the time of new construction, all internal and external surfaces of hatch coamings and hatch covers, and all internal surfaces of cargo holds, excluding the flat tank top areas and the hopper tank sloping plating up to approximately 300 mm below the side shell frame end brackets, are to have an efficient protective coating (epoxy coating or equivalent)~~epoxy or equivalent coating~~ applied in accordance with the manufacturer's recommendations. In the selection of coating due consideration is to be given by the owner to intended cargo conditions expected in service. For existing bulk carriers, where Owners may elect to coat or recoat cargo holds as noted above, consideration may be given to the extent of the close-up and thickness measurement surveys. Prior to the coating of cargo holds of existing vessels, scantlings are to be ascertained in the presence of the Surveyor. Internal surface of cargo hold includes those surfaces of stiffening members of top wing tank bottom, where fitted on hold side, and deck plating and associated beams, girders, etc. facing holds such as those between the main hatchways. In the selection of coatings, due consideration is to be given by the Owner to the intended cargoes and conditions expected in service.

Chapter 25 Equipment

Paragraph 25.1.6 has been added as follows:

25.1 General

25.1.6 The anchoring equipment required herewith is intended for temporary mooring of a ship within a harbour or sheltered area when the ship is awaiting berth, tide, etc. Additional class notation **ADW** may be assigned to ships intended for regular anchoring at deep and unsheltered water, in accordance with 25.11.

Paragraphs 25.2.1(c)&(d) have been added as follows:

25.2 Equipment Number

25.2.1 The equipment given in Table II 25-1 is based on the "Equipment Number", EN, which is to be calculated as follows:

$$EN = \Delta^{\frac{2}{3}} + 2BH + 0.1A$$

where:

Δ	=	Molded displacement to the summer load waterline, in ton.
B	=	Breadth of ship, in m, as specified in 1.2.2.
H	=	a + Σh, in m.
a	=	Vertical distance amidships from the summer load line to the top of uppermost continuous deck beam at side, in m.
Σh	=	Sum of the heights, in m, at centerline of superstructure and each tier of deck-houses having a breadth greater than 0.25B.
A	=	Sum of the profile area, in m^2, of the hull above summer load waterline, superstructures and deckhouses having a breadth greater than 0.25B, which are within the length of ship L.

(a) In calculation of H, sheer, camber and trim may be neglected. Where a deckhouse having a breadth greater than 0.25B is located above a deckhouse with a breadth of 0.25B or less, the wide deckhouse is to be included, but the narrow deckhouse ignored.

(b) Screens and bulwarks more than 1.5 m in height are to be regarded as parts of superstructure or deckhouse when calculating H and A. Where a screen or bulwark is of varying height, the portion exceeding 1.5 m in height is to be included.

(c) The equipment length of the ship is the length between perpendiculars but is not to be less than 96% nor greater than 97% of the extreme length on the Summer Load waterline (measured from the forward end of the waterline).

(d) The total length of chain given in Table II 25-1 is to be divided in approximately equal parts between the two bower anchors.

Paragraph 25.3.6 has been amended as follows:

25.3 Anchors

~~25.3.6 For ships with length less than 90 m and with service restricted, mass of one of the two anchors may be reduced to 85% of the mass required in Table II 25-1.~~

25.3.6 For ships in unsheltered water with depth up to 120m, anchors should be of the stockless High Holding Power (HHP) type. The mass of the head of a stockless anchor given in Table II 25-2, including pins and fittings, should not be less than 60% of the total mass of the anchor. The material, construction and test performance of anchor shall meet the requirements of CR Rules Part XI Chapter 12.

Paragraph 25.4.6~25.4.7 have been added as follows:

25.4 Anchor Cables

25.4.6 For restricted services the use of steel wire rope may be accepted in place of chain cable at the discretion of the Society.

25.4.7 For ships in unsheltered water with depth up to 120m, bower anchors should be associated with stud link chain cables of special (Grade 2) or extra special (Grade 3) quality. The total length of chain cable, as given in Table II 25-2 should be reasonably divided between the two bower anchors. For the proof and breaking loads of stud link chain cables reference is made to Chatper 13 Part XI, Table 13-3.

Paragraph 25.9.3(b)(i), (viii) & (ix) has been amended as follows:

25.9.3 Mooring Fittings

(b) Design Load

Design load, see Fig. II 25-1, for mooring fittings and their supporting structures are to be as specified in (i) to (vii) below:

(i) The design load on the line (see Fig. II 25-1) is to be ~~1.25~~ 1.15 times the breaking strength of the mooring line specified in Table II 25-1 according to the equipment number determined in 25.2.

(ii) The design load on fittings is to take into account all acting loads.

(iii) The point where the mooring force acts on mooring fittings is to be taken as the attachment point of the mooring line.

.....

(vii) The design load applied to supporting hull structures for capstans is to be 1.25 times the intended maximum hauling-in force.

(viii) If not otherwise specified by IACS Recommendation No. 10, side projected area including that of deck cargoes as given by the loading manual is to be taken into account for selection of mooring lines and the loads applied to shipboard fittings and supporting hull structure.

(ix) The increase of the minimum breaking strength for synthetic ropes according to IACS Recommendation No. 10 needs not to be taken into account for the loads applied to shipboard fittings and supporting hull structure.

Section 25.11 has been added as follows:

25.11 Anchoring in Deep and Unsheltered Water - ADW

25.11.1 Class notations **ADW**

Ships built in compliance with the requirements as specified in 25.11 will be assigned the additional notation related to anchoring in deep and unsheltered waters.

Note:

If the intended service of the vessel is such that frequent anchoring in open sea is expected, it is advised that the size of anchors and chains is increased above the rule requirements, taking into account the dynamic forces imposed by the vessel moving in heavy seas.

25.11.2 General

(a) The purpose of the additional class notation **ADW** is to demonstrate the vessels capability for anchoring in deep and unsheltered waters.

(b) The scope of the additional class notation **ADW** is to provide requirements for the anchoring equipment for vessels intended to anchor in deep and unsheltered water.

(c) The additional class notation **ADW** indicates that the vessel is designed to anchor in deep and unsheltered water. Assumed conditions are as follows:

- water depth up to 120 m
- current up to 1.54 m/s
- wind up to 14 m/s
- waves with significant height of up to 3 m
- wind, current, and waves from ahead and acting in the same direction.

Furthermore, these requirements are applicable to ships with a rule length of not less than 135 m.

25.11.3 Equipment Number for deep and unsheltered water

Anchors and chain cables should be in accordance with Table II 25-2 and based on the Equipment Number EN_1 obtained from the following equation:

$$EN_1 = 0.628\left[a\left(\frac{EN}{0.628}\right)^{1/2.3} + b(1-a)\right]^{2.3}$$

where

a = $1.83\cdot10^{-9}\cdot L^3 + 2.09\cdot10^{-6}\cdot L^2 - 6.21\cdot10^{-4}\cdot L + 0.0866$

b = $0.156\cdot L + 8.372$

L = Equipment length of the ship in compliance with 25.2.1(c)

EN = Equipment Number calculated in compliance with 25.2.1.

25.11.4 Anchors and Chain cables for bower anchors

For requirements of anchors and bower anchor chain cables, see Part II Chapter 25 Section 25.3 and 25.4.

25.11.5 Anchor windlass and chain stopper

The windlass unit prime mover should be able to supply for at least 30 minutes a continuous duty pull Z_{cont}, in N, given by:

$$Z_{cont} = 35\ d^2 + 13.4\ m_A$$

where

d = chain diameter, in mm, as per Table II 25-2

m_A = HHP anchor mass, in kg, as per Table II 25-2

As far as practicable, for testing purpose the speed of the chain cable during hoisting of the anchor and cable should be measured over 37.5 m of chain cable and initially with at least 120 m of chain and the anchor submerged and hanging free. The mean speed of the chain cable during hoisting of the anchor from the depth of 120 m to the depth of 82.5 m should be at least 4.5 m/min.

[PART II]

Table II 25-2 has been added as follows:

Table II 25-2
Anchoring Equipment for Ships in Unsheltered Water with Depth up to 120 m

Equipment Number EN1		High Holding Power stockless bower anchors		Stud link chain cable for bower anchors		
Equal to or greater than	Less than	Number	Mass per anchor (m_A) (kg)	Length (m)	Min. dia.(d)	
					Special quality (Grade 2) (mm)	Extra speical quality (Grade 3) (mm)
	1790	2	14150	1017.5	105	84
1790	1930	2	14400	990	105	84
1930	2080	2	14800	990	105	84
2080	2230	2	15200	990	105	84
2230	2530	2	16000	990	105	84
2530	2700	2	16300	990	105	84
2700	2870	2	16700	990	105	84
2870	3040	2	17000	990	105	84
3040	3210	2	17600	990	105	84
3210	3400	2	18000	990	105	84
3400	3600	2	18300	990	106	84
3600	3800	2	19000	990	107	85
3800	4000	2	19700	962.5	108	87
4000	4200	2	20300	962.5	111	90
4200	4400	2	21100	962.5	114	92
4400	4600	2	22000	962.5	117	95
4600	4800	2	22900	962.5	119	97
4800	5000	2	23500	962.5	122	99
5000	5200	2	24000	935	125	102
5200	5500	2	24500	907.5	130	105
5500	5800	2	25000	907.5	133	107
5800	6100	2	25500	880	137	111
6100	6500	2	25700	880	140	113
6500	6900	2	26000	852.5	143	115
6900	7400	2	26500	852.5	147	118
7400	7900	2	27000	825	152	121
7900	8400	2	27500	825	154	123
8400	8900	2	28000	797.5	158	127
8900	9400	2	28900	770	162	132
9400	10000	2	29400	770	-	135
10000	10700	2	29900	770	-	139
10700	11500	2	30600	770	-	143
11500	12400	2	31500	770	-	147
12400	13400	2	33200	770	-	152
13400	14600	2	35000	770	-	157
14600		2	38000	770	-	162

Chapter 30 Intact Stability

Paragraph 30.6.1(c) has been added as follows:

30.6.1 Stability curves and wind-heeling moment lever curves of ships are to comply with the following requirements in Fig. II 30-2.

(a) Heeling angle caused by steady wind is to be less than 16° or an angle corresponding to 80% of immersing angle of deck edge, whichever is less.

(b) Area "b" is not to be less than area "a".
where:

l_{w1} = Heeling moment lever caused by steady wind (m) given by the following formula:
$= \frac{0.0514AZ}{W}$
A = Projected lateral area of hull and cargoes on deck above waterline (m^2).
Z = Vertical distance between the centre of "A" and the centre of underwater projected lateral area of hull (m). In general, the centre of underwater projected lateral area may be approximated to locate at half the draught.
W = Displacement (ton).
l_{w2} = Heeling moment lever caused by gust (m) given by the following formula:
$= 1.5 l_{w1}$
a = Area encircled by stability curve, l_{w2} and θ_r (m · rad).
b = Area encircled by stability curve, l_{w2} and θ_2 (m · rad).
θ_r = Angle of rolling stop motion (degree). In general, it may be given by the formula $(\theta_0 - \theta_1)$.
θ_c = Heeling angle at the second intersection between heeling moment lever (l_{w2}) and stability curve (degree).
θ_2 = Heeling angle (degree) to be taken of whichever is the least, down flooding angle, θ_c or 50°.
θ_0 = Angle of heel under action of steady wind (degree).
θ_1 = Angle of roll to windward due to wave action (degree) given by the following formula :
$= 109 x_1 x_2 k \sqrt{rs}$
x_1 = Values obtained from Table II 30-1 according to the value of B/d. In case the value of B/d becomes intermediate, values are to be determined by interpolation.
x_2 = Values obtained from Table II 30-2 according to the value of C_b. In case the value of $C_b$becomes intermediate, values are to be determined by interpolation.
C_b = Block coefficient given by the following formula :
$= \frac{W}{1.025LBd}$
L = Length of the ship at waterline (m)
k = Values determined as follows;
= 1.0 for round-bilged ships having neither bilge keels nor bar keels,
= 0.7 for ships with sharp bilges,
For ships with bilge keel and/or bar keels: Values obtained from Table II 30-3 according to the value of $\frac{100A_k}{LB}$.
In case $\frac{100A_k}{LB}$ becomes intermediate, values are to be determined by interpolation.
A_k = Total area of bilge keels, projected lateral area of bar keels or sum of those areas (m^2).
r = Values obtained from the following formula.
However, the value of r need not be taken over 1.0.

$= 0.73 + 0.6\frac{OG}{d}$

OG = Distance between the centre of gravity and the waterline (m), and is taken as positive when the centre of gravity is above waterline.

s = Values obtained from Table II 30-4 according to the value of T. In case T becomes intermediate, values are to be determined by interpolation.

T = Rolling period (seconds) obtained from the following formula,

$$= \frac{2B}{\sqrt{G_0M}}\left(0.373 + 0.023\frac{B}{d} - 0.043\frac{L}{100}\right)$$

G_0M = As specified in 30.5.

(c) Alternative means for determining the wind heeling lever (lw1) may be accepted, to the satisfaction of the Society, as an equivalent to calculation in 30.6.1(b). When such alternative tests are carried out, reference shall be made based on the Guidelines developed by the Organization (MSC.1/Circ.1200). The wind velocity used in the tests shall be 26 m/s in full scale with uniform velocity profile. The value of wind velocity used for ships in restricted services may be reduced to the satisfaction of the Society.

Chapter 31 Ship Recycling

Paragraph 31.5.3(b) has been amended as follows:

31.5.3 Survey

(b) Annual Survey

An annual survey is also to be conducted to confirm that the Inventory reflects any modifications, repairs, or changes to the vessel that involve the removal or addition of hazardous materials.

~~Upon successful completion of the annual survey, the Statement will be endorsed.~~

AMENDMENT TO "THE RULES FOR THE CONSTRUCTION AND CLASSIFICATION OF STEEL SHIPS 2019 AND AMENDMENTS THEREOF "

PART III SPECIAL SERVICE AND TYPE OF SHIPS

List of major changes in Part III from 2019 edition

2.10.9	Revised
5.1.5	Revised
5.2.1	Revised
13.1	Revised
13.1.2(a)	Revised
13.7.1(a)	Revised
13.7.3	Revised

Rules for the Construction and Classification of Steel Ships 2019 and amendments thereof have been partly amended as follows:

Chapter 2 Oil Tankers

Paragraph 2.10.9 has been amended as follows:

2.10.9 Welding

The special requirements of welded construction for oil ~~carriers~~ tanker are to comply with the requirements given in Chapter 5 of Part XII.

Chapter 5 Chemical ~~Carriers~~ Tanker

Chapter 5 has been amended as follows:

Chapter 5 Chemical ~~Carriers~~ Tanker

Paragraph 5.1.5 has been amended as follows:

5.1.5 Chemical ~~carriers~~ tanker also intended for carriage of oil are to comply with the rules for oil tankers in Chapter 2 of this Part.

Paragraph 5.2.1 has been amended as follows:

5.2.1 For ships to which the requirements in this chapter applies, a notation of **"Chemical ~~Carriers~~ Tanker "** is to be assigned in accordance with 1.4.5 of Part I.

Chapter 13 Mobile Offshore ~~Service~~ Unit

Chapter 13 has been amended as follows:

Chapter 13 Mobile Offshore ~~Service~~ Unit

Section 13.1 has been amended as follows:

13.1 General

This Chapter applies to units classed in accordance with the provisions in Chapter 1 of Part I and built for the purpose of ocean service.

Units complying with the requirements of this Chapter are to be assigned a notation of "**Mobile Offshore ~~Service~~ Unit**" and a notation of unit type,"**Self-Propelled Unit**", "**Non Self-Propelled Unit**" or "**Self-Elevating Unit**", as defined in 13.1.1.

Paragraph 13.1.2(a) has been amended as follows:

13.1.2 Environmental Loadings

(a) General

A unit's modes of operation should be investigated using anticipated loads, including gravity and functional loads together with relevant environmental loads due to the effects of wind, waves, currents, and where deemed necessary by the Owner or designer, the effects of earthquake, sea bed supporting capabilities, ambient temperature, fouling, ice, etc. Where applicable, the loads indicated herein are to be adhered to for all types of mobile offshore ~~service~~ unit. The Owner is to specify the environmental conditions for which the plans for the unit are to be approved. These design environmental conditions are to be recorded in the Operating Manual.

Paragraph 13.7.1(a) has been amended as follows:

13.7.1 General requirement

(a) The electrical apparatus and the wiring system of a classed mobile offshore ~~service~~ unit are to be constructed, installed, and tested under the supervision and to the satisfaction of the Surveyor in accordance with the following requirements. Considerations will be given, however, to the arrangements or details of the equipment and machinery which comply with other recognized standards provided they are not less effective than the requirements of this chapter.

Paragraph 13.7.3 has been amended as follows:

13.7.3 Power and control circuits of steering gear installed in self-propelled mobile offshore ~~service~~ units are to comply with Section 2.3, Part VII of the Rules.

AMENDMENT TO "THE RULES FOR THE CONSTRUCTION AND CLASSIFICATION OF STEEL SHIPS 2019 AND AMENDMENTS THEREOF "

PART IV MACHINERY INSTALLATIONS－CONSTRUCTION AND SHAFTING

List of major changes in Part IV from 2019 edition

1.3.3	Revised
Table IV 1-1	Revised
4.3.2(e)	New
4.3.3	Revised
4.3.6	Revised
4.3.7	New
4.3.8	New
4.3.9	New
4.3.10	New
4.3.11	New
4.5	New
4.5.4	New
4.5.5	New
4.5.6	New
4.6.4(c)	Revised
9.1.1	Revised
9.2.3(a)	Revised
9.2.4	Revised
9.2.5	New
9.2.6	New
9.2.7	New

Rules for the Construction and Classification of Steel Ships 2019 and amendments thereof have been partly amended as follows:

Chapter 1 General

Paragraph 1.3.3 has been amended as follows:

1.3.3 Auxiliaries include their prime movers and controllers which are necessary for the safety of life and for the safety or operation of the ship at sea:

Bilge pumps (including pumps for oily bilge separator use).

Ballast pumps.

Fire pumps.

Steering gear.

Athwartship thrust units.

Windlasses.

Mooring winches or capstans.

Hydraulic appliances (for windlasses and mooring machineries).

~~Ventilating fans (for machinery spaces).~~

Fans serving hazardous spaces.

Electric generators (for emergency source of power).

Machineries and equipment of venting, purging, gas freeing and ventilation systems (for tankers).

Machinery and boiler control equipment.

Incinerator.

Table IV 1-1 has been amended as follows:

Table IV 1-1
Inclination ~~of Ships~~

~~Type of machinery~~ ~~Installations~~ Installations, components	Athwartships (~~1~~2)		~~Bow-and-stern~~ Fore-and-aft (~~1~~2)	
	Static ~~inclination (list)~~	Dynamic ~~inclination (rolling)~~	Static ~~inclination (trim)~~	Dynamic ~~inclination (pitching)~~
~~Main propulsion machinery~~ ~~Main boilers and important auxiliary boilers~~ ~~Prime movers driving generators (excluding those for emergency) auxiliary machinery (excluding auxiliary machinery for specific use etc.) and their driving units~~ Main and auxiliary machinery	15°	22.5°	5° (4)	7.5°
~~Emergency installations (emergency generators, emergency fire pumps and prime movers to drive them)~~ ~~Switch gears(2) (Circuit breakers, etc.)~~ ~~Equipment for automatic and remote controls~~ Safety equipment, e.g. emergency power installations, emergency fire pump and their devices Switch gear, electrical and electronic appliances (1), and remote control systems	22.5° (3)	22.5° (3)	10°	10°

Notes:

(1) ~~Athwartships and bow and stern inclinations may occur simultaneously.~~ No undesired switching operations or operational changes are to occur.

(2) Up to an angle of inclination of 45°, undesired switching operations or operational changes are not to be caused. Athwartships and fore-end-aft inclinations may occur simultaneously.

(3) In ships carrying liquefied gases in bulk and ships carrying dangerous chemicals in bulk, the arrangement is to be such that the emergency power supply must also remain operable with the ship flooded to a final athwartships inclination up to a maximum of 30°. In ships for the carriage of liquefied gases and of chemicals the emergency power supply must also remain operable with the ship flooded to a final athwartships inclination up to maximum of 30°.

(4) Where the length of the ship exceeds 100m, the fore-and-aft static angle of inclination may be taken as 500/L degrees where L = length of the ship, in meters.

Chapter 4 Deck Machinery and Essential Auxiliaries

Paragraph 4.3.2(e) has been added as follows:

4.3.2 Definitions

(a) "Working Load": The working load, derived from the nominal diameter and the grade of anchor chain cables, is the tensile force exerted upon the cable lifter in the tangential direction when the anchor and anchor chain cables are being hoisted.

(b) "Overload Pull": The necessary temporary overload capacity of the windlass.

(c) "Holding Load": The maximum static load on the anchor chain cables which the cable lifter brake is to withstand.

(d) "Nominal Speed": The average speed of recovery of 55 m (two lengths) of anchor chain cables when 82.5 m (three lengths) of the cables are submerged and freely suspended at commencement of lifting.

(e) "Hoisting Speed": The mean speed of the chain cable during hoisting of the anchor.

Paragraph 4.3.3 has been amended as follows:

4.3.3 Mechanical Design ~~Performance~~

~~The windlass is to have the following performance:~~

~~(a) The windlass is to be capable of continuous operation for a period of 30 minute under the working load and also be capable of operating under the overload for a period of 2 minutes at reduced speed.~~

~~(b) The working load of the windlass is to be based on the following values:~~

~~(i) Grade E1 anchor chain cable: 37.5 d^2 (N).~~

~~(ii) Grade E2 anchor chain cable: 42.5 d^2 (N).~~

~~(iii) Grade E3 anchor chain cable: 47.5 d^2 (N).~~

~~where~~

~~d = Nominal diameter of anchor chain cable (mm).~~

~~(c) The overload is to be 150% of the working load.~~

~~(d) The holding load is to be as follows:~~

~~(i) with cable stopper: 0.45 × breaking test load of cable;~~

~~(ii) without cable stopper: 0.8 × breaking test load of cable.~~

~~(e) The holding load of control brake is to be 130% of the working load when equipped with the control brake.~~

~~(f) The rated hoisting speed is to be 0.15 m/s or more. The conditions in this case are such that the anchor and the anchor chain cables are used where the efficiency of the hawse pipe is 70%.~~

(a) Design Loads

(i) Holding Loads

Calculations are to be made to show that, in the holding condition (single anchor, brake fully applied and chain cable lifter declutched), and under a load equal to 80% of the specified minimum breaking strength of the chain cable, the maximum stress in each load bearing component will not exceed yield strength (or 0.2% proof stress) of the material. For installations fitted with a chain cable stopper, 45% of the specified minimum breaking strength of the chain cable may instead be used for the calculation.

(ii) Inertia Loads

The design of the drive train, including prime mover, reduction gears, bearings, clutches, shafts, cable lifter and bolting is to consider the dynamic effects of sudden stopping and starting of the prime mover or chain cable so as to limit inertial load.

(b) Continuous Duty Pull

The windlass prime mover is to be able to exert for at least 30 minutes a continuous duty pull (e.g., 30-minute short time rating corresponding to S2-30 min. of IEC 60034-1), Zcont1, corresponding to the grade and diameter, d, of the chain cables as follows:

Grade of chain	Zcont1	
	N	kgf
1	$37.5\ d^2$	$3.82\ d^2$
2	$37.5\ d^2$	$4.33\ d^2$
3	$37.5\ d^2$	$4.84\ d^2$
Unit of d	mm	mm

The values of the above table are applicable when using ordinary stockless anchors for anchorage depth down to 82.5 m.

For anchorage depth deeper than 82.5 m, a continuous duty pull Zcont2 is:

$$\mathrm{Zcont2[N]} = \mathrm{Zcont1[N]} + (\mathrm{D} - 82.5) \times 0.27\mathrm{d}^2$$

or

$$\mathrm{Zcont2[kgf]} = \mathrm{Zcont1[kgf]} + (\mathrm{D} - 82.5) \times 0.0275\mathrm{d}^2$$

where

d is Nominal diameter of anchor chain cable (mm).

D is the anchor depth, in metres.

The anchor masses are assumed to be the masses as given in UR A1 and Recommendation 10. Also, the value of Zcont is based on the hoisting of one anchor at a time, and that the effects of buoyancy and hawse pipe efficiency (assumed to be 70%) have been accounted for. In general, stresses in each torque-transmitting component are not to exceed 40% of yield strength (or 0.2% proof stress) of the material under these loading conditions.

(c) Overload Capability

The windlass prime mover is to be able to provide the necessary temporary overload capacity for breaking out the anchor. This temporary overload capacity or “short term pull” is to be at least 1.5 times the continuous duty pull applied for at least 2 minutes. The speed in this period may be lower than normal.

(d) Hoisting Speed

The mean speed of the chain cable during hoisting of the anchor and cable is to be at least 0.15 m/sec. For testing purposes, the speed is to be measured over two shots of chain cable and initially with at least three shots of chain (82.5 m or 45 fathoms in length) and the anchor submerged and hanging free.

(e) Brake Capacity

The capacity of the windlass brake is to be sufficient to stop the anchor and chain cable when paying out the chain cable. Where a chain cable stopper is not fitted, the brake is to produce a torque capable of withstanding a pull equal to 80% of the specified minimum breaking strength of the chain cable without any permanent deformation of strength members and without brake slip. Where a chain cable stopper is fitted, 45% of the breaking strength may instead be applied.

(f) Chain Cable Stopper

Chain cable stopper, if fitted, along with its attachments is to be designed to withstand, without any permanent deformation, 80% of the specified minimum breaking strength of the chain cable.

(g) Support Structure

For hull supporting structures of windlass and chain cable stoppers, refer to A1.7 of UR A1.

Paragraph 4.3.6 has been amended as follows:

4.3.6 Tests and Inspection

The windlass and cable lifter unit are to be inspected during fabrication at the manufacturers' facilities by the Surveyor for conformance with the approved plans. Acceptance tests, as specified in the specified standard of compliance, are to be witnessed by the Surveyor and include the following tests, as a minimum. The test results are to be recorded.

(a) "No-load Test": The windlass is to be run without load once in normal and once in reverse directions, for a sum of 30 minutes, under the rated voltage at the speed of rotation equivalent to the rated speed. When the windlass is provided with a gear change, an additional 5 min similar test is to be carried out for each additional gear change.

During the test, the following items are to be checked or measured:

(i) tightness against oil leakage;

(ii) temperature of bearings;

(iii) pressure of abnormal noise.

(b) "Load Test": ~~The windlass is to, as a rule, be checked to verify that the working load, rated speed and overload pull are attainable as specified in 4.3.3 above.~~ The windlass is to be tested to verify that the continuous duty pull, overload capacity and hoisting speed as specified in 4.3.3 can be attained. Where the manufacturing works does not have adequate facilities, these tests, including the adjustment of the overload protection, can be carried out on board ship. In these cases, functional testing in the manufacturer's works is to be performed under no-load conditions.

(c) Brake capacity test. The holding power of the brake is to be verified either through testing or by calculation.

(~~c~~d) "Cable Lifter Brake Test": The holding power of the cable lifter brake is to be verified. The cable lifter brake is also to be tested with the anchor dropping, operated onboard with the holding load controlled and sustained by applying the brake at each half length of the chain.

(~~d~~e) Performance Tests

(i) When provided with the remote control or other special device, their performances are to be verified.

(ii) The function of the automatic control brake system for electric windlass is to be tested at the manufacturer's shop of the electric motor.

(iii) The clutch and slipping clutch (for electric windlass) are to be tested to verify their performance.

Each windlass is to be tested under working conditions after installation onboard to demonstrate satisfactory operation. Each unit is to be independently tested for braking, clutch functioning, lowering and hoisting of chain cable and anchor, proper riding of the chain over the cable lifter, proper transit of the chain through the hawse pipe and the chain pipe, and effecting proper stowage of the chain and the anchor. It is to be confirmed that anchors properly seat in the stored position and that chain stoppers function as designed if fitted. The mean hoisting speed, as specified in 4.3.3, is to be measured and verified. The braking capacity is to be tested by intermittently paying out and holding the chain cable by means of the application of the brake. Where the available water depth is insufficient, the proposed test method will be specially considered.

Paragraphs 4.3.7 ~ 4.3.11 have been added as follows:

4.3.7 Hydraulic Systems

Hydraulic systems where employed for driving windlasses are to comply with the provisions of the class society.

4.3.8 Electrical Systems

(a) Electric Motors

Electric motors are to meet the requirements of the class society and those rated 75 kW and over are to be certified. Motors exposed to weather are to have enclosures suitable for their location as provided for in the requirements of the class society. Where gears are fitted, they are to meet the requirements of the class society and those rated 75 kW and over are to be certified.

(b) Electrical Circuits

Motor branch circuits are to be protected in accordance with the provisions of the class society and cable sizing is to be in accordance with the requirements of the class society. Electrical cables installed in locations subjected to the sea are to be provided with effective mechanical protection.

4.3.9 Protection of Mechanical Components

To protect mechanical parts including component housings, a suitable protection system is to be fitted to limit the speed and torque at the prime mover. Consideration is to be given to a means to contain debris consequent to a severe damage of the prime mover due to overspeed in the event of uncontrolled rendering of the cable, particularly when an axial piston type hydraulic motor forms the prime mover.

4.3.10 Couplings

Windlasses are to be fitted with couplings which are capable of disengaging between the cable lifter and the drive shaft. Hydraulically or electrically operated couplings are to be capable of being disengaged manually.

4.3.11 Marking

Windlass shall be permanently marked with the following information:

(a) Nominal size of the windlass (e.g. 100/3/45 is the size designation of a windlass for 100 mm diameter chain cable of IACS Grade 3, with a holding load of 45 % of the breaking load of the chain cable)

(b) Maximum anchorage depth, in metres.

Section 4.5 has been amended as follows:

4.5 Pumps

Pumps shall be delivered with the Society's product certificate.

Paragraphs 4.5.4~4.5.6 have been added as follows:

4.5.4 Relief valves

Displacement pumps shall be fitted with relief valves. For pumps transporting flammable liquids, the discharge from the relief valve may be led back to suction side of the pump.

4.5.5 Hydrostatic tests

Pump housings, except those for cargo oil pumps, shall be hydrostatically tested at a pressure of 1.5 times the design pressure.

Cargo oil pumps shall be tested to 1.3 times the design pressure, with a minimum of 14 bar. For centrifugal pumps the design pressure shall be the design pressure head on the head-capacity curve. For displacement pumps the design pressure shall not be taken less than the relief valve opening pressure.

The steamside of steam-driven pumps shall be hydraulically tested to 1.5 times the steam pressure.

Hydrostatic testing of pump housings on submerged pumps may not be required.

4.5.6 Capacity tests

Pump capacities shall be checked with the pump running at design condition (rated speed and pressure head, viscosity, etc.).

Capacity test may be dispensed with for pumps produced in series when previous satisfactory tests have been carried out on similar pumps.

For centrifugal pumps having capacities less than 1000 m^3/h, the pump characteristic (head-capacity curve) shall be determined for each type of pump. For centrifugal pumps having capacities equal to or greater than 1000 m^3/h, the pump characteristic shall be determined over a suitable range on each side of the design point, for each pump.

Special survey arrangement for testing of pumps may be agreed upon.

Paragraph 4.6.4(c) has been added as follows:

4.6.4 Controls and instrumentation

(c) Failure detection and response

Notwithstanding 4.6.4(a) and 4.6.4(b) above, 2.3.13 of Part VII and 4.2.8(c) of Part IV ~~VII~~ of the Rules for steering gear, apply.

Chapter 9 Special Requirements for Machinery Installed in Ships with Restricted Area of Service and Small Ships

Paragraph 9.1.1 has been amended as follows:

9.1.1 Scope

The requirements in this Chapter apply to machinery to be installed in ships with ~~a gross tonnage~~ less than 500 gross tonnage ~~tons~~ or intended for registry with restricted areas of service or are not engaged in international voyage in place of the relevant requirements in Part II, IV, V, VI and VII.

Paragraph 9.2.3(a) has been amended as follows:

9.2.3 Bilge suction arrangement in machinery spaces

(a) At least two bilge suctions are to be provided for draining the propulsion engine room. At least one of these suctions is to be connected directly to a bilge pump.The suctions are to be located at the lowest points of the compartment.

Additional suctions may be required if the flow of water towards the suctions is disturbed by irregularities of the bottom. At least one bilge suction is to be provided in watertight compartments other than the propulsion engine room.

~~For ships of less than 500 gross tonnage, the number of direct bilge suctions in 3.7.1~3.7.3 of Part VI may be changed to 1. The number of branch suction may be changed to 2.~~

~~For ships of less than 100 gross tonnage, the number of branch suction in 3.7.1~3.7.3 of Part VI may be changed to 1.~~

Paragraph 9.2.4 has been amended as follows:

9.2.4 Pumps and ejectors Bilge pumps and bilge piping

(a) Pumps ~~The number of power bilge pumps and drive modes for each ship as specified in 3.12 of Part VI may be required for the following ships:~~

(i) at least two power bilge pumps are to be provided; one of these pumps may be driven by a main propulsive engine.

(ii) for passenger ships not engaged on international voyages of less than 100 gross tonnage, carrying not more than 100 passengers, 2 independent bilge pumps may be provided if navigation period is less than 4 hours;

(iii) for cargo ships of less than 100 gross tonnage, one of power driven type and one hand pump may be provided.

(iv) the Society may permit, after special consideration, that one of the pumps be replaced by an ejector.

(v) for ships of 12 m in length and over, the bilge pumps are to be connected to the bilge main mentioned in 9.2.5(a) of this Part, unless the alternative arrangement in 9.2.6 is complied with

(vi) for ships of less than 24 m in length, the Society may permit, after special consideration, that one of bilge pumps be a fixed hand pump

(vii) small compartments may be drained by means of portable or fixed hand pumps.

(b) Ejectors

Where an ejector is used in lieu of a driven pump, its suction capacity is not to be less than the required capacity of the pump it replaces.

(c) Capacity of the pumps

The capacity of the bilge pumps is to be such that a speed of water not less than 1.22 m/s may be obtained in the bilge main the diameter of which is given in 9.2.5(a) of this Part. The capacity of each pump is therefore not to be less than:

$$Q = 0.00345\ d_1^2$$

where:

Q = Minimum capacity of each pump, in m^3/h
d_1 = Internal diameter, in mm, of the bilge main as defined in 9.2.5(a) of this Part.

(d) Use of other pumps for bilge duties

(i) other pumps may be used for bilge duties, such as fire, general service or ballast pumps, provided that:

(1) they meet the capacity requirements

(2) suitable piping arrangements are made

(3) pumps are available for bilge duty when necessary.

(~~b~~e) For ships of 25 m or less in length, the internal diameter of branch bilge pipes as required in 3.11.1(d) of Part VI may be reduced to 40 mm.

(~~c~~f) For ships of less than 500 gross tonnage, the capacity of bilge wells for cargo holds as specified in 3.6.2(c) of Part VI may be suitably reduced but not to be less than 0.1 m^3.

Paragraphs 9.2.5 ~ 9.2.7 have been added as follows:

9.2.5 Size of bilge pipes

(a) Bilge main

The internal diameter, in mm, of the bilge main, is to be of the commercial size nearest to the diameter given in the following formula, in mm:

$$d_1 = 1.68\sqrt{L_{LL}(B + D)} + 25$$

where:

L_{LL} = Loadline length of the ship, in m,
B = Breadth of the ship, in m,
D = Moulded depth of the ship, in m,

In addition, d_1 is not to be less than 35 mm.

(b) Suctions in holds and machinery spaces

The internal diameter, in mm, of bilge pipes situated between collecting boxes and suctions in holds and machinery spaces, is to be of the commercial size nearest to the diameter given by the following formula, in mm:

$$d_2 = 2.16\sqrt{L_1(B + D) + 25}$$

where:
B, D = Dimensions defined in 9.2.5(a) of this Part.
L_1 = Length of the compartment, in m.
In addition, d_2 is not to be less than 35 mm.

9.2.6 Alternative arrangement

(a) Principle

As an alternative to 9.2.4 and 9.2.5 of this Part ships may be fitted with individual bilge pumps situated in each compartment required to be drained. In such case 9.2.6 (b) to 9.2.6(e) of this Part are to be complied with.

(b) Total pump capacity

The total capacity of the bilge pumps is not to be less than 2.4 times the capacity of the pump defined in 9.2.4(c) of this Part.

(c) Individual pumps capacity

The capacity of each pump Q_n , in m^3/h, is not to be less than:

$$Q_t = \frac{Q_n}{(N - 1)} \text{ with a minimum of } 6\ m^3/h$$

where:
Q_t = Total capacity as defined in 9.2.6 (b) this Part.
N = Number of individual pumps.

(d) Additional portable pump

At least one additional means of pumping is to be provided for use in each individual space which can be a portable pump.

(e) Machinery space

The machinery space is to be provided with at least two individual pumps or equivalent means of pumping capacity with two suctions.

9.2.7 Arrangement of bilge lines and their accessories

(a) Passage of pipes through certain compartments

If not contained in pipe tunnels, the part of bilge pipes passing through tanks are to be provided with non-return valves at their ends in the holds.

(b) Non-return valves

Accessories are to be provided to prevent intercommunication of compartments or lines which are to remain segregated from each other. For this purpose, non-return valves or similar devices are to be fitted, namely on the pipe connections to bilge distribution boxes or to the alternative cocks, if any.

(c) Strainers and mud boxes

Strainers and mud boxes are to be fitted on bilge lines wherever they are necessary.

(d) Draining of fore and aft peaks

Where the peaks, if any, are not used as tanks and bilge suctions are not fitted, drainage of both peaks may be effected by hand pump suction provided that the suction lift is well within the capacity of the pump and in no case exceeds 7.3 m.

(e) Draining of spaces above fore and aft peaks

(i) provision is to be made for the drainage of the chain lockers and watertight compartments above the fore peak tank, if any, by hand or power pump suctions

(ii) steering gear compartments or other small dry enclosed spaces situated in the aft peak may be drained by scuppers discharging in the machinery space if fitted with self-closing cocks situated in visible and readily accessible positions. However, in the case of rudder stock glands located below the summer load line, the draining of the steering gear compartment are to be connected to the main bilge system.

(f) Access to valves and distribution boxes

All distribution boxes and manually operated valves in connection with the bilge pumping arrangement are to be in positions which are accessible under ordinary circumstances

AMENDMENT TO "THE RULES FOR THE CONSTRUCTION AND CLASSIFICATION OF STEEL SHIPS 2019 AND AMENDMENTS THEREOF "

PART V BOILERS, PRESSURE VESSELS, THERMAL OIL HEATERS AND INCINERATORS

List of major changes in Part V from 2019 edition

3.1.1	Revised
3.1.2	Revised
3.1.3	Revised
3.1.5	Deleted
3.2.2	Revised
3.2.3	Revised
3.2.4~3.2.6	Renumbered and Revised
3.2.7	Revised
Fig V 3-1	Revised
Table V 3-4	Revised
Table V 3-5	Renumbered
Table V 3-6~3-7	Revised
3.3.1~3.3.5	Revised
3.4.8	Revised

Rules for the Construction and Classification of Steel Ships 2019 and amendments thereof have been partly amended as follows:

Chapter 3 Strength Calculations

Paragraph 3.1.1 has been amended as follows:

3.1 Cylindrical Shell Under Internal Pressure ~~Shell, Drums or Headers~~

3.1.1 General Equations

The minimum thickness of cylindrical shells, drums or headers subject to internal pressures is to be calculated by the following formula:

Seamless and fusion-welded shells are to be in accordance with the following equations. The equations to be used are subject to 3.1.2 for boiler shells and to 3.1.3 for pressure vessel shells.

~~$T = \frac{WRF}{SE - 0.5WF} + C$~~

$$W = \frac{fSE(T - C)}{R + (1 - y)(T - C)} \text{ or } T = \frac{WR}{fSE - (1 - y)W} + C \quad (1)$$

$$W = \frac{fSE\{(R_0 - C)^2 - R^2\}}{(R_0 - C)^2 + R^2} \quad (2)$$

$$W = \frac{2fSE(T - C)}{D - 2y(T - C)} \text{ or } T = \frac{WD}{2fSE - 2yW} + C \text{ for } W \geq 6.9 \text{ bar} \quad (3)$$

Where:

f = factor for units of measure = 10 (100) for SI (MKS) units respectively

W = maximum allowable working pressure; bar (kgf/cm^2)
For equation (3), W is not to be taken as less than 6.9 (7, 100) respectively for any condition of service or steel material

S = maximum allowable working stress at the design temperature material, to be obtained from Tables V 3-4; in N/mm^2 (kgf/mm^2).

E = Efficiency of longitudinal joint or of ligament between tube holes or other openings, whichever is the least, determined from Tables V 3-2A and V 3-2B.

T = minimum thickness of shell, mm

R = inside radius of the weakest course of the shell; mm

R_o = outside radius of the above shell under consideration; mm

D = outside diameter of header or drum, mm

C = Corrosion allowance as given in Table V 3-3; mm.

y = coefficient having values as follows (values between temperatures may be interpolated):

	≤ 482°C	510°C	538°C	566°C	593°C	≥621°C
Ferritic steel	0.4	0.5	0.7	0.7	0.7	0.7
Austenitic steel	0.4	0.4	0.4	0.4	0.5	0.7

Paragraph 3.1.2 has been amended as follows:

3.1.2 Boiler Shells

The minimum thickness of spherical shells subject to internal pressures is to be calculated by the following formula:

(a) Thickness Less than 1/2 the Inside Radius

Where the thickness is less than 1/2 the inside radius, drums and headers are to be in accordance with Equation (1) or (3).

(b) Thickness Greater than 1/2 the Inside Radius

The maximum allowable working pressure for parts of boilers of cylindrical cross section, designed for temperatures up to that of saturated steam at critical pressure (374.1°C) is to be determined using Equation (2).

(c) Minimum Thickness

The minimum thickness of any boiler plate under pressures is to be 6.4 mm or when pipe over 127 mm (5 in.) OD is used in lieu of plate for the shell of cylindrical components under pressure, its minimum wall is to be 6.4 mm.

(d) Weld Seam Efficiency

The value of E is to be as follows and is to be used for calculations for the corresponding part of the shell.

(i) Seamless shells: E = 1.00.

(ii) Welded shells: longitudinal and circumferential weld seams of boiler shells are to be accomplished by double-welded butt type, or equivalent, and are to be examined for their full length by radiography, E = 1.00.

(e) Corrosion Allowance, C

A corrosion allowance is to be added if corrosion or erosion is expected. The value is to be specified in the submitted plans.

~~$$T = \frac{WR}{2SE - W} + C$$~~

Paragraph 3.1.3 has been amended as follows:

3.1.3 Pressure Vessel Shells

The above formulae are only applicable where the resulting thickness does not exceed half the inside radius, i.e., where Ro is not greater than 1.5R. In the case of Ro exceeding 1.5R, it is to be submitted for special consideration.

(a) Maximum Allowable Working Pressure

The maximum allowable working pressure is to be determined using Equation (1) when W does not exceed 3.85SE (SI units), 38.5SE (MKS units), or 0.385SE (US units) or when the thickness does not exceed one half of the inside radius. Where the thickness of the shell exceeds 1/2 of the inside radius, or when W exceeds 3.85SE (SI units) pressure vessels designed for pressures above 207 bar (210 kgf/cm^2), Equation (2) is to be used.

(b) Corrosion Allowance

A corrosion allowance, C, of not less than 1/6 of the calculated thickness is to be used in determining the thickness of pressure vessels intended for air, steam or water or any combination thereof when they are designed with S values taken from Tables V 3-4 and the minimum required thickness is less than 6.4 mm, except that the sum of the calculated thickness and corrosion allowance need not exceed 6.4 mm. This corrosion allowance is to be provided on the surface in contact with the substance. A corrosion allowance may be omitted for the following cases:

(i) When 0.8 of the S values taken from Tables V 3-4 are used in the design or,

(ii) When values of E in column (c) of Tables V 3-2A and V 3-2B are used in the design, or

(iii) When seamless vessel parts are designed with E = 0.85.

(c) Minimum Thickness

Plates are not to be less than 2.4 mm thick after forming and without allowance for corrosion.

(d) Weld Joint Efficiency

Efficiencies for welded, unfired pressure vessels are to be determined from Tables V 3-2A and V 3-2B. For Group I pressure vessels, longitudinal and circumferential weld seams of shell are to be accomplished by double-welded butt type, or equivalent, and are to be examined for their full length by radiography, in which case, E = 1.00.

Paragraph 3.1.5 has been deleted as follows:

~~3.1.5 The notations used in 3.1.1 to 3.1.4 above are defined as follows:~~

~~T = Minimum thickness of plate, in mm.~~
~~W = Design pressure, in MPa.~~
~~S = Minimum tensed strength of the material of which the shell, drum or header is designed to be made, in N/mm^2.~~
~~E = Efficiency of longitudinal joint or of ligament between tube holes or other openings, whichever is the least, determined from Tables V 3-2A and V 3-2B.~~
~~R = Maximum inside radius of shell, drum or header, in mm.~~
~~C = Corrosion allowance as given in Table V 3-3, in mm.~~
~~R_o = Maximum outside radius of shell, drum or header, in mm.~~
~~F = Constant as given in Table V 3-1.~~

Paragraph 3.2.2 has been amended as follows:

3.2 End Plates without Stays or Other Supports

3.2.1 Flat end plates

The minimum thickness of unseated flat end plates is to be determined by the following formula:

$$T = K_1 d \sqrt{\frac{ZWF}{S}} + C$$

3.2.2 Torispherically and Hemispherically Dished Heads

(a) Minimum Thickness

The minimum thickness for heads without manholes or handholes and having the pressure on the concave side is to be determined by the following equation. See Fig. V 3-1. For heads having pressure on the convex side, see 3.2.2 (g)

$$T = \frac{WRM}{2fSE - 0.2W} + C$$

$$M = 0.25\left(3 + \sqrt{\frac{R}{r}}\right)$$

$M = 1.00$ for hemispherically dished heads

(b) Dish Radius

The radius to which a head is dished is to be not greater than the outside diameter of the flanged portion of the head.

(c) Knuckle Radius

The inside radius of the flange formed on any head for its attachment to the shell plate is to be

(i) Not less than 3 times the thickness of the head, and

(ii) In the case of dished heads, not less than 6% of the outside diameter of the flanged portion of the head.

(d) Maximum Allowable Working Stress

The maximum allowable working stress may be taken from Table V 3-4, except that in the case of pressure vessels where spot radiography is not carried out the maximum allowable unit working stress is not to exceed 0.85 of the appropriate S value in Table V 3-4.

(e) Joint Efficiency

For boilers and Group I pressure vessels, weld seams in the heads are to be of the double-welded butt type and are to be fully radiographed, thus, E = 1. For seamless heads, use E = 1.00. For Group II pressure vessels, use E values in Table V 3-2A.

Head to shell seams are to be considered circumferential seams of shell and are to be dealt with as in 3.1.2 (d) for boiler and 3.1.3 (d) for Group I pressure vessels. However, for hemispherical heads without a skirt, where the attachment of the head to the shell is at the equator, the head to shell joint is to be included in evaluating the joint efficiency of the head.

(f) Corrosion Allowance

The values of the corrosion allowance are to be in accordance with 3.1.2 (e) for boilers and 3.1.3 (b) for pressure vessels.

(g) Heads Having Pressure on the Convex Side

The minimum thickness of a dished head having pressure on the convex side is not to be less than the thickness calculated by the equation in 3.2.1 (a) using 1.67 × W, where W is the maximum working pressure on the convex side.

~~3.2.2 Dished end plates~~

~~The minimum thickness of dished end plates without manholes or other openings and having the pressure on the concave side is to be determined by the following formula:~~

$$T = \frac{K_{\neq} W R_{\neq} F}{2SE - 0.5WF} + C$$

Paragraph 3.2.3 has been amended as follows:

3.2.3 Ellipsoidal Heads

(a) Heads with Pressure on the Concave Side

The minimum thickness of a dished head of an ellipsoidal form having pressure on the concave side is to be in accordance with the following equation:

$$T = \frac{WDK}{2fSE - 0.2W} + C$$

$$K = \frac{1}{6}\left(2 + \left(\frac{D}{2h}\right)^{2}\right)$$

~~3.2.3 Hemi-spherical end plates~~

~~The minimum thickness of hem spherical end plates without stays or other supports and having the pressure on the concave side is to be determined by the following formula:~~

$$T = \frac{WR_{\neq} F}{2SE - 0.5WF} + C$$

Paragraphs 3.2.4~3.2.7 have been renumbered and amended as follows:

~~3.2.4 Semi-ellipsoidal end plates~~

~~The minimum thickness of semi-ellipsoidal end plates without stays or other supports having the pressure on the concave side is to be determined by the following formula:~~

$$T = \frac{WdF}{2SE - 0.5WF} + C$$

3.2.4~~5~~ The thickness of end plates except hemispherical type is not to be less than the required thickness of a seamless shell of the same diameter.

3.2.5~~6~~ The minimum thickness of formed end plates subjected to pressure on their convex sides is to be determined by the same formulae as specified in 3.2.1 to 3.2.3~~4~~ above, and the design pressure, W, in the formulae is to be substituted by 1.67 W.3.2.6~~7~~ The notations used in 3.2.2~~1~~ to 3.2.7~~4~~ above are defined as follows:

T	=	Minimum thickness of end plate, in mm.
W	=	Design pressure (See 1.1.4 of this Part), in MPa.
S	=	maximum allowable working stress at the design temperature material, to be obtained from Table V 3-4; in N/mm^2
~~S~~	~~=~~	~~Minimum tensile strength of the material of which the end plate is designed to be made, in N/mm^2.~~
F	=	Constant as shown in Table V 3-1.
E	=	Minimum efficiency of joint determined from Table V 3-2.
d	=	Inside diameter (for circular end plates) or short span (for non-circular end plates), in mm.
~~d_1~~	~~=~~	~~Long span of non-circular end plates measured perpendicular to short span, in mm.~~
Z	=	1 for circular end plates, and $(3.4-2.4d/d_1)$ for non-circular end plates, but need not be over 2.56
R	=	Inside radius of curvature of end plates as shown in Fig. V 3-1, in mm.
r	=	Inside radius of knuckle of end plates as shown in Fig. V 3-1, in mm.
C	=	Corrosion allowance as given in Table V 3-3, in mm.
K_1	=	Constant as shown in Table V 3-5~~4~~.
~~K_2~~	~~=~~	~~Constant as shown in Table V 3-5.~~
h	=	inside depth of the head not including the skirt; mm in Fig. V 3-2

Fig V 3-1 has been amended as follows:

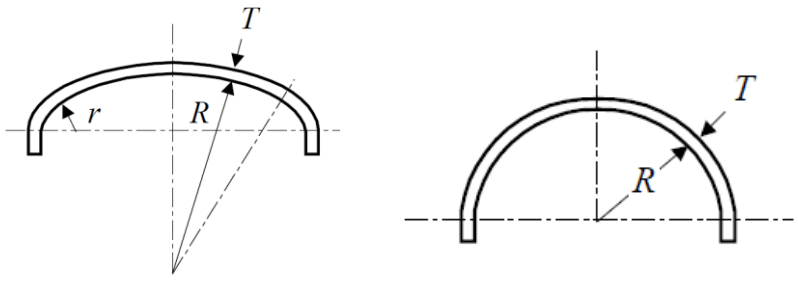


Fig. V 3-1
Torispherical and Hemispherical ~~Dished~~ End Plate

Table V 3-4 has been amended as follows:

Table V 3-4
Maximum Allowable Stress Values for Ferrous Materials – N/mm^2(SI units)

Grade	Tensile Strength (N/mm^2)	Metal temperature(℃) not exceeding											
		-29 to 149	204	260	316	343	371	399	427	454	482	510	538
0-235	400~510	113.7	113.7	113.7	108.9	104.6	101.5	87.0	72.8	60	40.7		
0-315	490~610	140.9	140.9	140.9	136.1	132.1	127.0	103.5	83.7	60	40.7		
0-355	520~640	150.0	150.0	150.0	145.2	141.3	135.4	108.9	87.3	60	40.7		
0-410	550~670	159.1	159.1	159.1	154.3	150.5	143.9	114.4	90.9	60	40.7		
0-450	570~700	165.2	165.2	165.2	160.4	156.6	149.5	118.0	93.3	60	40.7		
0-490	610~740	177.3	177.3	177.3	172.5	168.9	160.8	125.3	98.1	60	40.7		
1-410	410~550	116.7	116.7	116.7	111.9	107.7	104.4	88.9	74.0	60.0	40.7	27.6	17.2
1-450	450~490	128.8	128.8	128.8	124.0	119.9	115.7	96.2	78.8	60.0	40.7	27.6	17.2
1-480	480~620	137.9	137.9	137.9	133.1	129.1	124.1	101.6	82.5	60.0	40.7	27.6	17.2
2-450	450~590	128.8	128.8	128.8	124.0	119.9	115.7	96.2	78.8	60.0	40.7	27.6	17.2
2-480	480~620	137.9	137.9	137.9	133.1	129.1	124.1	101.6	82.5	60.0	40.7	27.6	17.2

Notes

(1) Upon prolonged exposure to temperatures above 425°C, the carbide phase of carbon steel may be converted to graphite.

(2) Upon exposure to temperatures above about 470°C, the carbide phase of carbon-molybdenum steel may be converted to graphite.

(3) Only killed steel is to be used above 482°C.

(4) Flange quality in this specification not permitted above 454°C.

(5) Above 371°C these stress values include a joint efficiency factor of 0.85. When material to this specification is used for pipe, multiply the stress values up to and including 371°C by a factor of 0.85.

(6) Tensile value is expected minimum.

(7) To these values a quality factor of 0.80 is to be applied unless nondestructive testing (NDT) is carried out beyond that required by material specification.

~~**Table V 3-5**~~
~~**Constant K_2 for Dished End Plates**~~

~~r/R_1~~	~~0.06~~	~~0.07~~	~~0.08~~	~~0.09~~	~~0.10~~	~~0.12~~	~~0.14~~
~~K_2~~	~~1.77~~	~~1.69~~	~~1.63~~	~~1.58~~	~~1.54~~	~~1.47~~	~~1.42~~
~~r/R_1~~	~~0.16~~	~~0.18~~	~~0.20~~	~~0.22~~	~~0.24~~	~~0.26~~	~~0.28~~
~~K_2~~	~~1.38~~	~~1.34~~	~~1.31~~	~~1.28~~	~~1.26~~	~~1.24~~	~~1.22~~

~~**Notes:**~~

~~(1) The inside radius of curvature of end plates, R_1 is to be less than the outside diameter of the shell.~~

~~(2) The inside radius of knuckle of end plates, r is not to be less than 3 times the thickness of end plates nor less than 0.06 times the inside diameter of the shell.~~

~~(3) The cylindrical part of dished end plates, *l*, is not to be less than twice the end plate thickness, T, but need not be over 38 mm.~~

~~(4) The value K_2 may be determined by interpolation at intermediate ratio of r/R_1.~~

Table V 3-5 has been renumbered as follows:

Table V 3-54
Constant K_1 for Flat End Plates

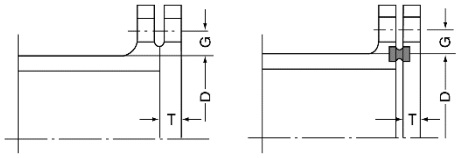
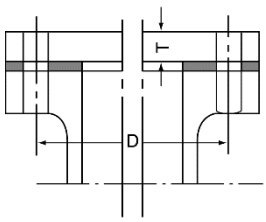
Fig. V 2-1	K_1		Description
	Circular	Non-circular	
B-1	0.50	0.50	In case L is not restricted, R $\geq 3\ T_E$
	0.39	—	In case $L \geq (1.1 - 0.8 \times \frac{T_s^2}{T_E^2}\sqrt{dT_E})$
B-2	0.50	0.50	
B-3	0.70	0.70	
B-4 to B-8	0.55	0.70	
B-9	0.55	—	
B-10	0.70	0.70	
—	0.55	0.55	Flat end plate bolted to shell, flange or side plate. 
—	0.50	0.50	 Flat end plate bolted with a full-face gasket to shell, flange or side plate.

Table V 3-6~3-7 have been amended as follows:

Table V 3-6
Constant K_{32} for Stayed Flat Surfaces

Way of Fixing Stay or Stay Tube in Fig. V 2-1		K_{32}	
		Where the plates are not exposed to flame	Where the plates are exposed to flame
In case the fixing stay are inserted into the plate	E-1	0.35	0.38
	E-2	0.37	0.40
	E-3	0.41	0.44
	E-4	0.50	0.53
In case the stay tube are inserted into the plate	F-1	0.42	0.45
	F-2	0.49	0.52
	F-3	0.49	0.52

Table V 3-7 has been amended as follows:

Table V 3-7
Constant K_{43} for Flat Tube Plates within Tube Nests

In case the stay tubes are inserted into the plate in Fig. V 2-1	K_{43}	
	In case the plates are not exposed to flame	In case the plates are exposed to flame
F-1	0.51	0.54
F-2	0.57	0.61
F-3	0.57	0.61

Paragraph 3.3.1~3.3.5 have been amended as follows:

3.3 Stayed Surfaces

3.3.1 Flat surfaces except tube nests supported by stays other than tube plates of combustion chamber

The minimum thickness of flat surfaces supported by regularly pitched stays or stay tubes is to be determined by the following formula:

$$T = K_{22}\sqrt{\frac{WF(P_1^2 + P_2^2)}{S}} + 1$$

3.3.2 Tube plates of combustion chamber

The minimum thickness of tube plates of combustion chamber or tube plates under compression is to be determined by the following formula:

$$T = \frac{WLP}{183(P - d)}$$

3.3.3 Flat tube plate within tube nests

The minimum thickness of tube plates supported by stay tubes within tube nests is to be determined by the following formula:

$$T = K_{34}P_m\sqrt{\frac{WF}{S}} + 1$$

3.3.4 In applying the above requirement, where the points of support are irregularly pitched or the plate is reinforced by flanging, the following provisions are to be taken into account.

(a) Flanged flat plates may be considered as stayed plates by regarding the commencement of curvature as point of support. In this case the inner radius of the curvature is greater than 2.5 times of the plate, the points located at a distance of 3.5 times the thickness of the plate from the outer surface of the flange may be considered as a commencement of the curvature. In this case, the value of constant K_{22} is to be 0.36 where plates are not exposed to flame or 0.39 where plates are exposed to flame.

(b) Where flat plates are directly attached to shells or furnaces without flanging, the inside of plain ends welded on shells or furnaces is to be regarded as points of support. In this case, the value of constant K_{22} is to be 0.43 where plates are not exposed to flame or 0.47 where plates are exposed to flame.

(c) In 3.3.1 above, the portion of flat surfaces are supported by irregularly pitched stays or stay tubes, C^2 is to be used instead of $P_1^2+P_2^2$. "C" is the diameter of the largest circle, which can be drawn passing through not less than 3 points of support, and has not any support within the circle.

3.3.5 The notations used in 3.3.1 to 3.3.4 above are defined as follows:

T = Minimum thickness of stayed flat surface or tube plate, in mm.
W = Design pressure, in MPa.
S = Minimum tensile strength of plate of which the stayed flat surface or tube plate is designed to be made, in N/mm^2.
F = Constant as given in Table V 3-1.

P_1 = Horizontal pitch of stays or stay tubes, in mm.
P_2 = Vertical pitch of stays or stay tubes, in mm.
P = Pitch of tubes, measured horizontally where tubes are chain pitched, or diagonally where tubes are staggered pitched and the diagonal pitch is less than the horizontal pitch, in mm.
d = Inside diameter of plain tubes, in mm.
L = Internal width of the combustion chamber measured from tube plate to back chamber plate, in mm.
P_m = Mean pitch of stay tubes supporting any positions of tube plates, being the sum of 4 sides of any quadrilateral divided by 4, in mm.
K_{32} = Constant as given in Table V 3-6.
K_{43} = Constant as given in Table V 3-7.

Paragraph 3.4.8 has been amended as follows:

3.4.8 The notations used in 3.4 of this Part are defined as follows:

d_m = Maximum allowable diameter of opening without compensation, in mm.
D_o = Outside diameter of shell, in mm.
T_a = Actual thickness of vessel wall, in mm.
M = $\frac{WD_oF}{1.82ST_a}$, but not more than 0.99.
W = Design pressure, in MPa.
S = Minimum tensile strength of the material of which the shell, end plate or header is designed to be made, in N/mm^2.
F = Constant as given in Table V 3-1.
A = Minimum required area for compensation as specified in Appendix V-1, in mm^2.
d_s = Maximum diameter of finished opening in the longitudinal cross section for shell or in the cross section for end plate, in mm.
d = Diameter of finished opening in a given plane, in mm.
T_s = Required thickness omitting the corrosion allowance C of a seamless shell, header or end plate without opening, in mm.
Except that:
for the dished or hem-spherical end plate when the opening and its compensation are entirely within the spherical portion, T_s is the thickness required by the formula given in 3.2.3 of this Part using E = 1 and C = 0, and for semi-ellipsoidal end plate when the opening and its compensation are located entirely within a circle the center of which coincides with the center of the end plate and the diameter of which is 0.8 times of the shell inside diameter, T_s is thickness required by the formula given in 3.2.3 of this part using E = 1, C = 0 and R = 0.9 of the inside diameter of the shell.
A_1 = Area in excess thickness in the wall of shell or end plate available for compensation, in mm^2.
A_2 = Area in excess thickness in the nozzle wall available for compensation, in mm^2.
E = Joint efficiency
= 1, when an opening is in the plate or when the opening passes through a circumferential joint in a shell (exclusive of end plate to shell joints), or
= the longitudinal joint efficiency, when any part of the opening passes through any other welded joint.
T_n = Actual thickness of nozzle wall, in mm.
T_{ns} = Required thickness of a seamless nozzle wall determined by the same formula used for the shell in 3.1.1 of this Part omitting the corrosion allowance C, in mm.
T_c = Thickness of added compensation, in mm.
C = Corrosion allowance as given in Table V 3-3, in mm.
H = Total depth of flange, in mm.

AMENDMENT TO "THE RULES FOR THE CONSTRUCTION AND CLASSIFICATION OF STEEL SHIPS 2019 AND AMENDMENTS THEREOF "

PART VI PIPING AND PUMPING SYSTEMS

List of major changes in Part VI from 2019 edition

1.5.3	Revised
3.2.1	Revised
3.2.2	Revised
3.2.3	Deleted
3.2.4	Renumbered
3.2.5	Revised
3.2.6~3.2.17	Renumbered

Rules for the Construction and Classification of Steel Ships 2019 and amendments thereof have been partly amended as follows:

Chapter 1 General

Paragraph 1.5.3 has been amended as follows:

1.5.3 Material for pipes, valves and relative fittings belonging to Class I and II and for valves and pipes fitted on the ship's side and for valves fitted on the collision bulkhead are to be tested in accordance with the Rules of the Society. (See Chaper 2.3 of this Part)

Chapter 3 Hull Piping Systems

Paragraph 3.2.1 has been amended as follows:

3.2.1 General ~~The structural arrangements in the double bottom and other tanks are to be such as to permit the free passage of air and gas from all parts of the double bottom and tanks to air pipes.~~

(a) All tanks and cofferdams are to be provided with air pipes having sufficient cross sectional areas to permit easy venting from any part of the tank and cofferdam.

(b) Tanks having top plates not less than 7 meters either in length or in width are to be provided with 2 or more pipes arranged a suitable distance apart. However, tanks having inclined top plates may be provided with 1 air pipe located at the highest part of the top plate.

(c) For tanks requiring more than 1 air pipe, overflow pipes may be used in lieu of air pipes as long as proper air flow from the tank to the atmosphere is ensured; all tanks, however, are to be provided with at least 1 air pipe.

(d) In cases where tanks or cofferdams are of a complicated profile, special consideration is to be given to the number and positions of all air pipes.

(e) Air pipes are to be arranged to be self-draining.

(f) Vent pipes for fuel oil service, settling and lubrication oil tanks are to be located and arranged so that, in cases where such pipes break, there is no direct risk of any ingress of seawater or rainwater.

Paragraph 3.2.2 has been amended as follows:

3.2.2 Open Ends of Air Pipes ~~Air pipes are to be placed as far away from filling pipes as possible. Air pipes on the open deck are to be terminated by automatic closing devices. The extension of the air pipes to different tanks is to be as follows:~~

(a) The position of the open ends of air pipes are to be in accordance with the following requirements (i) to (iv) depending on the type and purpose of tanks. ~~Air pipes to tanks extending to the shell plating or to tanks which can be filled from the sea, are to be carried up to above the bulkhead deck.~~

(i) Air pipes to the following tanks and cofferdams are to be led above the bulkhead deck.

(1) Double bottom tanks

(2) Deep tanks

(3) Tanks which allow for ingress of sea water

(4) Cofferdams

(ii) Air pipes to the following tanks and cofferdams are to be led to the weather part.

(1) Fuel oil tanks and thermal oil tanks

(2) Cargo oil tanks

(3) Heated lubricating oil tanks and hydraulic oil tanks

(4) Tanks which hold liquids and are filled by pumps, (only for tanks which are situated outside machinery spaces and not provided with overflow pipes)

(5) Cofferdams adjacent to fuel oil tanks and cargo oil tanks.

(iii) Air pipes to tanks, which hold liquids and are filled by pumps, are to be led to a safe position where the equipment cannot suffer any damage from any overflowing which may occur when the tank is being filled with a liquid.

(iv) Air pipes to tanks carrying combustible or flammable liquids are to be led to a safe position where there is no possibility of fire caused by any oil or gas leaking from the openings when the tank is being filled.

(b) All openings of air pipes leading above the weather deck are to be provided with automatic closing devices. ~~Air pipes from lubricating oil tanks may be terminated in the machinery space but are to be so located that the possibility of overflowing of oil on electric equipment or high temperature surface is precluded. Pipe openings are to be terminated well above the deep load line.~~

(c) The open ends of air pipes to fuel oil and cargo oil tanks are to be provided with a flame arresting wire gauze of corrosion resistant materials that is easy to clean and detach as well as have a clear area through the mesh of not less than the required sectional area of the air pipe. ~~Air pipes to oil fuel and cargo oil tanks and cofferdams are to be carried above the weather deck where no danger is to be incurred from the escaping oil or vapor during the filling of the tanks.~~

Paragraph 3.2.3 has been deleted as follows:

~~3.2.3 The open ends of air pipes to oil fuel and cargo oil tanks are to be provided with a return bend fitted with a corrosion-resisting wire gauze readily removable for cleaning or renewal. The area of the opening at the open ends is to be twice that of the air pipes. Where an automatic vent head is fitted, the arrangement is to be submitted for approval.~~

Paragraph 3.2.4 has been renumbered as follows:

3.2.3~~4~~ The height of air pipes carried above the weather deck is to be in accordance with 21.2.2 of Part II.

Paragraph 3.2.5 have been amended as follows:

3.2.4~~5~~ Size of Air Pipes

Sizes of air pipes are to be as follows: The diameter of each air pipe is not to be less than 38 mm I.D. for fresh water tanks; 51 mm I.D. for water-ballast tanks; 63 mm I.D. for oil tanks unless specially approved otherwise.

~~Where tanks are to be filled by pump pressure, the aggregate area of the air pipes in the tank is to be at least 125% of the effective area of the filling line, except that when overflows are fitted.~~

(a) The total sectional area of air pipes to tanks, which hold liquids and are filled by pumps, is not to be less than 1.25 times the total sectional area of the filling pipes. In cases where the tank is provided with an overflow pipe, the total sectional area may include that of air pipes to tanks to which overflow pipes are connected. The internal diameter of the air pipes is not to be less than 50 mm.

(b) Provisions are to be made for relieving vacuum when the tanks are being pumped out.

(c) The internal diameter of air pipes to cofferdams or tanks which form part of ship's structure is not to be less than 50 mm.

Paragraphs 3.2.6~3.2.17 have been renumbered as follows:

3.2.5~~6~~ A tank having a comparatively large capacity is required to have at least 2 air pipes, one of which is to be located at the highest part of the tank. For small tanks such as fuel oil settling tanks, only one pipe may be fitted but it is not to be used as the fuel tank filling.

3.2.6~~7~~ The openings of air pipes are to be provided with satisfactory arrangements to prevent free entry of water.

3.2.7~~8~~ Air and overflow pipes are to be so arranged as to be self-draining under normal conditions of trim.

3.2.8~~9~~ Air and overflow pipes are to be of steel having a minimum thickness as specified in Table VI 2-3.

3.2.9~~10~~ The overflow system is to be so arranged that in the event of any one of the tanks being flooded, the water from the sea cannot enter other tanks located in separate watertight compartments through overflow pipes.

3.2.10~~11~~The outlets of overflow pipes if arranged to discharge through the ship's side, are to be located as far above the deep load line as practicable and provided with a non-return value located on the ship's side. Where the pipe does not extend above the freeboard deck, an efficient and accessible means for preventing water from passing inboard is to be provided in addition.

3.2.11~~12~~The cross-sectional area of overflow pipes if fitted is to be at least 25% in excess of the effective area of filling pipes.

3.2.12~~13~~Where tanks for fuel oil or cargo oil are provided with an overflow system, the discharge from the system is to be led to an overflow tank.

3.2.13~~14~~The overflow from settling tanks or daily service tanks is to be led back to the fuel oil tank or to the overflow tank and the overflow pipe is to be fitted with an alarm device or a sight glass, indicating the overflow when taking place. If a sight flow glass is also provided in the overflow pipe. Then such sight glasses are to have documentation verifying that a prototype of the assembly has a suitable degree of fire resistance and are adequately protected from mechanical damage and are to be fitted only in vertical sections of overflow pipes.

3.2.14~~15~~The overflow tank is to have a capacity large enough to take an overflow of 10 minutes at the normal rate of loading.

3.2.15~~16~~The air pipes for fuel oil service, settling and lubrication oil tanks are to be located and arranged to prevent the risk of ingress of seawater splashes or rainwater in the event of a broken air pipe.

3.2.16~~17~~Where tanks which can be filled by pumps, overflow pipes are to be provided where:

(a) The total cross-sectional area of the air pipe is less than that required by 3.2.4~~5~~ of this Part.

(b) Fuel oil service and settling tanks

(c) Where tanks which have openings below the open ends of air pipes.

AMENDMENT TO "THE RULES FOR THE CONSTRUCTION AND CLASSIFICATION OF STEEL SHIPS 2019 AND AMENDMENTS THEREOF "

PART VII ELECTRICAL INSTALLATIONS

List of major changes in Part VII from 2019 edition

1.2.1(c)	Revised
2.5.12	Revised
4.1.5 & 4.1.6	Revised
6.1.15	New
7.2.1 & 7.2.3	Revised
7.3.2	Deleted
11.4.5(g)	New and Renumbered
13.1.3	Revised
13.1.8	New
14.4.1	Revised
14.6.1	Revised
16.3.2	Revised

Rules for the Construction and Classification of Steel Ships 2019 and amendments thereof have been partly amended as follows:

Chapter 1 General

Paragraph 1.2.1(c) has been amended as follows:

1.2.1 The shipbuilder or manufacturer is to submit the following drawings and data for approval before the work commences:

(c) For essential motors ~~over 15 kW~~ of 75 kW and above but below 375 kW:

Chapter 2 System Design of Distribution and Circuit Protection

Paragraph 2.5.12 has been amended as follows:

2.5.12 Engineers' Alarm

~~An engineers' alarm operable at the centralized propulsion machinery control station or the propulsion machinery local control position is to be provided. It is to be clearly audible in each engineer's cabin.~~ The engineers' alarm is to comply with the requirement specified in 1.6.10.(c) of Part IV of this Rule.

Chapter 4 Motors

Paragraph 4.1.5 and 4.1.6 have been amended as follows:

4.1.5 Motors ~~over 15 kW~~ of 75 kW and above, intended for essential services, are to be tested and surveyed by the Surveyor during manufacture in accordance with the requirement of 4.2 of this part.

4.1.6 Motors ~~of 15 kW and below~~ below 75 kW, intended for essential services, are to be tested by the manufacturer in accordance with ~~manufacturer's specification~~ 4.2 of this Part. The test reports are to be made available when requested by the Surveyor. Acceptance of machines will be based on satisfactory performance after installation.

Chapter 6 Batteries

Paragraph 6.1.15 has been added as follows:

6.1.15 For ships installed with lithium-ion batteries, see the requirements in CR Guidelines for Lithium-ion Batteries Applied to Marine System/equipment.

Chapter 7 Transformers

Paragraphs 7.2.1&7.2.3 have been amended as follows:

7.2.1 ~~Transformers in accommodation spaces are to be of dry, naturally cooled type. In machinery spaces they may be of oil immersed, naturally cooled type.~~ Transformers are normally to be of the dry, naturally air-cooled type. When a forced air or liquid cooling system is used, an alarm is to be activated in the event of its failure.

7.2.3 ~~Oil immersed transformers rated at 10 kVA or more are to be provided with oil gauges and drain cocks or plugs, and those rated at 75 kVA or more with thermometers in addition.~~ Liquid-cooled transformers may be used provided that:

- the liquid is non-toxic and of a type which does not readily support combustion
- the construction is such that the liquid is not spilled in inclined position
- temperature and pressure relief devices with an alarm are installed
- drip trays or other suitable arrangements for collecting the liquid from leakages are provided
- a liquid gauge indicating the normal liquid level range is fitted.

Paragraph 7.3.2 has been deleted as follows:

~~7.3.2 The percentage error of the voltage ratio is to be within 0.5% of the declared ratio, or equal to $\frac{1}{10}$ of the percentage impedance voltage at rated load, whichever is the smaller.~~

Chapter 11 Main Source and Emergency Source of Electrical Power

Paragraph 11.4.5(g) has been amended and renumbered as follows:

11.4 Emergency Source of Electrical Power in Cargo Ships

11.4.5 The electrical power available is to be sufficient to supply all those services that are essential for safety in an emergency, due regard being paid to such services as may have to be operated simultaneously. The emergency source of electrical power is to be capable, having regard to starting currents and the transitory nature of certain loads, of supplying simultaneously at least the following services for the periods specified hereinafter, if they depend upon an electrical source for their operation:

(g) For period of half an hour: any watertight doors if electrically operated together with their indicators and warning signals.

(~~g~~h) In a ship engaged regularly in voyages of short duration, the Society if satisfied that an adequate standard of safety would be attained may accept a lesser period than the 18 hour period specified in 11.4.5(b) to (e) above but not less than 12 hours.

Chapter 13 Additional Requirements for Electric Propulsion Equipment

Paragraph 13.1.3 has been amended as follows:

13.1.3 ~~Propulsion generators and motors which are enclosed or in which the air gap is not directly exposed are to be fitted with fire-extinguishing systems suitable for fires in electrical equipment. This will not be required where it can be established that the generator insulation is self-extinguishing.~~ Propulsion generators , motors , and converters are to be provided with means to prevent the accumulation of moisture and condensate when idle.

Paragraph 13.1.8 has been added as follows:

13.1.8 In general, for a ship to be assigned an unrestricted service notation, it is to have two independently driven propellers or other propulsion devices, each connected with at least one electric motor, where these form the sole means of propulsion.

Chapter 14 High Voltage Installations with Voltages above 1 kV up to 15 kV

Paragraph 14.4.1 has been amended as follows:

14.4.1 General

Dry type transformers have to comply with IEC Publication 60076-11~~60726~~. Liquid cooled transformers have to comply with IEC Publication 60076. Oil immersed transformers are to be provided with the following alarms and protections:

Paragraph 14.6.1 has been amended as follows:

14.6.1 General

Switchgear and controlgear assemblies and to be constructed according to the IEC Publication 62271-200~~60298~~ and the following additional requirements.

Chapter 16 Tests after Installation on Board

Paragraph 16.3.2 has been amended as follows:

16.3.2 ~~Generating sets are to be run at full load for a sufficient duration to demonstrate that temperature rises, the operation of the speed governer, over speed trip, reverse current (or power) trip, other safety devices, lubrication and the balance of vibration are satisfactory. If generators are intended to operate in parallel, they are to be tested to demonstrate that the voltage regulation, synchronizing device, load share and the parallel operation are satisfactory.~~ Generators are to be operated for a time sufficient to show satisfactory operation, individually and in parallel, and with all possible load combinations.

AMENDMENT TO "THE RULES FOR THE CONSTRUCTION AND CLASSIFICATION OF STEEL SHIPS 2019 AND AMENDMENTS THEREOF "

PART VIII AUTOMATIC OR REMOTE CONTROL AND MONITORING SYSTEMS

List of major changes in Part VIII from 2019 edition

1.1	Revised	3.7	Revised
1.2	Revised	3.8~3.13	Deleted
2.1	Revised	Table VIII 3-1	Revised
2.2.3 & 2.27	Revised	Table VIII 3-2	New
2.2.8	New	Fig. VIII 3-1	New
2.3	Revised	4.1	Revised
2.3.6	Revised	4.2	Revised
2.3.10	Revised	4.3.3(b)	Revised
2.3.11	New	4.4.1	Revised
2.4	Deleted	4.5	Deleted
2.5 & 2.6	Renumbered and revised	4.6	Revised
2.6	New	4.10	Revised
2.7	Revised	4.11	Revised
2.8	New	4.14.1(a)	Revised
2.9	Revised	4.15	Revised
2.8	Renumbered and Revised	Table VIII 4-2	Revised
2.10	Renumbered and Revised	Table VIII 4-3	Revised
2.11	Renumbered and New	Table VIII 4-4	Revised
Table VIII 2-1	New	Table VIII 4-5A	Revised
Table VIII 2-2	Renumbered and Revised	Table VIII 4-5B	Revised
3	Revised	Table VIII 4-6	Revised
3.1	Revised	Table VIII 4-7	Revised
3.2	Revised	Table VIII 4-8	Revised
3.3	Revised	Table VIII 4-9	Revised
3.4	Revised	Table VIII 4-10	New
3.5	Revised	5.3	Revised
3.6	Revised	5.5	Revised

5.11.1	Revised
5.13	Revised
6.2~6.3	Revised
7.1~7.9	Deleted
7.10	Renumbered and Revised
7.2	New
Table VIII 7-1 ~ 7-5	Deleted
Table VIII 7-6	Renumbered
8	New

Rules for the Construction and Classification of Steel Ships 2019 and amendments thereof have been partly amended as follows:

Chapter 1 General Requirements

Section 1.1 has been amended as follows:

1.1 General

1.1.1 When it is desired to fit with control and monitoring systems having one or more control stations and embodying various degrees of automatic or remote control and monitoring of the propulsion machinery, propulsion machinery space, and other machinery and systems are to meet the requirements contained in this part to assure operation as effective as could be obtained with the same systems arranged for manual control and monitoring by watch-keeping. The requirements for automation or remote control and monitoring systems are detailed in the following chapters:

(a) ~~Automatic or remote control and monitoring systems for propulsion machinery and monitoring systems for propulsion machinery space .The requirements in Chapter 1 through Chapter 6, as applicable, are to be complied with. For propulsion class symbols, see 1.1.2.~~ Chapter 1 deals with general requirements and provides the required submittals of automation systems

(b) ~~Other Machinery and systems~~ Chapter 2 provides the essential features requirements which are all generic requirements for control system, monitoring/alarm system, safety system, power supply, remote propulsion control on navigation bridge and other than on navigation bridge.

~~The requirements in Chapter 1, 2 and 7 are applicable to the automatic or remote control and monitoring of the following machinery and systems:~~

~~(i) Auxiliary oil fired boilers.~~

~~(ii) Incinerators.~~

~~(iii) Inert gas generators.~~

~~(iv) Auxiliary gas or steam turbines.~~

~~(v) Auxiliary diesel engines.~~

~~(vi) Bilge and ballast machinery/systems.~~

~~(vii) Hazardous liquid cargo handling machinery/systems.~~

~~(viii) Cargoes refrigeration machinery.~~

~~(ix) Main electrical power generating plant.~~

(c) Chapter 3 provides requirements for computer-based systems which include system categories, software and hardware requirements.

(d) Chapter 4 provides requirements for **CAS** symbol.

(e) Chapter 5 provides requirements for **CAU** symbol.

(f) Chapter 6 provides requirements for **CAB** symbol.

(g) Chapter 7 provides requirements for other automatic or remote control and monitoring systems.

(h) Chapter 8 provides requirements for integrated automation system

1.1.2 Automation symbol

Automatic or remote control and monitoring systems for propulsion machinery and monitoring systems for propulsion-machinery space that comply with the requirements in Chapter 1 through Chapter 6, as applicable, will be distinguished in the Register as follows:

(a) **CAS** symbol

~~Automatic or remote control and monitoring systems complying with Chapter 4 will be distinguished in the Register by the symbol **CAS.**~~ Where, in lieu of manning the propulsion machinery space locally, it is intended to control and monitor the propulsion and auxiliary machinery by qualified personnel from a continuously manned centralized control station, the provisions of chapter 4 are to be complied with. And upon verification of compliance, the class symbol **CAS** will be assigned.

(b) **CAU** symbol

~~Automatic or remote control and monitoring systems complying with Chapter 5 will be distinguished in the Register by the symbol **CAU.**~~ Where it is intended that propulsion machinery space be periodically unmanned and that propulsion machinery be controlled from the navigation bridge and a centralized location, the provisions of chapter 5 are to be complied with. And upon verification of compliance, the class symbol **CAU** will be assigned.

(c) **CAB** symbol

~~Automatic or remote control and monitoring systems complying with Chapter 6 will be distinguished in the Register by the symbol **CAB.**~~ Where it is intended that propulsion machinery space be periodically unmanned and that propulsion machinery be controlled from the navigation bridge, the provisions of chapter 6 are to be complied with. And upon verification of compliance, the class symbol **CAB** will be assigned.

1.1.3 Consideration is to be given to automatic or remote control and monitoring systems for propulsion machinery and monitoring systems for propulsion-machinery space with details and arrangements in accordance with other recognized standards provided they are not less effective.

~~1.1.4 An operational guidance manual is to be provided on board the ship for reference and is to contain the necessary system technical information and give operating instructions for normal and emergency operations.~~

Section 1.2 has been amended as follows:

1.2 Plans and Data

The following plans and data are to be submitted for review, as applicable.

1.2.1 Specifications

A general description of the operation of the system is to be provided. This is to include the system configuration, general arrangements for the ship and the layout of the propulsion machinery with essential auxiliaries, specifications of main equipment with information of manufacturer's name, type, rating and number of the equipment.

1.2.2 System Design Plans

(a) Propulsion Control System

(i) Schematic diagrams showing connections between all main components (units, modules) of the system, human machine interfaces (HMI) and interfaces with other systems.

(1) Propulsion control stations (e.g. from navigation bridge, centralized control station, etc.)

(2) Type and size of propulsion prime movers and auxiliary machinery and electric propulsion motors (if applicable)

(3) Independent local manual control

(4) Shaft turning gear interlocking arrangements

(5) Propulsion manual emergency shutdown

(6) Control station instrumentation

(7) Communications systems

(8) Essential auxiliary machinery and their controls, such as electrical power generating plant, hydraulic or pneumatic power generation, storage, vital auxiliary pumps, etc.

(9) Power supply arrangement

(ii) Operational descriptions for the following items:

(1) Starting of propulsion machinery

(2) Control transfer

(3) Critical speeds

(4) Essential auxiliary machinery automatic starting arrangement if fitted

(5) Power management arrangements where specially required by the Rules

(b) Propulsion Machinery Safety System

Safety systems descriptions may include a list of all monitored parameters with settings for implemented protective actions (e.g., automatic shutdown and automatic slowdown), schematic diagrams showing the connections between the safety devices, control and display units, alarm devices, human machine interface (HMI) and power supply arrangement, as appropriate, and operational descriptions for the following items:

(i) Initiation of automatic shutdown

(ii) Initiation of automatic slowdown

(iii) Initiation of automatic starting of standby units

(iv) Override of automatic shutdown

(v) Override of automatic slowdown

(vi) Re-start of propulsion machinery

(c) Propulsion Machinery Monitoring System

Schematic diagrams showing the connections between the sensing devices, control and display units, alarm devices, human machine interfaces (HMI) and power supply arrangement, and description of monitoring systems including a list of alarms and displays including preset parameters for the propulsion machinery and all essential auxiliary machinery and systems the following stations:

(i) Centralized control station alarm and instrumentation

(ii) Monitoring station in the engineers accommodation

(iii) Navigation bridge instrumentation

(d) Failure Modes and Effect Analysis (FMEA)

The FMEA as required, is to contain at least the following:

(i) System block diagrams showing system breakdown and components of interests.

(ii) A tabulation of the following:

(1) Systems and components of interests

(2) Potential failures modes

(3) Predictable cause associated with each failure mode

(4) Failure detection means

(5) Responses of the system to the failures

(6) Possible consequences of the failures

(7) Conclusions, comments or recommendations

(e) Programmable Electronic System (PES)

The following are to be submitted as appropriate:

(i) Block diagram showing the system configuration including the user interface, description of hardware specifications, hardware FMEA, fail-safe features, security arrangements, power supply, and independence of systems (control, monitoring and safety shutdown).

(ii) Software logic flow chart, description of software functions, self-test features and documentation on quality standard of software development and testing.

(iii) Calculations and/or methods used to determine the Worst Case Response Time (WCRT) for TABLE VIII 3-1 Category III Systems' alarms with respect to design data volume and CPU(s) capability including: data communication protocol(s) and the Worst Case Execution Time (WCET) of the alarm processing task(s). This requirement is also applicable to Category III Systems reduced to Category II, due to independent effective back up or other means of averting danger for the control functions (such as mitigation of alarms missing deadlines).

(iv) For integrated systems, the documentation is to be submitted to verify independence of the regular alarm, control and safety functions for each of the essential services. Refer to 1.2.2(d), 3.2.11, 3.6.1(b),8.2, 8.3 and 8.4 of the Rules.

(v) For documentation of software and hardware, refer to Table VIII 3-2.

The complete system testing plan is to be specified and submitted before the hardware and software test will be carried out. The testing plan is to at least include test schedule, test levels according to different system categories and test cases.

(f) Wireless Data Communication Equipment

The following documentation is to be submitted for wireless data communication equipment.

(i) Documentation which demonstrates that the wireless data communication equipment provides an improvement in the safety of the ship, compared to wired data communication.

(ii) General details of the wireless system and equipment.

(iii) Risk analysis.

(iv) Evidence of type testing.

(v) On-board test schedule.

(vi) Details of manufacturer's recommended installation and maintenance practices. Network plan with arrangement and type of antennas and identification of location. Details of the wireless data communication network.

(vii) Specification of wireless communication system protocols and management functions.

(viii) Details of radio-frequency and power levels.

(ix) For functions that are provided with an alternative means of control, a description of the functions and a description of the alternative means of control.

(h) Equipment Plans

Schematic diagrams with a list of major electrical, electronic, hydraulic and pneumatic equipment / components (including manufacturer's names, model names, material, ratings, degree of protection and permissible angles of inclination), function descriptions, construction plans, outline view and elevation details, certificates or test reports as appropriate at testing to the suitability to the intended services and operating conditions in compliance with the environmental criteria set forth in 2.12.

(i) Navigation bridge console

(ii) Centralized control and monitoring console

(iii) Safety systems and devices

(iv) Computer based systems

(v) Hydraulic equipment

(vi) Pnuematic equipment

(i) Installation Plans

(i) Installation Arrangements

Locations of centralized control station and remote control stations on the navigation bridge; arrangements of the centralized control station containing control consoles and other equipment, including glass windows, doors, and ventilation fitting, as applicable.

(ii) Electrical One-line Diagrams

Type, size and protection of cables between control and monitoring equipment.

(iii) Installation Methods

Installation methods for all power and automatic or remote control and monitoring (electrical, pneumatic and hydraulic). This is to include details of cable or pipe runs, separation of cables of different voltage rating and insulating rating, cable tray laying, deck or bulkhead penetration, prevention of magnetic interference, etc.

~~1.2.1 Plans and specifications including the following information are to be submitted for approval:~~

~~(a) Machinery arrangement showing location of control stations in relation to controlled units.~~

~~(b) Arrangements and details~~

~~of control consoles including front views, installation arrangements together with schematic diagrams for all power, control and monitoring systems including their functions.~~

~~(c) A complete operational description of the automatic or remote control and monitoring systems including a list of alarms and displays and functional sketches or description of all special valves, actuator, sensors and relays.~~

~~(d) A simplified one line diagram (electrical and piping) of all power and automatic or remote control and monitoring systems. This is to include power supplies, circuit or piping protection ratings and settings, cable or pipe sizes and materials, rating of connected loads, etc.~~

~~(e) A schematic diagram of all control, alarm, display, safety and emergency shut down systems. This is to include detailed description of the system and interaction with other systems.~~

~~(f) For computer-based systems, the following is to be included:~~

~~(i) Overall description and specification of the systems and equipment.~~

~~(ii) Block diagrams for the computer hardware showing interfacing between the work stations, input/output (I/O) units, local controllers, traffic controllers, data highways, etc.~~

~~(iii) Logic flow chart or ladder diagrams.~~

~~(iv) Description of the alarm system indicating the ways it is acknowledged, displayed on the monitor or mimic display board, etc.~~

~~(v) Description of the system redundancy and back-up equipment, if any.~~

~~(vi) Description of the data communication protocol including anticipated data process response delays.~~

~~(vii) Description of the system's security protocol to prevent unauthorized program changes which may compromise the integrity of the automatic or remote systems.~~

~~(viii) Description of the system with regard to the degree of independence or redundancy provided for the control systems, alarm/display systems and safety systems.~~

~~(ix) Description of system's task priorities.~~

~~(x) Where applicable, description of UPS (uninterruptable power supply) and their capacities including system's power consumption.~~

~~(xi) Equipment ratings and environmental parameters.~~

~~(g) A matrix chart for each of the systems indicating the following, as applicable, upon activation of a given alarm or safety action:~~

~~(i) Name, device designations and type, and location of alarms.~~

~~(ii) Preset parameter values, if any.~~

~~(iii) Automatic tripping and other safety provisions of controlled equipment.~~

~~(iv) Location of control stations where shutdown, and control and monitoring power supply transfer devices are fitted.~~

~~(v) Special remarks, if any.~~

~~(h) Schematic plans and supporting data of fire protection and extinguishing systems, including fire detection and alarm systems, bilge high water alarms.~~

~~(i) Certificates or test reports, as appropriate, attesting to the suitability of the particular equipment including connected sensing devices and indicating its compliance with the environmental criteria set forth in 2.10 and 2.11, as applicable.~~

~~(j) System Failure Mode and Effect Analysis (FMEA) or similar, as required.~~

Chapter 2 Systems Design and Arrangements

Section 2.1 has been amended as follows:

2.1 General

~~Except as noted in this part the requirements contained in this Chapter are applicable to all automatic or remote control and monitoring systems referenced in 1.1.1(a) and 1.1.1(b). Automatic or remote controls and monitoring systems as referenced in this part include control, alarm/display, safety and emergency shutdown systems. For computer-based systems, see 2.7 of this Part.~~ The requirements of this chapter apply to control systems, monitoring systems, alarm systems, safety systems, and automatic or remote controls on board ships, where fitted.

Paragraphs 2.2.3 & 2.2.7 have been amended as follows:

2.2.3 Transfer of controls from a remote control station under operation to other associated remote stations is to be possible by a request from the receiving station and acceptance by the station in operation, or vice versa. See ~~3.2~~ 2.8.6.(c) for propulsion control systems. All control stations are to have indicators showing which station is in control.

2.2.7 Equipment associated with automatic or remote control systems is to be suitable for the intended location. Control systems associated with propulsion related machinery/systems are to comply with the requirements contained in ~~2.10~~ 2.11 and ~~2.11~~ 2.12 of this Part.

Paragraph 2.2.8 has been added as follows:

2.2.8 Systems performing different functions (e.g., monitoring systems, control systems, and safety systems) are to be, as much as practicable, independent of each other such that a single failure in one will not render the others inoperative. Specifically, the shutdown function of the safety system is to be independent of control and monitoring systems. Common sensors will be acceptable for any functions other than shutdown functions and automatic start/changeover of the required pumps as listed in Table VIII 4-3 through Table VIII 4-7

Section 2.3 has been amended as follows:

2.3 Monitoring/Alarm Systems

Paragraph 2.3.6 has been amended as follows:

2.3.6 ~~Where a centralized control and monitoring station is provided, the silencing of the audible alarm from an associated remote control station is not to lead automatically to the silencing of the original alarm at the centralized control and monitoring station.~~ Acknowledgement shall be possible only from the local controls or the centralized control position station. The silencing of the alarm at an associated remote control station is not to automatically mute and steady, or acknowledge, the same alarm signals at the centralized control station.

Paragraph 2.3.10 has been amended as follows:

2.3.10 Equipment associated with automatic or remote alarm systems is to be suitable for the intended location. Alarm systems associated with propulsion related machinery/systems are to comply with the requirements contained in ~~2.10~~ 2.11 and ~~2.11~~ 2.12 of this Part.

Paragraph 2.3.11 has been added as follows:

2.3.11 As much as practicable, a fault in the visual alarm circuits is not to affect the operation of the audible alarm circuits.

Section 2.4 has been deleted as follows:

~~2.4 Display Systems~~

~~2.4.1 Displays systems are to comply with 2.3.1 to 2.3.4 and 2.3.9 to 2.3.10.~~

~~2.4.2 Operating parameter displays are to be displayed in a distinguishable manner such that displays of similar machinery or systems are grouped together. Operating parameter displays are to be fitted in control stations as required in this Part.~~

~~2.4.3 For Propulsion system, when logic circuits are used for sequential start-up or for operating individual plant components, indicators are to be provided at the control console to show the successful completion of the sequence of operations by the logic circuit for start-up and operation of the component. If some particular step is not carried out during the sequence, the sequence is to stop at this point and such condition is to be alarmed at the control console or, where provided, at the centralized control and monitoring station. Manual override is to be fitted in vital functions to permit control in case of failure of a logic circuit.~~

Sections 2.5~2.6 have been renumbered and amended as follows:

2.~~5~~4 Safety Systems

2.~~5~~4.1 Safety systems are to be provided as required in this part. Considerations will be given to the manual activation of safety systems provided that measures are taken, by the inherent design of the systems or by suitable arrangements, to retard the escalation of the abnormal condition and to alert personnel to take the appropriate action prior to the developing of a dangerous condition.

2.~~5~~4.2 Safety systems are to be of the fail-safe type and are to respond automatically to fault conditions that may endanger the machinery or safety of the crew. Unless otherwise required in this part or specially approved, this automatic action is to cause the machinery to take the least drastic action first, as appropriate, by reducing its normal operating output or switching to a stand-by machinery and last, by stopping it, i.e., disrupting source of fuel or power supply, etc.

2.~~5~~4.3 Safety systems for different parts of the machinery plant are to be independent of each other. The safety system intended for the functions of shutdown is to be completely independent of the control and alarms systems so that a failure in these systems will not prevent the safety system from operating. However, for the function of reducing the output of the machinery and starting of standby units, complete independence of the safety systems from the control and alarm systems is not required.

2.~~5~~4.4 Each safety action is to be alarmed at the associated remote station. However, where a centralized control and monitoring station is fitted, individual alarms are to be provided at that station; in which case, a summary-alarm for the specific safety system will be acceptable at other associated remote stations. When both an alarm and a safety action are required for a specific failure condition, the alarm is to be activated first.

2.~~5~~4.5 Machinery that is stopped as a result of a safety action, is not to resume operation unless it is reset manually.

2.~~5~~4.6 Remote overrides are not to override those safety actions specified in other part of the Rules. For safety action specified in this chapter, any overrides of safety provisions are to be so arranged that they cannot go unnoticed and their activation and condition are to be alarmed and indicated at the associated remote station. The override is to be arranged to preclude inadvertent operations and is not to deactivate alarms associated with safety provisions. The override mechanism to disconnect safety provisions is to be fitted at the associated remote station except that where a centralized control and monitoring station is fitted, the override mechanism may be fitted at the centralized station instead. Overrides fitted on the bridge are to be operable only when in the bridge control mode.

2.~~5~~4.7 Equipment associated with safety systems is to be suitable for the intended location. Safety systems associated with propulsion related machinery/systems are to comply with the requirements contained in ~~2.10~~ 2.11 and ~~2.11~~ 2.12 of this Part.

2.~~6~~5 Emergency Shutdown Systems

2.~~6~~5.1 Emergency shutdown systems are to be of the fail-safe type. The manually activated emergency shutdown systems, which are provided for the propulsion machinery and other machinery/systems within the machinery plant, are to be operable independently of each other's systems.

2.~~6~~5.2 Activation of a specific shutdown system is to be accomplished only by the deliberate action of the operator and is to be arranged so as to prevent its inadvertent operation.

Section 2.6 has been added as follows:

2.6 Automatic Safety Shutdown

To avert rapid deterioration of propulsion and auxiliary machinery, the following automatic shutdowns are to be provided, regardless of the mode of control: manual, remote or automatic. These shutdowns are not to be fitted with manual override.

2.6.1 For all diesel engines:

(a) Overspeed

(b) Lube oil system failure

2.6.2 For all gas turbines

(a) Failure of lubricating oil system

(b) Failure of flame or ignition

(c) High exhaust gas temperature

(d) High compressor vacuum

(e) Overspeed

(f) Excessive vibration

(g) Excessive axial displacement of rotors

2.6.3 For all steam turbines:

(a) Failure of lubricating oil system

(b) Overspeed

(c) Back-pressure for auxiliary turbines

2.6.4 For all boilers:

(a) Failure of flame

(b) Failure of flame scanner

(c) Low water level

(d) Failure of forced draft pressure

(e) Failure of control power

2.6.5 For propulsion reduction gears:

(a) Shutdown prime movers upon failure of reduction gear lubricating oil system.

(b) Where prime movers are diesel engines, shutdown is mandatory for high speed or medium speed diesel engines coupled to a reduction gear.

2.6.6 For generators:

(a) For generators fitted with forced lubrication system only: shutdown prime movers upon failure of generator lubricating oil system

2.6.7 For propulsion DC motor

(a) Overspeed

Section 2.7 has been amended as follows:

2.7 Remote Propulsion Control System Requirements

2.7.1 Propulsion and Maneuvering Application

The provisions of this section are applicable:

(a) Where it is intended that the propulsion machinery be directly controlled from the navigation bridge or from any remote propulsion control station within or outside the propulsion machinery space;

(b) Where, in lieu of manning the propulsion machinery space locally, it is intended to monitor it and to control and monitor the propulsion and auxiliary machinery by qualified personnel from a continuously manned centralized control station; or

(c) Where it is intended that the propulsion machinery space be periodically unmanned. Provisions for remote control of steering gears and of athwartship or positioning thrusters are given in 4.2 of Part IV and 10.4 of Part IV, respectively.

2.7.2 General Requirements

The remote propulsion control station is to be:

(a) As effective as local control

(b) Provided with control of speed and direction of thrust of the propeller

(c) Provided with instrumentation sufficient to provide the operator with information about the state of the propulsion machinery and the control system itself

2.7.3 System Design

In general, conceptual requirements in 2.2 are to be applied. Further requirements are provided in 2.4, 2.8, and 2.9.

2.7.4 System Power Supply

(a) Power Source

The requirement of power source is to comply with 2.10.

~~**2.7 Computer-based Systems**~~

~~2.7.1 Computer-based systems are to be designed so that failure of any of the system's components will not cause unsafe operation of the system. Hardware and software serving vital and non-vital systems are to be arranged to give priority to vital systems.~~

~~2.7.2 Control, alarm and safety shut-down system functions are to be arranged such that a single failure or malfunction of the electronic computer equipment will not affect more than one of these system functions. This is to be achieved by dedicated equipment for each of these functions within a single system, or by the provision of back-up equipment, or by other suitable means considered not less effective.In the case of computer-based systems for which the safety functions are not backed-up by hard-wired safety systems, a FMEA is to be performed and submitted for review.~~

~~2.7.3 Visual Display of Alarms~~

~~(a) In addition to the requirements contained in 2.3, and when displayed by way of a computer monitor (video display unit), alarms are to be presented in an identifiable manner, and when displayed, alarms are to appear in the sequence as the incoming signals are received. Alarming of incoming fault signals are to automatically appear on the screen, to alert the on-duty personnel, regardless of whether the computer and monitor (video display unit) are in a mode other than the monitoring mode, i.e., computing or displaying other system's mimic or schematic diagrams.~~

~~(b) Alarms associated with faults which have not been rectified may be displayed in a summarized fashion until all the faults have been dealt with.~~

~~(c) Displays on the computer monitor (video display unit) are to be clearly visible under ambient lighting conditions. For propulsion systems, computer monitors on the navigating bridge are to be provided with dimmers to control display lighting. Data displayed on computer monitors are to be readable by the operator from the normal operating position.~~

~~(d) For propulsion systems, unless display means other than computer monitor display are provided therein, the centralized control and monitoring station is to be provided with at least two computer monitors (video display units) including keyboards.~~

~~(e) For propulsion related system applications, the time limit on response delays for safety and alarm displays is not to exceed 2 seconds.~~

~~2.7.4 Computer system's memory is to be of sufficient capacity to handle the operation of all computer programs (software) as configured in the computer system. The time response for processing and transmitting data is to be such that undesirable chain of events may not arise as a result of unacceptable data delay or response time during the computer system's worst data overload operating condition (multi-tasking mode).~~

~~2.7.5 To preclude the possible loss or corruption of data as a result of power disruption, program and associated memory data considered to be essential for the operation of the specific system is to be stored in non-volatile memory or a volatile memory with a secure uninterruptible power supply (UPS).~~

~~2.7.6 For propulsion systems, where automatic or remote control and monitoring system for specific machinery is arranged to operate in a Local Area Network (LAN), the following is to be complied with.~~

~~(a) The network topology is to be configured so that in the event of a failure between nodes, or at a node, the system on the network remains operational.~~

~~(b) In the event of failure of the network controller, the network is to be arranged to automatically switch to a standby controller. A network controller failure is to be alarmed at the associated remote control station.~~

~~(c) Safeguards are to be provided to prevent unacceptable data transmission delays (overloading of network). An alarm is to be activated at the associated remote control stations prior to a critical network data overload condition. See 2.7.4.~~

~~(d) The communication data highway is to be provided in duplicate and is to be arranged so that upon failure of the on-line highway, the standby data highway is automatically connected to the system. The standby data highway is not to be used to reduce traffic in the on-line highway.~~

~~2.7.7 The system's software and hardware is to be designed so that upon restoration of power supply, after power failure, automatic or remote control and monitoring capabilities can immediately be available after the pre-established computer control access (sign-in) procedure has been completed.~~

~~2.7.8 Alteration of parameters that may affect the system's performance are to be limited to authorized personnel by means of key switch, keycard, password or other approved methods. Similarly, computer program or system's configuration changes are to be effected only by authorized personnel.~~

Section 2.8 has been added as follows:

2.8 Remote Propulsion Control on Navigation Bridge

2.8.1 General

Where propulsion machinery is to be controlled from the navigation bridge, means for control and monitoring are to be as provided in Table VIII 2-1. The following control and monitoring features are also to be provided. These requirements do not apply to bridge wing propulsion control stations.

2.8.2 Propeller Control

The speed, direction of thrust and, where applicable, the pitch of the propeller, are to be fully controllable from the navigation bridge under all sailing conditions, including maneuvering. The control is to be performed by a single control device for each independent propeller, with automatic performance of all associated services, including, where necessary, means of preventing overload of the propulsion machinery. Where multiple propellers are designed to operate simultaneously, they may be controlled by one control device.

2.8.3 Ordered Speed and Direction

When under navigation bridge control, ordered speed and direction of propulsion machinery, including pitch of propellers, where applicable, are to be indicated at the local propulsion machinery control position, and at the centralized control station if fitted.

2.8.4 Emergency Shutdown

A manually operated emergency-stopping device for the propulsion machinery is to be provided on the navigation bridge. This device is to be independent of the remote propulsion control system. The shutdown may only be activated by the deliberate action of the operator, and is to be so arranged as to prevent its inadvertent operation.

2.8.5 Starting of Propulsion Machinery

Where it is necessary to restart the propulsion machinery in order to reverse it to go astern, means to start the propulsion machinery is to be provided on the navigation bridge. In such cases, and in other cases where propulsion machinery can be started from a remote control station, the following are to be provided:

(a) An alarm to indicate a low level starting medium energy condition (e.g. a low starting air pressure) which is to be set at a level to permit further starting operation.

(b) A display to indicate starting medium energy level (e.g. starting air pressure).

(c) Where automatic starting of the propulsion machinery is fitted, the number of consecutive automatic attempts is to be limited in order to safeguard sufficient capacity for local manual starting.

(d) Starting of the propulsion machinery is to be automatically inhibited where conditions exist which may damage the propulsion machinery (e.g., shaft-turning gear engaged, insufficient lubricating oil pressure, etc.). The activation of such inhibition is to be alarmed at the remote control station.

2.8.6 Transfer Between Remote Control Stations

Remote control of the propulsion machinery is to be possible only from one location at a time. At each location there is to be an indicator showing which location is in control of the propulsion machinery. The following protocol is to be observed for transfer of control between stations:

(a) The transfer of propulsion control between stations is to take effect only with acknowledgment by the receiving station. This, however, does not apply to transfer of control between the centralized control station and the local manual control.

(b) The transfer of propulsion control between the navigation bridge and the propulsion machinery space is to be possible only in the propulsion machinery space (i.e. at either the centralized control station or the local manual control position).

(c) The centralized control station as required for **CAS** per Chapter 4 of this part or engine room remote propulsion control station, if fitted (see 2.7), is to be capable of assuming propulsion control at any time or blocking orders from other remote control stations. However, where special operating requirements of the ship prevail, override control over the centralized control station will be considered.

Notes:

Special consideration upon submittal of proposal should address where engine room takeover is not desired taking into account the following, as applicable:

(i) Mission deck over the side operations

(ii) Azimuth drives providing both propulsion and steering control

(iii) Itemized alarms in the navigation bridge instead of the required summary alarm for **CAU** per Line E1 of Table VIII 2-1.

(iv) **DPS** class notation where all thruster controls are to be available to the DP operator at all times

(v) **CAU** unattended machinery spaces

(vi) Proximity of distance between the remote control station and local controls

(vii) The proposal may subject to flag State acceptance with respect to the requirements of the governmental authority whose flag the ship flies.

(d) Propeller speed and direction of thrust are to be prevented from altering significantly when propulsion control is transferred from one control station to another.

2.8.7 Local Manual Control

Means are to be provided for local manual control so that satisfactory operation of the propulsion machinery can be exercised for lengthy periods in the event of the failure of the remote propulsion control system. For this purpose, indicators for propeller speed and direction of rotation (for fixed pitch propellers) or pitch position (for controllable pitch propellers) are to be provided at this local manual control station. The means of communication as required by 2.5 of Part VII is to be fitted also at this manual control station. It is also to be possible to control auxiliary machinery, which are essential for propulsion and safety of the ship, at or near the machinery concerned.

2.8.8 Communications Systems

For communication systems associated with propulsion control stations, the requirements in 2.5 of Part VII are applicable.

Section 2.9 has been amended as follows:

2.9 ~~Communication Systems~~ Remote Propulsion Control Station Other than Navigation Bridge

2.9.1 General

Where remote propulsion control station is provided at a location other than the navigation bridge, such station is to comply with requirements applicable to that at the navigation bridge, with the exception of the provision of telegraph.

2.9.2 Propulsion Machinery Space

Remote propulsion control stations fitted in ships having the propulsion machinery space manned are to be provided with the alarms, displays and controls as listed in Table VIII 2-1, items A1 through C2 as a minimum.

Where a remote propulsion control station is provided in or in the vicinity of the propulsion machinery space for the purpose of full remote operation of a locally manned propulsion machinery space, such a station is to be fitted with:

(a) Remote propulsion control station as in 2.9.1

(b) Alarms, displays and controls as required in Table VIII 4-2

(c) Alarms and displays of Table VIII 4-3 through Table VIII 4-10, as applicable.

~~For communication systems associated with propulsion control stations, the requirements in 2.5.9 of part VII are applicable.~~

Section 2.8 has been renumbered and amended as follows:

2.~~8~~10 Supply, Arrangement and System Protection of Automatic or Remote Control and Monitoring Systems

2.~~8~~10.1 Supply and Arrangement

(a) The requirements contained in 2.~~8~~10.1 are applicable to propulsion systems. The power distribution to control systems, alarm/display systems (considered as one for the purpose of this requirement) and safety systems is to be provided with their individual circuits so that a fault in one of the systems cannot cause loss of the other systems. Their supply status and failure condition is to be displayed and alarmed at the associated remote propulsion station.

(b) The supply circuits in 2.~~8~~10.1(a) may be either connected directly to the main switch-board or supplied via a common supply feeder connected to the main switchboard. The power supply status and failure condition of each of the circuits in 2.~~8~~10.1(a) is to be monitored on the load side of the feeder's protective device. Additionally, automatic or remote control and monitoring systems that may require constant power supply are to be provided with an uninterruptible power supply (UPS) system of sufficient capacity to cover the required main power transitionperiod. See ~~2.7.5~~ 3.2.2of this Part.

(c) The hydraulic pumps for control and monitoring systems are to be fitted in duplicate. The pump suctions are to be from a reservoir of sufficient capacity to contain all the fluid when drained from the system, maintain the fluid level at an effective working height and allow air and foreign matter to separate out. The pump suctions are to be sized and positioned to prevent cavitations or starvation of pump. A duplex filter which can be cleaned without interrupting the oil supply is to be fitted on the discharge side of pumps. The hydraulic fluid is to be suitable for its intended operation.

(d) Compressed air for control and monitoring systems is to be available from at least two air compressors. The starting air system may be used as a source of control air. The air pressure to the pneumatic control or display system is to be automatically maintained at a level required for the operation of the installation. Means to prevent the accumulation of moisture is to be provided. Additionally, means are to be provided to assure the supply, from a safe area, of clean, dry and oil-free air to the pneumatic controls or displays.

2.~~8~~10.2 System Protection

(a) Electrical

Circuits are to be arranged so that a fault in one circuit will not cause maloperation or failure on another circuit or system. It is to be possible to isolate the faulted circuit. Additionally, systems are to be protected against accidental reversal of power supply polarities, voltage spikes and harmonic interference, and in no case is the system's total harmonic distortion to exceed 5%.

(b) Hydraulic

Pipe systems subject to pressure build-up that may exceed the rated pressure of the pipe and associated components are to be provided with suitable pressure relief devices fitted on the pump's discharge side. Each relief valve is to be capable of relieving not less than full pump flow with a maximum pressure rise of not more than 10% of the relief valve setting.

(c) Pneumatic

The requirements in 2.~~8~~10.2(b) are to be complied with, as applicable.

Section 2.10 has been renumbered and amended as follows:

2.1~~0~~1 Equipment Construction, Design and Installation

2.1~~0~~1.1 General

Equipment associated with remote or automatic control and monitoring of propulsion related machinery/systems is to meet compliance with the requirements contained herein. Deviation from the environmental requirements such as temperature, humidity and corrosion will be considered for equipment intended for installation in ambient controlled rooms or enclosures. See also 2.1~~0~~1.5(b), 2.1~~0~~1.5(g) and 2.1~~0~~1.5(h). Similarly, where equipment is installed in environments having parameters other than those as specified in Table VIII 2-~~1~~2, i.e., cryogenic or highly corrosive environments, etc., special consideration corresponding to those of the operating environment will be required.

2.1~~0~~1.2 Electrical

(a) Equipment is to be constructed of robust, durable and flame-retardant material. It is to be designed to incorporate the degree of enclosure protection as required of Equipment location.

(b) Circuits are to be designed to permit the isolation of a fault while maintaining functionality of the remaining circuits or sub components, i.e., using printed circuit cards, or modules, etc., and are to allow the easy and safe replacement of the faulted portion of the circuit. Replaceable parts are to be arranged so that it will not be possible to connect them incorrectly or use incorrect replacements.

(c) Panels, cabinets, consoles, etc., are to be preferably self-supported with sides and back suitably protected. The arrangement of alarms, displays and control devices are to be laid out in a functional and logical manner so that it will allow the operator the easy and clear identification of each of the machinery or systems to be represented or included therein. Grouping of alike machinery or system devices, and the use of labels and color schemes are some of the methods to realize this intent. Precautions are to be taken to avoid the inadvertent operation of controls that may lead to critical situations, i.e., location of handles, recessed or covered switches, sequential operation, etc.

(d) Internal wiring is to be of the stranded type and its connection is to be designed not to become loose as a result of vibration effects; the use of connectors crimped on the wire insulation and connectors of the captive type such as the ring or flanged spade type is preferred. Direct soldered connections on printed circuit cards are to be avoided. Non-current carrying metal parts are to be effectively grounded.

2.1~~0~~1.3 Hydraulic

Hydraulic pumps, actuators, motors and accessories are to be suitable for the intended service, compatible with the working fluid and are to be designed to operate safely at full-power conditions. In general, the hydraulic fluid is to be non-flammable or have a flash point above 157°C.

2.1~~0~~1.4 Pneumatic

Air compressors, actuators, motors and accessories are to be suitable for the intended service and have working and other parts that will not be damaged or rendered ineffective by corrosion.

2.1~~0~~1.5 Installations

(a) General

The installation of equipment associated with automatic or remote control and monitoring systems is to be carried out taking into consideration adverse effects that may be introduced by their exposure to unintended temperatures, weather, vibration conditions, falling objects or liquid, electromagnetic interference, high voltage systems, electric noise, etc. Additionally, the installation is to facilitate the checking, adjustment and

replacement of components, including filters and sensing devices, without disrupting the normal operation of the system, as far as practicable.

(b) Ranges in ambient temperatures

For the selection and installation of equipment associated with control and monitoring systems, the following ranges in ambient temperatures are to be considered:

(i) 5°C to 55°C For machinery space, control rooms, accommodations and navigating bridge.

(ii) –25°C to 55°C For pump rooms, hold rooms and rooms with no heating.

When equipment is located inside panels or cubicles, consideration is to be given to the temperature rise inside those panels due to the dissipation of heat from its own components. See also Note 1 of Table VIII 2-~~1~~2.Where compliance with the above temperature ranges cannot be met, consideration will be given to the installation of equipment per 2.1~~0~~1.5(g) and 2.1~~0~~1.5(h).

(c) Electromagnetic and conductance interference

In general, the installation of equipment associated with automatic or remote control and monitoring systems in areas of unusual electromagnetic sources is to be avoided. Where the values per Table VIII 2-~~1~~2 may be exceeded, appropriate measures are to be implemented to reduce the effects of electromagnetic and conductance interference. To avoid electromagnetic noise caused by circulating currents, the conductive shield and cable armor is to be grounded only at one end of the cable. Description of the preventive measures to be followed is to be submitted for review.

(d) Shielded cables

To avoid possible signal interference, cables for automatic or remote control and monitoring systems occupying the same cable tray, trunk or conduit with power cables are to be of the shielded type.

(e) Electrical grounding

Automatic or remote control and monitoring systems are not to have common ground conductors with systems of higher voltage level.

(f) Condensation

Electrical equipment liable to be exposed to ambient temperature fluctuations is to be provided with means to prevent accumulation of moisture inside the component’s enclosure, i.e., by the provisions of space heaters that automatically energizes upon shutdown or disconnection of the electrical component.

(g) Cold environment

Electrical equipment which may be adversely affected by the exposure to temperatures lower than those for which they are designed for, is to be provided with suitable heating arrangements so that they may be readily operated when needed. See 2.1~~0~~1.5(b).

(h) Ambient controlled spaces or enclosures

Electrical equipment installed within ambient controlled spaces and enclosures such as consoles, cabinets, etc., is to be suitable for the ambient temperature expected therein. However, where air cooling systems are introduced to maintain the ambient temperature of the space and/or enclosure within the prescribed component’s temperature parameters, the following need to be complied with:

(i) The cooling system is to be of a sufficient capacity to maintain the required ambient temperature taking into account all heating sources installed in the space and/or enclosure.

(ii) A standby cooling system of required capacity is to be provided and arranged to automatically be brought up on-line upon failure of the operating cooling system.

(iii) Failure of the cooling system is to activate a visual and audible alarm locally.

(i) Protection against falling liquids or leakage of fluid medium

Electrical equipment is not to be installed in the same compartment or cabinet containing equipment or pipes carrying water, oil or steam unless effective measures are taken in order to protect the electrical equipment from possible fluid leakage, i.e., welded connections, physical isolation together with suitable draining arrangements, etc.

(j) Measuring and sensing devices

The installation of measuring and sensing elements is to permit their easy access for functional testing or replacement.

(k) Marking

All units, controllers, actuators, displays, terminal strips, cable and test points, etc. are to be clearly and permanently marked. Their systems and system's functions are to be included so that they can be easily identified in associated drawings and instrument lists.

Section 2.11 has been renumbered and added as follows:

2.11~~1~~2 Equipment/Components Qualifications and Trials

2.11~~1~~2.1 Equipment/Components Qualifications

The manufacturers and assemblers of automatic or remote control and monitoring equipment/components associated with propulsion related machinery/systems are to provide documented evidence showing that the equipment /components have been tested individually or by acceptable sampling to establish their suitability for the intended service. The requirements in 4.1.2 are applicable to equipment/components associated with propulsion related machinery/systems intended for installation onboard **CAS**, **CAU** or **CAB** classed ships.

2.11~~1~~2.2 Type Approval of Automatic or Remote Control and Monitoring Equipment

Equipment that meets the requirements contained in this Part or 4.1.2 is eligible to be certified by the Society upon formal request by the equipment manufacturer.

2.11~~1~~2.3 Testing and inspection

Automatic or remote control and monitoring equipment/component which is intended for installation on ships assigned classification symbols **CAS**, **CAU** or **CAB** is to be tested in accordance with 4.1.2(a).

2.11~~1~~2.4 Automatic or remote control and monitoring equipment/component which is intended for installation on ships not assigned classification symbols **CAS**, **CAU** or **CAB** is to be performance tested in accordance with 4.1.2(a)(iv).

2.12.5 Trials

(a) Automatic/Remote Control

The ability to effectively control the propulsion from the remote propulsion control station is to be demonstrated to the satisfaction of the Surveyor during sea trials or at dockside. These trials are to include propulsion control transfer, propulsion starting, verification of propulsion control responses, propulsion control power failure, actuation of propulsion emergency stop device (if station is installed in the navigating bridge) and for turbine-driven ship, actuation of the shaft-turning device.

(b) Independent Manual Control

Independent manual control of the propulsion machinery is to be demonstrated during the tests or trials to the satisfaction of the Surveyor. This is to include demonstration of independent manual control through the full maneuvering range and transfer from automatic control.

Table VIII 2-1 has been added as follows:

Table VIII 2-1
Instrumentation and Controllers on Remote Propulsion Control Stations

System	Monitored/Controlled Parameter		A	D	C	Notes: [A = Alarm; D = Display; C = Controller/Actuator] [x = applies]
Propulsion control & monitoring	A1	Propeller speed		x	x	
	A2	Propeller direction		x	x	
	A3	Propeller pitch		x	x	As applicable
	A4	Telegraph		x	x	Not applicable to certain ships < 500 GT,
	A5	Emergency shutdown of propulsion engine			x	To be protected from accidental tripping
	A6	Starting of propulsion engine			x	For reversible engines only
	A7	Stored starting energy level -low	x	x		For reversible engines and engines fitted with means of starting at remote control station
	A8	Inhibition of starting of propulsion engine	x			Where remote engine starting is fitted
	A9	Automatic shutdown activated	x			
	A10	Automatic slowdown activated	x			If provided
	A11	Safety system override	x	x	x	If fitted. To be of a design that cannot be left activated
	A12	Shaft turning gear engaged		x		To automatically inhibit starting of engine
	A13	Operating in barred speed range	x			For navigation bridge only
	A14	Threshold warning for safety systems activations	x			
System monitoring	B1	Power source -fails	x	x		For non-**CAS** ships, the failure alarm is applicable to main power source only. For **CAS** ships, applicable to main and emergency power sources.
	B2	Individual power supply to control, monitoring and safety systems -fails	x	x		Alarm may be common.
	B3	Alarm system -disconnected		x		
	B4	Integrated computer-based system: data highway abnormal conditions	x			Alarm is to be activated before critical data overload.
	B5	Integrated computer-based system: duplicated data link -failure of one link	x			
Others	C1	Control station transfer		x	x	Display: to indicate the station in control. Control: to provide 1) transfer switch & 2) acknowledgment switch.
	C2	Air conditioning system -fails	x			If necessary for equipment environment control
Additional requirements for Navigation Bridge for ships assigned with **CAS**						
CAS	D1	Propulsion-Prime movers, prolonged operation within critical speed range	x			Visual display may be acceptable
	D2	Fire pump- Start/stop switch			x	Not required if fire MAIN is maintained pressurized
	D3	Shaft turning- Propeller shaft roll-over (not rotating)	x			For steam turbine-driven vessels. See 4.7.4
Additional requirements for Navigation Bridge for ships assigned with **CAU, CAB**						
CAU,CAB	E1	Summary alarms -activated by alarm conditions in Table VIII 4-2 through Table 4-9	x			
	E2	High voltage rotating machine -Stationary windings temperature -high	x			14.3.2 of Part VII
	E3	Controllable pitch propeller hydraulic power		x	x	If standby unit is provided

		unit run/start/stop				with automatic starting, such starting is to be alarmed.
	E4	Steam turbine automatic shaft rollover - activated		x	x	Control: to deactivate automatic shaft rollover.
	E5	Steam turbine shaft stopped -in excess of set period	x			
	E6	Boiler steam pressure -low	x			For propulsion and associated electric power generating machinery
	E7	Boiler control power -failure	x			For propulsion and associated electric power generating machinery
	E8	System power source: main and emergency feeder -status and failure	x	x		
	E9	Propulsion machinery space -fire detected	x			
	E10	Start main fire pump and pressurize fire main		x	x	
	E11	Propulsion machinery space -bilge level high	x			
	E12	Start/stop and transfer switches			x	For **CAB** ships having nonintegrated propulsion machinery

Display = display of the analog or digital signal for the monitored parameter. The display of the signal is to provide indication of the monitored parameter in engineering units (such as degrees, PSI, RPM, etc.) or status indication. The engineering unit is to effectively display the relevant information concerning the monitored parameter. An alternative engineering unit which provides equivalent effectiveness, may be considered.

Table VIII 2-2 has been renumbered and amended as follows:

Table VIII 2-~~1~~2
Environmental Tests for Control and Monitoring Equipment

No	Test	Procedure according to (4)	Test parameters	Other information
1	Visual Inspection	–	–	– Conformance to drawings, design data; – quality of workmanship and construction.
2	Power supply variations (electric)	–	*AC supply* Combination / voltage Variation Permanent (%) / frequency variation permanent (%) 1 / + 6 / +5 2 / + 6 / – 5 3 / – 10 / – 5 4 / – 10 / +5 Combination / voltage Transient 1.5s (%) / frequency transient 5s (%) 5 / +20 / +10 6 / – 20 / – 10 *DC supply* Voltage tolerance continuous ±10% Voltage cyclic variation 5% Voltage ripple 10% Electric battery supply: – +30% to – 25% for equipment connected to charging battery or as determined by the charging /discharging characteristics, including ripple voltage from the charging device; – +20% to – 25% for equipment not connected to the battery during charging.	Verification of: – equipment behaviour upon loss and restoration of supply; – possible corruption of programme or data held in programmable electronic systems, where applicable.
	Power suppply variations (pneumatic and hydraulic)		Pressure:±20% Duration:15minutes.	
3	Dry heat	IEC Publication 60068-2-2 Test Bb for nonheat dissipating equipment	Temperature: 55°±2 °C Duration: 16 hours or Temperature: 70 °C ±2 °C Duration: ~~2~~16 hours (1)	– Equipment operating during conditioning and testing; – Functional test during the last hour of the test temperature; - For equipment specified for increased temperature the dry heat test is to be conducted at the agreed test temperature and duration.
		IEC Publication 60068-2-2 Test Be for nonheat dissipating equipment	Temperature: 55°±2 °C Duration: 16 hours or Temperature: 70 °C ±2 °C Duration: 16 hours (1)	– Equipment operating during conditioning and testing with cooling system on if provided; – Functional test during the last hour of the test temperature; - For equipment specified for increased temperature the dry heat test is to be conducted at the agreed test temperature and duration.

No	Test	Procedure according to (4)	Test parameters	Other information
4	Damp heat	IEC Publication 60068-2-30 Test D_b.	Temperature: 55 °C Humidity: 95% Duration: 2 cycles 2 × (12 + 12 hours)	– Measurement of insulation resistance before test; – the test shall start with 25°C ± 3°C and at least 95% humidity; – equipment operating during complete first cycle and switched off during second cycle except for functional test; – functional test during the first 2 hours of the first cycle at the test temperature and during the last 2 hours of the second cycle at the test temperature. Duration of the second cycle can be extended due to more convenient handling of the functional test; – recovery at standard atmosphere conditions; – insulation resistance measure-ments and performance test.
5	Cold	IEC Publication 60068-2-1	Temperature: +5 °C ±3 °C Duration: 2 hours or Temperature: –25 °C ±3 °C Duration: 2 hours (2)	– Initial measurement of insulation resistance; – equipment not operating during conditioning and testing except for functional test; – functional test during last hour at the test temperature; – insulation resistance measure-ment and the functional test after recovery
6	Salt mist	IEC Publication 60068-2-52 Test K_b	Four spraying periods with a storage of 7 days after each.	– Initial measurement of insulation resistance and initial functional test; – equipment not operating during conditioning; – functional test on the 7th day of each storage period; – insulation resistance measurement and performance test 4 to 6h after recovery. (3) – On completion of exposure, the equipment shall be examined to verify that deterioration or corrosion (if any) is superficial in nature.
7	Insulation resistance	–	Rated Supply Voltage (V) / Test voltage (V) / Minimum insulation resistance: Before test (M ohms) / After test (M ohms) Un≤65 / 2 Un (min. 24V) / 10 / 1.0 Un>65 / 500 / 100 / 10	– Insulation resistance test is to be carried out before and after: damp heat test, cold test, salt mist test and high voltage test; – between all phases and earth, and where appropriate, between the phases; – Un is the rated (nominal) voltage. Note: Certain components e.g. for EMC protection may be required to be disconnected for this test. For high voltage equipment reference is made to Chapter 14 of Part VII

No	Test	Procedure according to (4)	Test parameters	Other information
8	High voltage	–	Rated voltage Un (V): up to 65; 66 to 250; 251 to 500; 501 to 690 Test voltage (A.C. voltage 50 or 60 Hz) (V): 2 Un + 500; 1,500; 2,000; 2,500	– Separate circuits are to be tested against each other and all circuits connected with each other tested against earth; – printed circuits with electronic components may be removed during the test; – period of application of the test voltage: 1 minute.
9	Electrostatic discharge	IEC Publication 61000-4 -2	Contact discharge : 6 kV Air discharge: 2 kV, 4 kV, 8 kV Interval between single discharge: 1 sec. Number of pulses: 10 per polarity According to test level 3. ~~severity standard.~~	– To simulate electrostatic discharge as may occur when persons touch the appliance; – the test is to be confined to the points and surfaces that can normally be reached by the operator; – Performance criterion B (5).
10	Electromagnetic field	IEC Publication 61000-4-3	Frequency range: 80MHz to ~~2~~6 GHz Modulation*: 80%AM at 1,000Hz Field strength: 10 V/m Frequency sweep rate: ≤1.5 x 10^{-3}decades/sec. (or 1%/3 sec) According to test level 3. ~~severity standard.~~	– To simulate electromagnetic fields radiated by different transmitter; – the test is to be confined to the appliance exposed to direct radiation by transmitters at their place of installation; – Performance criterion A (6) **If for test of equipment an input signal with a modulation frequency of 1000 Hz is necessary ,a modulation frequency of 400Hz may be chosen.* - If an equipment is intended to receive radio signals for the purpose of radio communication (e.g. Wi-Fi router, remote radio controller), then the immunity limits at its communication frequency do not apply, subject to the requirements in 3.6.2
11	Conducted Low frequency	IEC Publication 60533	AC Frequency range: rated frequency to 200th harmonic. Test voltage(r.m.s): 10% of supply to 15th harmonic reducing to 1% at 100th harmonic and maintain this level to the 200th harmonic, min 3V r.m.s., max 2 W. DC Frequency range: 50 Hz - 10kHz Test voltage(r.m.s): 10% of supply, maximum 2W.	– To simulate distortions in the power supply system generated for instance, by electronic consumers and coupled in as harmonics ; – Performance criterion A (6). – See Fig. VIII 2-1, Test Set-Up. – For keeping max. 2 W, the voltage of the test signal may be lower.
12	Conducted radio frequency	IEC Publication 61000-4-6	AC, DC, I/O ports and signal/control lines: Frequency range: 150 kHz - 80 MHz Amplitude: 3 V r.m.s (7) Modulation**: 80%AM at 1,000Hz Frequency sweep rate: ≤ 1.5 x 10^{-3} decades/sec. (or 1%/3 sec.) According to test level 2. ~~severity standard.~~	– Equipment design and the choice of material is to simulate electromagnetic fields coupled as high frequency into the test specimen via the connecting lines; – Performance criterion A (6). ** *If for test of equipment an input signal with a modulation frequency of 1000 Hz is necessary, a modulation frequency of 400Hz may be chosen.*

No	Test	Procedure according to (4)	Test parameters	Other information
13	Burst / Electrical fast transients	IEC Publication 61000-4-4	Single pulse time: 5 ns (between 10% and 90% value) Single pulse width: 50ns(50% value) Amplitude (peak): 2kV line on power supply port/earth; 1kV on I/O data control and communication ports(coupling clamp); Pulse period: 300ms; Burst duration: 15ms; Duration/polarity: 5 min. According to test level 3. ~~severity standard.~~	– Arcs generated when actuating electrical contacts; – Interface effect occurring on the power supply, as well as at the external wiring of the test specimen; – Performance criterion B (5).
14	Surge~~ / transient~~	IEC Publication 61000-4-5	Test applicable to AC and DC power ports Open-circuit voltage: Pulse rise time: 1.2 µs (~~between 10% and 90% value~~ front time) Pulse width: 50 µs (~~50% value~~ time to half value) Amplitude (peak): 1kV line/earth; 0.5kV line/line; Short-circuit current: Pulse rise time: 8 µs (front time) Pulse width: 20 µs (time to half value) Repetition rate: ≥ 1 pulse/min. Number of pulses: 5 per polarity Application: continuous According to test level 2. ~~severity standard.~~	– Interference generated for instance, by switching "ON" and "OFF" high power inductive consumers; – Test procedure in accordance with figure 10 of the standard for equipment where power and signal lines are identical; – Performance criterion B (5).
15	Radiated emission	~~CISPR 16-1-1,16-2~~ CISPR 16-2-3 IEC 60945 for 156-165 MHz	Limits below 1000 MHz For equipment installed in the bridge and deck zone. Frequency range: Quasi peak Limits: 0.15-0.3 MHz 80-52 dBµV/m 0.3-30 MHz 50-34 dBµV/m 30-~~2,000~~ 1,000 MHz 54 dBµV/m except for: 156-165 MHz 24 dB µV/m For equipment installed in the general power distribution zone. Frequency range: Quasi peak Limits: 0.15-30 MHz 80-50 dBµV/m 30–100 MHz 60-54 dBµV/m 100-2,000 MHz 54 dBµV/m except for: 156-165 MHz 24 dBµV/m	– Procedure in accordance with the standard but distance 3 m between equipment and antenna; – For the frequency band 156 MHz to 165 MHz the measurement shall be recorded with a receiver bandwidth of 9 kHz (as per IEC 60945) Alternatively, the radiation limit at a distance of 3 m from the enclosure port over the frequency 156 MHz to 165 MHz shall be 30 dB micro-V/m peak (as per IEC 60945)
			Limits above 1000 MHz Frequency range: Quasi peak Limits: 1000-6000 MHz 54 dBµV/m	– Procedure in accordance with the standard (distance 3 m between equipment and antenna) Equipment intended to transmit radio signals for the purpose of radio communication (e.g. Wi-Fi router, remote radio controller) may be exempted from limit, within its communication frequency range, subject to the requirements in 3.6.2

No	Test	Procedure according to (4)	Test parameters	Other information
16	Conducted emission	CISPR ~~16-1,16-2~~ 16-2-1	Test applicable to AC and DC power ports For equipment installed in the bridge area and deck zone. Frequency range: Limits: 10-150 kHz 96-50 dBµV 150-350 kHz 60-50 dBµV 350 kHz - 30 MHz 50 dBµV For equipment installed in the general power distribution zone. Frequency range: Limits: 10-150 kHz 120-69 dBµV 150-500 kHz 79 dBµV 0.5-30 MHz 73 dBµV	
17	Flame retardant	IEC Publication 60092-101 or IEC Publication 60695-11-5	Flame application: 5 times 15 sec. each. Interval between each application: 15 sec. or 1 time 30 sec. Test criteria based upon application. The test is performed with the EUT or housing of the EUT applying needle-flame test method.	– In the burnt out or damaged part of the specimen by not more than 60 mm long. – no flame, no incandescence or – in the event of a flame or incandescence being present, it is to extinguish itself within30 s of the removal of the needle flame without full combustion of the test specimen. – any dripping material is to extinguish itself in such a way as not to ignite a wrapping tissue. The drip height is 200 mm ± 5 mm.
18	Vibration	IEC Publication 60068-2-6 Test F_C	2.0 (+3/–0) Hz to 13.2 Hz – amplitude ± 1 mm. 13.2 Hz to 100 Hz – acceleration ± 0.7 g. For severe vibration conditions such as, e.g. on diesel engines, air compressors, etc.: 2.0 Hz to 25 Hz – amplitude ± 1.6 mm 25.0 Hz to 100 Hz – acceleration ±4.0 g. *Note: More severe conditions may exist for example on exhaust manifolds of diesel engines especially for medium and high speed engines. Values may be required to be in these cases 40 Hz to 2000 Hz-acceleration ±10.0g at 600℃, duration 90 min.*	– Duration in case of no resonance condition: 90 minutes at 30 Hz; – duration at each resonance frequency at which Q ≥ 2 is recorded: 90 minutes; – during the vibration test, functional tests are to be carried out; – test to be carried out in three mutually perpendicular planes; – it is recommended as guidance that Q does not exceed 5. –where sweep test is to be carried out instead of the discrete frequency test and a number of resonant frequencies is detected close to each other, duration of the test is to be 120 min. Sweep over a restricted frequency range between 0.8 and 1.2 times the critical frequencies can be used where appropriate. Note: Critical frequency is a frequency at which the equipment being tested may exhibit: – malfunction and/or performance deterioration – mechanical resonances and/or other response effects occur, e.g. chatter

No	Test	Procedure according to (4)	Test parameters	Other information
19	Inclination	IEC Publication 60092-504	Static 22.5°	a) Inclined at an angle of at least 22.5° to the vertical. b) inclined at least 22.5° on the other side of the vertical and in the same plane as in (a). c) inclined at an angle of at least 22.5° to the vertical and in a plane at right angle to that used in (a). d) inclined to at least 22.5° on the other side of the vertical and in the same plane as in (c). Note: The period of testing in each position is to be sufficient to fully evaluate the behavior of the equipment.
			Dynamic 22.5°	Using the direction defined in a) to d) above, the equipment is to be rolled to an angle of 22.5° each side of the vertical with a period of 10 seconds. The test in each direction is to be carried out for not less than 15 minutes. On ships for the carriage of liquified gases and chemicals, the emergency power supply is to remain operational with the ship flooded up to a maximum final athwart ship inclination of 30°. Note: These inclination tests are normally not required for equipment with no moving parts.

Notes:

(1) Equipment to be mounted in consoles, housing etc. together with other heat dissipating power equipment are to be tested with 70°C.

(2) For equipment installed in non-weather protected locations or cold locations test is to be carried out at −25°C.

(3) Salt mist test is to be carried out for equipment installed in weather exposed areas.

(4) Alternative equivalent testing procedures may be accepted provided the requirements in the other columns are complied with.

(5) Performance criterion B (for transient phenomena): The equipment under test is to continuous to operate as intended after the tests. No degradation of performance or loss of function is allowed as defined in the technical specification published by the manufacturer. During the test, degradation or loss of function or performance which is self-recoverable is however allowed but no change of actual operating state or stored data is allowed.

(6) Performance criterion A (for continuous phenomena): The requirement under test is to continuous to operate as intended during and after test. No degradation of performance or loss is allowed as defined in relevant equipment standard the technical specification published by the manufacturer.

(7) For equipment installed on the bridge and deck zone, the test levels are to be increased to 10V rms for spot frequencies in accordance with IEC 60945 at 2,3,4, 6.2,8.2,12.6,16.5,18.8,22,25 MHz.

Chapter 3 ~~Control and Monitoring Systems of Propulsion Machinery~~ Computer-based Systems

Chapter 3 has been amended as follows:

Chapter 3 ~~Control and Monitoring Systems of Propulsion Machinery~~ Computer-based Systems

Section 3.1 has been amended as follows:

3.1 General

3.1.1 Computer based systems where used for control, monitoring, safety, or internal communication systems are to comply with the provisions of this chapter, and are subject to the classification requirements regardless of **CAS**, **CAU** or **CAB** symbol. Navigation systems , Radio-communication systems and vessel loading instrument/stability computer are not in the scope of this chapter.

~~3.1.1 The requirements contained in this chapter are applicable to propulsion machinery/systems intended for automatic operation or operation from a remote propulsion control station. Except as noted herein, the requirements in Chapter 1 and 2, as applicable, are to be complied with.~~

~~3.1.2 Under all sailing conditions, including maneuvering, the speed, direction of thrust and, where applicable, the pitch of the propeller, is to be fully controllable from the remote propulsion control station. The remote control is to be performed by a single control device for each independent propeller, with automatic performance of all associated services, including, where necessary, means of preventing overload of the propulsion machinery. Where multiple propellers are designed to operate simultaneously, they may be controlled by one control device.~~

~~3.1.3 Propulsion machinery orders from the navigating bridge are to be indicated in the main machinery control room and at the maneuvering platform. The navigation bridge, main machinery control room and maneuvering platform is to be fitted with indication of the following:~~

~~(a) Propeller speed and direction of rotation in the case of fixed pitch propeller, or~~

~~(b) Propeller speed and pitch position in the case of controllable propellers.~~

Section 3.2 has been amended as follows:

3.2 ~~Propulsion Control Command~~ Systems Requirements

3.2.1 System Security

Programmable electronic systems are to be provided with effective physical and/or logical security arrangements to prevent unintentional or unauthorized access to functions or alteration of configuration, programs or data by unauthorized personnel (see 3.7.10). Alteration of parameters that may affect the system's performance are to be limited to authorized personnel by means of keyswitch, keycard, password or other approved methods.

3.2.2 Program and Memory Data

To preclude the possible loss or corruption of data as a result of power disruption, programs and associated memory data considered to be essential for the operation of the specific system are to be stored in non-volatile memory or a volatile memory with a secure uninterruptible power supply (UPS).

3.2.3 Start-up After Power Failure

The system's software and hardware is to be designed so that upon restoration of power supply after power failure, automatic or remote control and monitoring capabilities can immediately be available after the pre-established computer control access (sign-in) procedure has been completed.

3.2.4 Self-Monitoring

(a) Function

Computer based systems are to be self-monitoring and any incorrect operation or abnormal condition is to be alarmed at the computer work station.

(b) Temperature

The processing hardware (CPU, microprocessor etc.) of computer-based systems is to be designed to operate satisfactorily at an ambient temperature of 55°C, preferably without forced ventilation. Where forced ventilation is necessary, an alarm warning of high temperature in the processing hardware is to be given.

3.2.5 Power Supply

The power supply is to be monitored for voltage failure and protected for short circuit. Where redundant computer systems are provided to satisfy 3.2.6, they are to be separately fed.

3.2.6 System Independence

Control, monitoring and safety systems are to be arranged such that a single failure or malfunction of the computer equipment will not affect more than one of these system functions. This is to be achieved by dedicated equipment for each of these functions within a single system, or by the provision of redundancy, or by other suitable means considered not less effective.

3.2.7 Response Time

Computer system's memory is to be of sufficient capacity to handle the operation of all computer programs as configured in the computer system. The time response for processing and transmitting data is to be such that an undesirable chain of events may not arise as a result of unacceptable data delay or response time during the computer system's worst data overload operating condition. For propulsion related system applications, the time limit on response delays for safety and alarm displays is not to exceed two (2) seconds. (The response delay is to be taken as the time between detection of an alarm or safety critical condition and the display of the alarm or actuation of the safety system.)

3.2.8 Fail-safe

Computer-based system is to be designed such that failure of any of the system's components will not cause unsafe operation of the process or the equipment it controls. Hardware and software serving vital and non-vital systems are to be arranged to give priority to vital systems.

3.2.9 Modifications

A significant modification is a modification which influences the functionality and/or safety of the system. Any significant modification to the software or hardware for system category II and III is to be submitted for approval. In addition, modifications of parameters for system Category III by the manufacturer are to be approved by CR.

3.2.10 Emergency Stops

Emergency stops, where required, are to be hard-wired and independent of any computer-based system.

3.2.11 FMEA

FMEA is to be used to determine that any component failure will not result in the complete loss of control, the unsafe shutdown of the process or equipment, or other undesirable consequences (see 3.7.4).

~~3.2.1 The remote propulsion control station in the propulsion machinery space is to be capable to assume control at all times and to block orders from other associated remote control stations, if fitted.~~

~~3.2.2 Considerations will be given to cases where, due to the intended ship's service and operational requirements, it may be necessary for other associated stations to have override controls over the remote propulsion control station in the propulsion machinery space.~~

Section 3.3 has been amended as follows:

3.3 ~~Propulsion Control Settings Deviation~~ Systems Configuration

3.3.1 System Categories

Computer-based systems subject to classification requirements are to be assigned into the appropriate system category (I, II or III) according to the possible extent of the damage that may be caused by a single failure within the computer-based systems and the effect on system functionality, as shown in Table VIII 3-1.

~~Control transfer arrangements are to include means to prevent the propelling thrust from altering significantly when transferring control from one propulsion control station to another.~~

Section 3.4 has been amended as follows:

3.4 ~~Propulsion Control Power Failure~~ Software

3.4.1 General

Software lifecycle activities, e.g. design, development, supply and maintenance, are to be carried out in accordance with an acceptable quality management system which has lifecycle models suitable to the nature of the software project, considering its size, complexity, safety, risk and integrity. Project specific software quality plans are to be submitted. These are to demonstrate that the provisions of ISO/IEC 90003: Software engineering – Guidelines for the application of ISO 9001:2008 to computer software, or equivalent, are incorporated. The plans are to define responsibilities for the lifecycle activities, including verification, validation, software module testing and, integration with other components or systems and security policies to be applied.

~~In the event of power failure of the propulsion control system, the propulsion units are to continue to operate at the last ordered speed and direction of thrust of the propellers until local control is in operation or control power is safely resumed. However, considerations will be given to special cases, where due to the intended ship's propulsion design and operational requirements, it may be necessary to automatically reduce the propulsion engine speed and reset the propeller pitch to zero upon control power failure.~~

Section 3.5 has been amended as follows:

3.5 ~~Propulsion Starting~~ Hardware

3.5.1 Design for Ease of Maintenance

The design and layout of the hardware is to ensure ease of access to interchangeable parts for repairs and maintenance. Each replaceable part is to be simple to replace and is to be constructed for easy and safe handling. All replaceable parts are to be so designed that it is not possible to connect them incorrectly or to use incorrect replacements. Where this is not practicable, the replaceable parts, their mounting location, including their means of electrical connection, are to be clearly marked.

3.5.2 User Interface and Input Devices

(a) General

Input devices are to have clearly marked functions and, as far as practicable, are to be arranged to avoid conceivable inadvertent errors in their operations.

(b) Security

Input devices, such as keyboard, which can be used to effect changes to equipment or processes under control, are to be provided with security arrangement, such as password, so as to limit access to authorized personnel only. Where a single action of, for example, pressing of a key is able to cause dangerous operating conditions or malfunctions, measures are to be taken to prevent execution by a single action such as use of two or more keys.

(c) Control Status

Where control action can be effected from more than one station, conflicting control station actions are to be prevented by means of interlock or warning. Control status is to be indicated at all stations.

3.5.3 Visual Display Unit

(a) General

The size, color and density of text and graphic information displayed on a visual display unit are to be such that it may be easily read from the normal operator position under all operational lighting conditions. The brightness and contrast are to be capable of being adjusted.

(b) Alarm Display

Where alarms are displayed by means of visual display unit, they are to appear in the sequence as the incoming signals are received. Alarming of the incoming fault signals are to appear on the screen regardless of the mode the computer or the visual display unit is in.

(c) Propulsion Monitoring

Where a computer is used as the operator initerface to display monitored parameters, the centralized control station is to be provided with at least two computer, including keyboards and monitors, unless other means of display are provided capable of displaying the same iniformation.

(d) Color Monitor

The failure of a primary color is not to prevent an alarm to be distinctly indicated.

3.5.4 Graphical Display

(a) General

Information is to be presented clearly and intelligibly according to its functional relations. Display presentations are to be restricted to the data which is directly relevant for the user.

(b) Alarms

Alarms are to be clearly distinguishable from other information and are to be visually and audibly presented with priority over other information regardless of the mode the computer or the visual display unit is in.

~~3.5.1 An alarm is to be provided in the propulsion machinery space and at any propulsion control station fitted outside the propulsion machinery space to indicate a low level starting condition which is to be set at a level to permit further main engine starting operations. Where automatic starting of the propulsion machinery is fitted, the number of consecutive attempts to automatically start an engine is to be limited in order to safeguard sufficient capacity for local starting from the propulsion machinery space.~~

~~3.5.2 Propulsion machinery control system is to be designed so that it will automatically inhibit the starting of the propulsion machinery where conditions exist which may damage the propulsion machinery, i.e., shaft turning gear engaged, insufficient lubricating oil pressure, etc.~~

Section 3.6 has been amended as follows:

3.6 ~~Remote Override of Safety Provisions~~ Data Communication

3.6.1 Data Communication

(a) Data Communication Network

(i) General

The requirements in 3.6.1 are applicable to the system of Category II and III using shared data communication network to transfer data between distributed programmable electronic equipment or systems.

(ii) Monitoring of the Network

The data communication network is to be continuously monitored to detect failures on the communication network itself and data communication failure on nodes connected to the network. Any detected abnormal condition is to be alarmed at the centralized control station and on the navigation bridge.

(iii) Prevention of Overloading

Safeguards are to be provided to prevent unacceptable data transmission delays (overloading of network). Alarm is to be activated prior to a critical data overload condition.

(iv) Integrity of Data

Means are to be provided to ensure the integrity of data and provide timely recovery of corrupted or invalid data.

(b) Duplicated Data Communication Network

(i) Duplication of the Network

When the same data communication network is used for two or more essential functions (e.g., propulsion control and generator control), this network is to be duplicated, and each is to be routed as far apart from the other as practical. The duplicate network is for standby purpose only and not to be used to reduce traffic in the online network.

(ii) Monitoring of the Network

Duplicated data communication network is to be arranged so that upon the failure of the online network, the standby network is automatically connected to the system. Switching between duplicated networks is not to disturb data communication or continuous functioning of the system. The failure of one network is to be alarmed at the centralized control station and on the navigation bridge.

(c) Connection Failure

A complete failure in connectivity between component systems and the data highway is not to affect individual functionality of the component systems. Where a single component failure results in loss of data communication, means are to be provided to automatically restore data communication. Loss of a data communication network is not to affect the ability to operate essential services by.

3.6.2 Wireless Data Communication

Wireless data communication will be specially considered depending upon the purpose.

(a) Non-essential and Recreational Purposes, Entirely Within the Living Accommodations

Wireless data communication used for non-essential and recreational purposes, entirely within the living accommodations, will be specially considered provided it is demonstrated that there is no detrimental effect on essential services. Further documentation is to be submitted for review which demonstrates compliance with 3.6.2(c)(iv), 3.6.2(c)(v), and 3.6.2(c)(vi).

(b) Non-essential and Recreational Purposes

Wireless data communication used for non-essential and recreational purposes, within the living accommodations and outside of the living accommodations, will be specially considered provided there is no detrimental effect on essential services. Further documentation is to be submitted for review which demonstrates compliance with 3.6.2(c)(i) through 3.6.2(c)(vii).

(c) Ship Services (Non-Recreational Purposes)

Wireless data communication used for ship services (such as essential services, category I systems, category II systems, category III systems, etc.) will be specially considered provided the use of the wireless data communications results in an improvement in the safety of the ship, compared to wired data communication. Documentation which demonstrates an improvement in safety is to be submitted for review. Further documentation is to be submitted for review which demonstrates compliance with 3.6.2(c)(i) through 3.6.2(c)(vii).

Note:
For assignment of system categories, see 3.3.

(i) Risk Analysis

A suitable risk analysis (such as a Failure Modes and Effects Analysis (FMEA)) is to be performed which demonstrates that an interruption or failure in the wireless data communication will not lead to a hazardous situation.

Note:

Consideration is to be given to the possibility of corrupted data and intermittent failures with comparatively long recovery times between interruptions.

(ii) Type Testing

The wireless equipment is to meet the environmental type testing requirements of 2.12 and Table VIII 2-2 based on the proposed location of installation.

(iii) Wireless Data Communication Tests

The wireless data communication is to not cause interference with any ship systems. This is applicable to all wireless data communication equipment (even wireless data communication equipment for non-essential services). Tests during harbor and sea trials are to be conducted to demonstrate that radio-frequency transmission from wireless data communication equipment does not cause failure of any equipment and does not cause the wireless data communication equipment itself to fail as a result of electromagnetic interference during expected operating conditions.

(iv) Wireless Data Communication Network

The wireless data communication network is to meet the requirements of 8.2.3, 3.6.1(a) , 3.6.1(b) and 3.6.1(c).

(v) Wireless System Protocols

Wireless data communication is to follow recognized international wireless system protocols that incorporate the following.

(1) Message integrity
Fault prevention, detection, diagnosis and correction so that the received message is not corrupted or altered when compared to the transmitted message.

(2) Configuration and device authentication
Only devices that are included in the wireless system are to permitted to connect to the wireless system.

(3) Message encryption
Protection of the confidentiality and criticality of the data content.

(4) Security management
Protection of network assets, prevention of unauthorized access to network assets.

(vi) Radio-Frequency and Power Level

The wireless system is to comply with the radiofrequency and power level requirements of the International Telecommunications Union and flag state requirements.

Note:

Consideration is to be given to system operation in the event of port state and local requirements that pertain to the use of radio-frequency transmission prohibiting the operation of a wireless data communication system due to radio-frequency and power level restrictions.

(vii) Alternative Means of Control

Functions that are required to operate continuously to provide essential services dependent on wireless data communication are to be provided with an alternative means of control that can be brought into action within an acceptable period of time.

~~3.6.1 Remote override of safety provisions is not permitted for the following:~~

~~(a) Shutdown of propulsion turbines and for ship's service generator turbines upon failure or loss of the oil lubricating system. See 2.7.2(a), (b), (c), and 2.8.2(b) of Part IV.~~

~~(b) Shutdown of prime movers for propulsion and ship's service generators upon activation of overspeed mechanism. See 2.7.1, 3.4.7 and 3.4.8 of Part IV. However, considerations will be given to specific cases where due to the ship's design and operational requirements, it may be necessary to momentarily override the propulsion machinery over the overspeed automatic shutdown.~~

~~(c) Shutdown of prime movers upon failure or loss of oil lubricating system to forced lubricated propulsion or ship's service generators.~~

~~(d) Except when in local control, closing of fired boiler fuel valve(s) associated with propulsion and main electrical power generating plant upon the conditions as specified in 4.4 of Part V.~~

Section 3.7 has been amended as follows:

3.7 ~~Critical Speeds~~ On Board Use and Application of Computer-based Systems

3.7.1 References

The following identified standards can be used for the development of hardware/software of computer based systems. Other industry standards may be considered:

(a) IEC 61508: Functional safety of electrical/electronic/programmable electronic safety-related systems

(b) SO/IEC 12207: Systems and software engineering – Software life cycle processes

(c) ISO 9001:2008 Quality Management Systems – Requirements

(d) ISO/IEC 90003: Software engineering - Guidelines for the application of ISO 9001:2008 to computer software

(e) IEC 60092-504: Electrical installations in ships – Part 504: Special features – Control and instrumentation

(f) ISO/IEC 25000: Systems and software engineering – Systems and software Quality Requirements and Evaluation (SQuaRE) - Guide to SQuaRE

(g) ISO/IEC 25041: Systems and software engineering – Systems and software Quality Requirements and Evaluation (SQuaRE) - Evaluation guide for developers, acquirers and independent evaluators

(h) IEC 61511: Functional safety – Safety instrumented systems for the process industry sector

(i) ISO/IEC 15288: Systems and software engineering – system life cycle process

3.7.2 Definitions

(a) Stakeholders

(i) Owner

The Owner is the party responsible for contracting the system integrator and/or suppliers to provide a hardware system including software according to the owner's specification. The Owner could be the Ship Builder Integrator (Builder or Shipyard) during initial construction. After ship delivery, the owner may delegate some responsibilities to the ship operating company.

(ii) System Integrator

The role of system integrator is to be filled by the yard unless an alternative organization is specifically contracted for or assigned this responsibility. The system integrator is responsible for the integration of systems and products provided by suppliers into the system according to the requirements specified herein and for providing the integrated system. The system integrator mayalso be responsible for integration of systems in the ship. If there are multiple parties performing system integration at any one time a single party is to be responsible for overall system integration and coordinating the integration activities. If there are multiple stages of integration different System Integrators may be responsible for specific stages of integration.

(iii) Supplier

The Supplier is any contracted or subcontracted provider of system components or software under the coordination of the System Integrator or Shipyard. The supplier is responsible for providing programmable devices, sub-systems or systems to the system integrator. The supplier provides a description of the software functionality that meets the Owner's specification, applicable international and national standards, and the requirements specified herein.

(b) Objects

Fig. VIII 3-1 shows the hierarchy and relationships of a typical computer-based system.

(i) Object Definitions

(1) Ship
Ship or offshore unit where the system is to be installed.

(2) System
Combination of interacting programmable devices and/or sub-systems organized to perform one or more specified actions.

(3) Sub-system
Identifiable part of a system, which may perform a specific function or set of functions.

(4) Programmable Device
Physical component where software is installed.

(5) Software Module
A Software Module is a standalone group of program or code intended to accomplish a function.

(c) Simulation Tests

Control system testing where the equipment under control is partly or fully replaced with simulation tools, or where parts of the communication network and lines are replaced with simulation tools.

3.7.3 System Categories

(a) Systems Typically Belonging to Category III

(i) Propulsion system of a ship, meaning the means to generate and control mechanical thrust in order to move the ship (devices used only during maneuvering, such as bow tunnel thrusters, are not in the scope of this requirement)

(ii) Steering system control system

(iii) Electric power system (including power management system)

(iv) Ship safety systems covering fire detection and fighting, flooding detection and fighting, internal communication systems involved in evacuation phases, ship systems involved in operation of life saving appliances equipment

(v) Dynamic positioning system of equipment classes 2 and 3 according to IMO MSC/Circ.645 or MSC.1/ Circ.1580.

(vi) Drilling systems

The exact category is dependent on the risk assessment for all operation scenarios.

(b) Systems Typically Belonging to Category II

(i) Liquid cargo transfer control system

(ii) Bilge level detection and associated control of pumps

(iii) Fuel oil treatment system

(iv) Ballast transfer valve remote control system

(v) Stabilization and ride control systems

(vi) Alarm and monitoring systems for propulsion systems

The exact category is dependent on the risk assessment for all operation scenarios.

Note: See the System Categories in Table VIII 3-1.

3.7.4 Risk Assessment of the System

This step to determine the risk to the system throughout the lifecycle by identifying and evaluating the hazards associated with each function of the system. This document is to normally be submitted by the System Integrator or the Supplier, including data coming from other suppliers. IEC/ISO 31010 Risk management – Risk assessment techniques may be applied in order to determine method of risk assessment. The method of risk assessment is to be agreed by this Society. Based on the risk assessment, a revised system category may be called for between this Society and the system supplier. Where the risks associated with a computer-based system are well understood, it is permissible for the risk assessment to be omitted. However, in such cases the supplier or the system integrator is to provide a justification for the omission. The justification should give consideration to:

(a) Manner in which the risks were discovered.

(b) The equivalence of the context of use of the current computer-based system and the computer-based system initially used to determine the risks.

(c) The adequacy of existing control measures in the current context of use.

3.7.5 Code Production and Testing

The following documentation is to be provided for Category II and III systems:

(a) Software modules functional description and associated hardware description for programmable devices. This is to be provided by Supplier and System Integrator

(b) Evidence of verification (detection and correction of software errors) for software modules, in accordance with the selected software development standard. Evidence requirements of the selected software standard might differ depending on how critical the correct operation of the software is to the function it performs (i.e., IEC 61508 has different requirements depending on SILs, similar approaches are taken by other recognized standard). This is to be supplied by the Supplier and System Integrator.

(c) Evidence of functional tests for programmable devices at the software module, sub-system, and system level. This is to be supplied by the Supplier via the System Integrator. Functional testing is to be designed to test the provisions of features used by the software but provided by the operating system, function libraries, customized layer of software and any set of parameters.

3.7.6 Integration Testing before Installation on Board

Intra-system integration testing is to be performed between system and sub-system software modules before being integrated on board. The objective is to confirm that software functions are properly executed, that the software and the hardware it controls interact and function properly together and that software systems react properly in case of failures. Faults are to be simulated as realistically as possible to demonstrate appropriate system fault detection and system response. The results of any required failure analysis are to be observed. Functional and failure testing can be demonstrated by simulation tests.

(a) For Category II and III systems:

(i) Test programs and procedures for functional tests and failure tests shall be submitted to the Class Society. A FMEA may be requested by the Society in order to support containment of failure tests programs.

(ii) Factory acceptance test including functional and failure tests shall be witnessed by Society.

(b) The following documentation is to be provided:

(i) Functional description of software.

(ii) List and versions of software installed in system.

(iii) User manual including instructions for use during software maintenance.

(iv) List of interfaces between system and other ship systems.

(v) List of standards used for data links.

(vi) Additional documentation as requested by this Society to demonstrate the adequacy of failure test case applied.

3.7.7 Approval of Programmable Devices for Category II and III

(a) Approval of programmable devices integrated inside a system is to be delivered to the system integrator or supplier. Approval can be granted on case by case basis, or as part of the CR Type Approval Program Limited approval: Sub-systems and programmable devices may be approved for limited applications with service restrictions by this Society when the ship system where they will be integrated is not known. In this case, requirements and additional drawings, details, tests reports and surveys related to the Standard declared by the Supplier may be required by this Society.

3.7.8 Final Integration and Onboard Testing

(a) Simulation tests are to be undertaken before installation, when it is found necessary to check safe interaction with other computerized systems and functions that could not be tested previously. Onboard tests are to confirm that a computer-based system in its final environment, integrated with all other systems with which it interacts:

(i) Performs the functions it was designed for

(ii) Reacts safely in case of failures originated internally or by devices external to the system

(iii) Interact safely with other systems implemented on board ship

(b) For final integration and onboard testing of Category II and III systems:

(i) Test specifications shall be submitted to the Society for approval

(ii) The tests shall be witnessed by the Class Society

3.7.9 Modifications During Operation

(a) Responsibilities

Organizations in charge of software modifications are to be clearly declared by Owner to CR. A System integrator is to be designated by the Owner and is to fulfil requirements mentioned in Chapter 3. Limited life cycle steps may be admitted for modifications already considered and accepted in the scope of initial approval.

At the ship level, it is the responsibility of Owner to manage traceability of these modifications; the achievement of this responsibility is to be supported by system integrators updating the Software Registry.

This Software Registry is to contain:

(i) List denoting types and versions of software installed in systems required in 3.7.6.

(ii) Results of security scans as described in 3.7.10.

(b) Change Management

The owner is to ensure that necessary procedures for software and hardware change management exist on board, and that any software modification/upgrade are performed according to the procedure. All changes to computer-based systems in the operational phase are to be recorded and be tracked.

3.7.10 System Security

The Owner, system integrator and suppliers are to adopt security policies and include them in their quality systems and procedures. For Category I, II, and III systems, physical and logical security measures are to be put in place to prevent unauthorized or unintentional modification of software, whether undertaken at the physical system or remotely. Prior to

installation, all artefacts, software code, executables and the physical medium used for installation on the ship are to be scanned for viruses and malicious software. Results of the scan are to be documented and kept with the Software Registry.

3.7.11 Requirements for Data Links for Category II and III Systems

(a) General Requirements

(i) Loss of a data link is to be specifically addressed in risk assessment analysis.

(ii) A single failure in data link hardware is to be responded to automatically in order to restore the proper working of system. For Category III systems a single failure in data link hardware is not to influence the proper working of the system. See 3.6.1.

(iii) Characteristics of data link is to prevent overloading in any operational condition of system. See 3.6.1.(a).iv.

(iv) The data link is to be self-checking, detecting failures on the link itself and data communication failures on nodes connected to the link. Detected failures are to initiate an alarm. See 3.6.1.

(b) Specific Requirements for Wireless Data Links

(i) Category II Systems

Category III systems are not to use wireless data links unless specifically considered by ABS on the basis of an engineering analysis carried out in accordance with an International or National Standard acceptable to the Society. See Note in 3.6.2(c).

(ii) Other Categories of Systems

Other categories of systems may use wireless data links with requirements in 3.6.1(c)(vi), 3.6.1(c)(vii), and 3.6.1(c)(iv).

3.7.12 Quality System

System integrators and suppliers are to operate a quality system regarding software development and testing and associated hardware such as ISO 9001 taking into account ISO 90003. Satisfaction of this requirement is to be demonstrated by either the quality system being certified as compliant to the recognized standard by an organization with accreditation under a national accreditation scheme, or CR confirming compliance to the standard through a specific assessment

This quality system is to include:

(a) Relevant procedures regarding responsibilities, system documentation, configuration management and competent staff.

(b) Relevant procedures regarding software lifecycle and associated hardware:

(i) Organization set in place for acquisition of related hardware and software from suppliers.

(ii) Organization set in place for software code writing and verification.

(iii) Organization set in place for system validation before integration in the ship.

(c) Approval of quality system:

(i) A specific procedure for verification of software code of Category II and III at the level of systems, sub-systems and programmable devices and modules.

(ii) Check points for Category II and III systems (see Table VIII 3-2).

(iii) Specific procedure for software modification and installation on board the ship defining interactions with owners.

3.7.13 Documents submission and test attendance

Documents submission and test attendance of computed-based systems are to be in accordance with Table VIII 3-2.

~~Adequate means are to be provided at the remote propulsion control station to alert the station operator of prolonged operation of the propulsion drives within barred speed ranges.~~

Sections 3.8~3.13 have been deleted as follows:

~~3.8 Shaft Turning Gear~~

~~For steam turbine driven ships, where a slow turning gear is provided to rotate the propeller shaft for the period when the turbine is stopped, provision to indicate the operational status (engaged or disengaged) or such device is to be fitted at the remote propulsion control stations. Additionally, means are to be provided to prevent operation of the turbine when such device is engaged, or vice versa.~~

~~3.9 Emergency Shutdown~~

~~The propulsion machinery is to be provided with an emergency stopping device on the navigating bridge which is to be independent of the navigating bridge control system.~~

~~3.10 Safety System Alarms~~

~~3.10.1 Threshold warning for safety system activations~~

~~Where the propulsion machinery is capable of remote control from the navigation bridge regardless of manned or unmanned machinery space, automation systems are to be designed in a manner such that a threshold warning of impending or imminent slowdown or shutdown of the propulsion system is given to the officer in charge of the navigational watch in time to assess navigational circumstances in an emergency.In particular, the systems are to control, monitor, report, alert and take safety action to slowdown or shutdown propulsion while providing the officer in charge of the navigational watch an opportunity to manually intervene (override), except for those cases where manual intervention will result in total failure of the engine and/or propulsion equipment within a short time, for example in the case of over speed.~~

~~3.10.2 Alarms for safety system activations~~

~~Activation of safety system to automatic slowdown or automatic shutdown of propulsion machinery is each to be arranged with individual alarm at remote propulsion control station. Audible alarm may be silenced at the control station, however, visual alarm is to remain activated until it is acknowledged in the machinery space.~~

~~3.11 Automatic Propulsion Control System~~

~~3.11.1 The automatic propulsion control system is to be designed and arranged so that a failure in the system is not to compromise the integrity nor the manual operation of the propulsion machinery.~~

~~3.11.2 Automatic control systems for oil fired boilers associated with propulsion are to meet the requirements in 4.4 of Part V and 4.12 and 5.8 of this Part as applicable.~~

~~3.12 Controls and Instrumentation on Remote Propulsion Control Stations~~

~~Remote propulsion control stations fitted in ships having the propulsion machinery space manned are to be provided with the controls, alarms and displays as listed in Table VIII 3-1, as a minimum; this requirement is not applicable to portable propulsion control units interconnected with and arranged for operation within sight from the associated remote~~

~~propulsion control station. For computer based systems, the requirement in 2.7.3(d) is also applicable to remote propulsion control stations which are not manned centralized control and monitoring stations.~~

~~3.13 Trials~~

~~3.13.1 Automatic/Remote Control~~

~~The ability to effectively control the propulsion from the remote propulsion control station is to be demonstrated to the satisfaction of the Surveyor during sea trials or at dockside. These trials are to include propulsion control transfer, propulsion starting, verification of propulsion control responses, propulsion control power failure, actuation of propulsion emergency stop device (if station is installed in the navigating bridge) and for turbine driven ship, actuation of the shaft turning device.~~

~~3.13.2 Independent Manual Control~~

~~Independent manual control of the propulsion machinery is to be demonstrated during the tests or trials to the satisfaction of the Surveyor. This is to include demonstration of independent manual control through the full maneuvering range and transfer from automatic control.~~

[PART VIII]

Table VIII 3-1 has been amended as follows:

Table VIII 3-1
System Categories

System Category	Effect of Failure	Typical System Functionality
I	Failure will not lead to dangerous situations for human safety, safety of the ship and/or threat to the environment.	Monitoring function for informational/ administrative tasks
II	Failure could eventually lead to dangerous situations for human safety, safety of the ship and/or threat to the environment.	-Alarm and monitoring functions -Control functions that are necessary to maintain the ship in its normal operational and habitable conditions
III	Failure could immediately lead to dangerous situations for human safety, safety of the ship and/or threat to the environment.	-Control functions for maintaining the ship's propulsion and steering -Ship safety functions

~~Table VIII 3-1~~
~~Control Station in Navigating Bridge (Applicable to All Classed Ships)~~

~~Item~~		~~Alarm~~ ~~(1), (11)~~	~~Display~~	~~Provisions of device on station.~~ ~~(1)~~	~~Remarks~~
~~Required for all ships~~ ~~(8), (9)~~					
~~Control and monitoring system~~	~~Failure or malfunctioning of system~~	~~*~~			~~(2), (12)~~
	~~Failure, supply~~	~~*~~	~~Main/Emergency~~		~~Automatic transfer, for **CAS**, **CAU** or **CAB**.~~ ~~(2), (12)~~
	~~Sequential logic operation, failure~~	~~*~~	~~Sequential Display~~		~~If required. See 2.4.3~~
	~~Control station in operation~~		~~Station~~		
	~~Control transfer and acknowledgment switch~~			~~*~~	
	~~Alarm, disabled (override)~~		~~Disabled~~		~~(4)~~
	~~Safety, activation~~	~~*~~			~~(3), (12)~~
	~~Safety disabled~~	~~*~~	~~Disabled~~	~~*~~	~~(4), (12)~~
	~~Failure, air conditioned system~~	~~*~~			~~For room or enclosure. See 2.10.5(h)~~
	~~Failure of Local Area Network (LAN) controller~~	~~*~~			~~For computerized system. See 2.7.6(b).~~ ~~(12)~~
	~~Data overloading of Local Area Network (LAN)~~	~~*~~			~~For computerized system. See 2.7.6(c).~~ ~~(12)~~
~~Propulsion, general~~	~~Remote controls~~			~~*~~	~~For each propelling unit and all units, as applicable~~
	~~Threshold warning for safety system activations~~	~~*~~			~~see 3.10.1~~
	~~Propeller shaft, speed~~		~~Speed~~		
	~~Propeller shaft, direction~~		~~Direction~~		
	~~Propeller, pitch~~		~~Pitch~~		~~For controllable-pitch propeller~~
	~~Telegraph or similar~~			~~*~~	
~~Propulsion, starting~~	~~Starting medium, pressure or level, low~~	~~*~~	~~Pressure or Level~~		~~(5)~~
	~~Hazardous condition present~~	~~*~~			~~See 3.5.2~~
~~Shaft turning~~	~~Slow turning gear~~		~~Engaged/ Disengaged~~		~~If provided. See 3.8~~
~~Emergency shutdown~~	~~Propulsion~~			~~*~~	~~See 3.9~~
~~Required for **CAS** Classed Ships~~					
~~Propulslion~~	~~Prime movers, prolonged operation within critical speed range~~	~~*~~			~~Visual display may be acceptable~~
~~Fire pump~~	~~Start/stop switch~~			~~*~~	~~Not required if fire MAIN is maintained pressurized~~
~~Shaft turning~~	~~Propeller shaft roll over (not rotating)~~	~~*~~			~~For steam turbine driven ships. See 4.7.4~~

Table VIII 3-1
Control Station in Navigating Bridge (Applicable to All Classed Ships)(cont-)

Item		Alarm (1),(11)	Display	Provisions of device on station.(1)	Remarks
Required for **CAU** or **CAB** Classed Ships.(10)					
Propulsion, starting	Start/stop switch for starting system			×	
Shaft roll-over	Activation of auto. shaft roll-over		Activated		For steam turbine-driven vessels. See 5.6
	Deactivation of auto. shaft roll-over			×	For steam turbine-driven vessels. See 5.6
Control pitch propeller (CPP)	Start/stop switch for CPP hydraulic motor			×	If provided
	CPP hydraulic motor running		Running		If provided
	Automatic starting of required standby pump	×			If provided
Electric propulsion	Propulsion generator load share overload	×			See 5.2.2
Steam oil boilers	Steam pressure reduction	×			For propulsion and elect. power generating machinery
	Loss of control power	×			For propulsion and elect. power generating machinery
Summary alarms	Propulsion and associated machinery, failure	×			(6), (7)
Bilges in machinery space	Level, bilges, high	×			See 4.14.1(a).(7)
Fire in machinery space	Fire indication panel	×	Fire	×	See 5.3.1.(7)
Essential auxiliary pumps	Start/stop and transfer switches			×	For **CAB** ships

Notes:

(1)Required actuation device or alarm is denoted by a (×).

(2)For each system: control systems, alarm/display systems and safety systems. See 2.8.1(a) and 4.4.

(3)Actuation of propulsion safeties is to either reduce output or shutdown the propulsion machinery as required. See also 2.5, 3.6 and Tables VIII 4-3 through VIII 4-9.

(4)Deactivation means are to be arranged so that such action cannot be done inadvertently. Alternative means to indicate disabling of safety actions or alarms will be considered.

(5)This alarm is also to be provided in the machinery space.

(6)This summary alarm is to be activated by any of the alarm conditions as listed in Tables VIII 4-3 through VIII 4-9. See 5.11.

(7)These alarms are also to be alarmed at the engineer's accommodations.See 5.11.

(8)The listed instrumentation is only required if the navigating bridge is fitted with propulsion controls or the ship is classed **CAU** or **CAB**.

(9)The listed instrumentation is also applicable to other remote propulsion control stations installed outside the navigating bridge. See 3.12.

(10)For **CAU** or **CAB** ships, instrumentation required for **CAS** ships is also to be included.

(11)Provided the audible alarms re-activate automatically after a preset time, audible alarms may be by-passed or de-activated during machinery start-up.

(12)May be arranged as a summary alarm (common).

Table VIII 3-2 has been added as follows:

Table VIII 3-2
Documents Submission and Test Attendance of Computed-Based Systems[7]

Requirement	Suppler involved	System integrator involved	Owner involved	Category I[4]	Category II	Category III
Quality Plan	X	X		A [5]	A [5]	A [5]
Risk assessment report		X		I [5]	I [5]	I [5]
Software modules functional description and associated hardware description	X (if necessary)	X			I	I
Evidence of verification of software code	X (if necessary)	X			I	I
Evidence of functional tests for elements included in systems of Category II and III at the level of software module, sub-system and system	X	X			I	I
Test programs and procedures for functional tests and failure tests including a supporting FMEA or equivalent, at the request of the Class Society		X			A	A
Factory acceptance test event including functional and failure tests	X	X			W	W
Test program for simulation tests for final integration		X			A	A
Simulation tests for final integration		X			W	W
Test program for on board tests (includes wireless network testing)		X			A	A
On board integration tests (includes wireless network testing)		X			W	W
List and versions of software installed in system ■ Functional description of software ■ User manual including instructions during software maintenance		X			I	I

■ List of interfaces between system and other ship systems						
Updated Software Registry		X	X		I	I
Procedures and documentation related to Security Policy	X	X	X		I	I
Test reports according to 2.12	X	X		A [6]	A	A

Notes:

1 I = Provided (For Information).

2 A = Submitted (For Approval).

3 W = To be witnessed by the Surveyor.

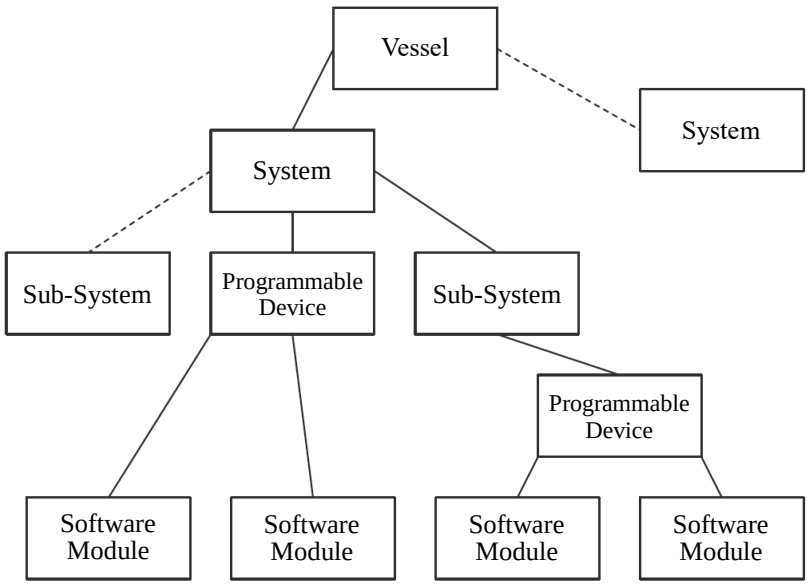
4 Additional documentation may be required upon request

5 Upon request

6 If in the scope of Class requirement

7 Test after modifications for Category II and III depend on the level of modification and subject to CR review Engineers' judgment, whether the tests need to be witnessed by surveyors

Fig. VIII 3-1 has been added as follows:



Note: Dashed lines on drawing indicate branches not yet developed

Fig. VIII 3-1
Typical Computer-based System

Chapter 4 Machinery Operated from a Centralized Control Station – CAS Symbol

Section 4.1 has been amended as follows:

4.1 General

4.1.1 Ships having the means to control and monitor the propulsion machinery and propulsion-machinery space from a continuously manned centralized control and monitoring station installed within or adjacent to, the propulsion-machinery space are to comply with the requirements contained in this chapter. Except as noted herein, the requirements in Chapter 1 through Chapter 3 of this Part as applicable, are to be complied with. Additionally, the requirements in this chapter cover the operation required for propulsion machinery start-up, safe sailing during open sea and maneuvering conditions, and do not cover operations after anchoring or mooring.

4.1.2 Equipment associated with the remote or automatic control and monitoring of the propulsion machinery installed in **CAS**, **CAU** and **CAB** ships are to comply with the following requirements.

(a) Testing of equipment

(i) Testing is to be carried out in accordance with Table VIII 2-~~1~~2 and Table VIII 4-1. Where environmental operating parameters exceed those specified herein, special arrangements will be considered. With the exception of field sensors, all required system's components are to be subjected to these tests. For computer-based systems, the equipment to be tested includes microprocessors, storage devices, power supply units, signal conditioners, analog/digital converters, computer monitors (video display units), keyboards, etc., but it excludes printers, data recording or logging devices not required in this part.

(ii) The manufacturer or assembler of the associated equipment is to provide documented evidence indicating that the equipment meets the criteria specified in Table VIII 2-~~1~~2 and Table VIII 4-1. Additionally, for computer-based systems, evidence is to be included to indicate that semiconductor devices such as CPU, non-volatile memories, etc., have been subjected to a burn-in test for a period not less than 72 hours, at an operating temperature of 70°C, with power connected to the device.

(iii) Environmental testing on the associated equipment is to be carried out in accordance with the criteria outlined in Table VIII 2-~~1~~2. With the exception of the inclination and vibration tests, all environmental tests are to be carried out and satisfactorily reported upon by the manufacturer and/or assembler; such test report is to be submitted for review. Inclination and vibration tests are to be carried out in the presence of the Surveyor at the manufacturer's or assembler's plant, or at an independent testing laboratory in accordance with Table VIII 2-~~1~~2.

(iv) Performance testing in accordance with Table VIII 4-1 are to be carried out in the presence of the Surveyor at the testing plant or after installation of the equipment onboard the ship. Where deemed necessary by the Surveyor, insulation resistance and high voltage tests in accordance with Table VIII 2-~~1~~2 may be required to be carried out.

(b) Failure Mode and Effect Analysis (FMEA)

The integrity of the associated automatic or remote control and monitoring systems is to be verified by means of a Failure Mode and Effect Analysis (FMEA) or equivalent method on the basis of a single failure mode criteria. The analysis is to show that no single failure will lead to such a condition that endangers human safety and/or the ship. A Failure Mode and Effect Analysis (FMEA) or equivalent is to be submitted for review. For computer-based systems, see ~~2.7.2~~ 3.2.11of this Part.

Section 4.2 has been amended as follows:

4.2 Station in Navigating Bridge

In order to provide water delivery from the main fire system at a suitable pressure, means of remote starting any one of the main fire pumps are to be provided at the navigating bridge unless the fire main is permanently pressurized. Further, if fitted, the navigating bridge propulsion control station is to include controls, displays and alarms as per Table VIII ~~3-1~~2-1.

Paragraph 4.3.3(b) has been amended as follows:

4.3.3 Controls and Instrumentation

(b) The installed control and monitoring system is to provide the same degree of control as if the propulsion-machinery space was manned. Control functions from this station may be designed for either remote manual or automatic control. See Tables VIII 4-2 through VIII 4-~~9~~10 for required controls, safety provisions, alarms and displays to be fitted at such station.

Paragraph 4.4.1 has been amended as follows:

4.4.1 The power supply arrangement is to be in accordance with ~~2.8.1(a)~~ 2.10.1.(a). In addition, an emergency feeder or pipe is to be provided for control systems, display/alarm systems and safety systems associated with propulsion.

Section 4.5 has been amended as follows:

4.5 Continuity of Power

The electrical power generating machinery is to be arranged so that upon failure of the on-line ship's service generator, the standby generator can be started and placed in service from a single location. This location may be at the centralized control and monitoring station (centralized monitoring station for **CAB**), main switchboard or at the location of the ship's service generators. Alternatively, this requirement may be satisfied by compliance with 5.5 of this Part. ~~However, where the standby generator can be started from the centralized control and monitoring station, the requirements in 7.9 of this Part, as applicable, are to be complied with in order to effect such action.~~

Section 4.6 has been amended as follows:

4.6 ~~Automatic Transferring and Starting/ Stopping of Essential Auxiliary Pumps~~ Propulsion Auxiliaries

~~Where fitted, automatic transferring of essential auxiliary pumps is to be alarmed at the centralized control and monitoring station (however, see 4.7.2 and 4.7.3 for required automatic starting of the sea water main circulating pump and lube oil pump, respectively). Similarly, the centralized control and monitoring station is to be provided with the means to start/stop essential auxiliary pumps associated with the following machinery or systems:~~ The centralized control station is to be provided with means to remotely start and stop auxiliary pumps associated with the operation of the following:

4.6.1 Propulsion engine

4.6.2 Electrical power generators

4.6.3 Controllable pitch propellers(CPP)

4.6.4 Propulsion boilers and boilers supporting propulsion (including power generation)

4.6.5 Fuel oil transfer system

Automatic transferring of vital auxiliary pumps, where fitted, is to be alarmed at the centralized control station.

~~(a) Propulsion Machinery.~~

~~(b) Electrical Power Generating Machinery.~~

~~(c) Controllable Pitch Propellers (CPP).~~

~~(d) Oil Fired Boilers Associated with Propulsion and Electrical Power Generating Machinery.~~

~~(e) Sea Water Main Circulating System.~~

~~(f) Propulsion machinery Space Bilge System.~~

~~(g) Fuel Oil Transfer or Service System. This is applicable to pumps associated with settling and daily service tanks.~~

Section 4.10 has been amended as follows:

4.10 Electric Propulsion

The centralized control and monitoring station is to be provided with the safety provisions, alarms and displays as listed in Table VIII 4-6 for electric propulsion machinery, and as listed in Table ~~VIII 4-4 and VIII 4-5B~~VIII 4-7 as applicable for generator prime mover for electric propulsion.

Section 4.11 has been amended as follows:

4.11 ~~Electrical Power Generating Machinery~~ Auxiliary Turbines and Diesel Engines

The centralized control and monitoring station is to be provided with the safety provisions, alarms and displays as listed in Table VIII 4-~~7~~10. ~~The requirements in 7.9.5 of this Part are also to be complied with.~~

Paragraph 4.14.1(a) has been amended as follows:

4.14.1 Bilges

(a) The propulsion-machinery space is to be provided with two independent bilge waterlevel systems to detect excessive water influx or rise in the propulsion machinery space bilges, at the various angles of heel and trim; the bilge wells are to be large enough to accommodate the normal drainage. Excessive water influx or rise in the bilge wells is to be alarmed at the centralized control and monitoring station. See also Tables VIII ~~3-1~~ 2-2and VIII 4-2 for alarms and displays.

Section 4.15 has been amended as follows:

4.15 Sea Trials

In addition to the requirements in ~~3.13~~ 2.12.5, effective operation of the following is to be demonstrated to the satisfaction of the Surveyor. With the exception of 4.15.6, it is recommended that these demonstrations or tests be carried out before sea trials and are to include simulated failures so that proper corrective actions may be carried out and witnessed by the Surveyor.

Table VIII 4-2 has been amended as follows:

Table VIII 4-2
Centralized Control and Monitoring Station (Applicable to CAS, CAU, and CAB Ships)

System	Monitored/Controlled Parameter		A	D	C	Notes: [A = Alarm; D = Display; C = Controller/Actuator] [x = applies]
Propulsion control & monitoring	A1	As in Table VIII 2-2 items A1 through C2, with following additional features	x	x	x	Following items of Table VIII 2-2 are to be modified: - Item A4: additional telegraph is not required for centralized control station. - Item A6: starting of propulsion engine is required for all engine types - Item C1: acknowledgement switch for transfer of control station is not required in centralized control station
	A2	System power supply main and emergency feeders: failure, status and transfer	x	x	x	
	A3	Propulsion engine auxiliaries and boiler auxiliaries - status and start/stop		x	x	Automatic start/stop, if fitted, is to be alarmed. Applicable to propulsion boilers and boilers supporting propulsion.
	A4	Controllable pitch propeller (CPP) hydraulic power unit start/stop		x	x	
	A5	CPP hydraulic oil pressure - low and high	x			High-pressure alarm is required only if required by design.
	A6	CPP hydraulic oil temperature - high	x			If it is a system design feature
	A7	CPP hydraulic oil tank level - low	x			
	A8	Steam turbine shaft stopped - excess of set period	x			
	A9	Steam turbine shaft rollover - activated		x	x	To be activated automatically for **CAU**
Electric Power Generating Plant	B1	Starting, paralleling and putting generator on line			x	Not required if main switchboard is located in the centralized control station
	B2	Generator running		x		
	B3	Voltage - high and low	x	x		
	B4	Current - high	x	x		
	B5	Frequency - high and low	x	x		
	B6	Failure of on - line generator	x			
	B7	Generator engine auxiliaries start/stop		x	x	Automatic start/stop, if fitted, is to be alarmed
	B8	Bearing lub oil inlet pressure - low	x	x		Automatic shutdown prime mover.
	B9	Generator cooling inlet pump or fan motor - fails	x			
	B10	Generator cooling medium temp. - high	x	x		
High voltage rotating machine	C1	Stationary windings temperature - high	x			

Fuel oil system	D1	Settling and service tank level - low and high	x			High level alarm required only if automatic filling is provided, or if **CAU**
	D2	Overflow tank and drain tank level - high	x			
	D3	Transfer pump start/stop		x	x	Start/stop may be automatic.
	D4	Heated fuel oil in settling and service tank, fuel oil temperature – high	x	x		
	D5	Fuel oil tank heating medium temperature - high	x			
	D6	Fuel oil heater, fuel oil temperature - high (or viscosity low) or flow - low	x			
	D7	Fuel oil heater, heating medium temperature - high	x			
Stern tube lub. Oil	E1	Tank level - low	x			
Boiler, thermal oil heater, incinerator, etc.	F1	Automatic shutdown	x			Propulsion boilers and auxiliary boilers supporting propulsion are to meet Table VIII 4-8 and Table 4-10
Propulsion machinery space	G1	Bilge level - high	x			
	G2	Bilge pump status	x	x		Alarm applicable to automatically started bilge pump that starts/stops excessively or running unduly long
	G3	Fire detected	x			
	G4	Air condition system - fails	x			If necessary for equipment environmental control

Display = display of the analog or digital signal for the monitored parameter. The display of the signal is to provide indication of the monitored parameter in engineering units (such as degrees, PSI, RPM, etc.) or status indication. The engineering unit is to effectively display the relevant information concerning the monitored parameter. An alternative engineering unit which provides equivalent effectiveness, may be considered.

Item		Alarm (1), (8)	Display	Provisions of device on station (1)	Remarks
Control and monitoring system	Failure or malfunctioning of system	×			(2), (6)
	Failure, supply	×	Main/Emergency		Automatic transfer to standby supply (2), (6)
	Supply transfer switches			×	(2), (6)
	Sequential logic operation, failure	×	Sequential Display		If required. See 2.4.3
	Control station in operation		Station		
	Control transfer switch			×	
	Control power available, pressure or level		Pressure/Level		(6)
	Alarm, disabled (override)		Disabled		(4), (6)
	Safety, activation	×			(3), (6)
	Safety disabled	×	Disabled		(4), (6)
	Safety, disabled (override) switch			×	See 2.5.6 (6)
	Failure, air conditioned system	×			For room or enclosure. See 2.10.5(h) (6)
	Failure of Local Area Network (LAN) controller	×			For computerized systems. See 2.7.6(b). (6)
	Data overloading of Local Area Network (LAN)	×			For computerized systems. See 2.7.6(c). (6)
Propulsion, general	Remote controls			×	
	Propeller shaft, speed		Speed		(6)
	Propeller shaft, direction		Direction		(6)
	Propeller, pitch		Pitch		For controllable-pitch propeller. (6)
	Controllable pitch propeller (CPP) hydraulic power unit start/stop		×	×	
	CPP hydraulic oil pressure low and high	×			High-pressure alarm is required only if required by design.
	CPP hydraulic oil temperature high	×			If it is a system design feature
	CPP hydraulic oil tank level low	×			
	Prime movers, prolonged operation with critical speed range	×			Visual display may be acceptable
	Engine order telegraph or similar			×	
Propulsion starting	Start/stop switch for starting system			×	
	Starting medium, pressure or level, low	×	Pressure or Level		(6)
	Hazardous condition present	×			See 3.5.2 (6)
Diesel propulsion	Alarms and displays				See Table VIII 4.5

Table VIII 4-2
Centralized Control and Monitoring Station (Applicable to CAS, CAU, and CAB Ships)(cont.)

Item		Alarm (1), (8)	Display	Provisions of device on station (1)	Remarks
Steam turbine propulsion	Alarms and displays				See Tables VIII 4-3 and VIII 4-8
	Propeller shaft slow-turning gear		Engaged/ Disengaged	×	If provided. See 3.8
	Propeller shaft stopped	×			See 4.7.4
	Activation of auto. shaft roll over		Activated		See 5.6
	Deactivation of auto. shaft roll over			×	See 5.6
Gas turbine propulsion	Alarms and displays				See Table VIII 4-4
Electric propulsion	Alarms and displays				See Table VIII 4-6
	Propulsion generator load share overload	×			See 5.2.2
Elect. gen. machinery	Alarms and displays				See Table VIII 4-7
Aux. oil fired boiler	Alarms and displays				See Table VIII 4-9
Essential auxiliary pumps	Start/stop and transfer switches			×	(5), (6), (7)
FO setting and daily service tanks	Level, tank, low	×			(6)
	Level, tank, high	×			If automatic filling provided (6)
	Pump motor running		Running		(6)
	Oil temperature, high	×			See 4.14.2(d) (6)
FO and LO Collect. Tank	Level, tank, high	×			See 4.14.2(b) (6)
High pres. FO system	Leakage	×			See 4.14.2(a) (6)
LO stern tube tank	Level, oil, low	×			(6)
Bilges in machinery space	Level, bilges, high	×			See 4.14.1(b) (6)
	Excessive running of bilge pump motor	×			If auto. starting provided. See 4.14.1(b) (6)
	Pump motor running		Running		(6)
Fire in machinery space	Fire detected	×			
	Manual fire alarm release switch			×	
Emergency shutdown	Propulsion			×	See 4.3.2

Notes:

(1) Required actuation device or alarm is denoted by a (×).

(2) For each system: control systems, alarm/display systems and safety systems. See 2.8.1(a) and 4.4.

(3) Actuation of propulsion safeties is to either reduce output or shutdown the propulsion machinery, as required. See 3.6 and Tables VIII 4-3 through VIII 4-9.

(4) Deactivation means are to be arranged so that such action cannot be done inadvertently. Alternative means to indicate disabling of safety actions or alarms will be considered.

(5) Applicable to required essential auxiliary pumps serving propulsion machinery, electrical power generating machinery, oil fired boilers associated with propulsion and electrical power generating machinery. C.P.P. pumps, sea water main cooling pumps, bilge pumps and pumps for fuel oil settling and daily service tanks. See 4.6.

(6) For **CAB** ships, only these items and the alarms and displays per Table VIII 4-3 through VIII 4-9, as applicable, need to be provided on such station.

(7) Not applicable to **CAB** Ships having integrated propulsion machinery.

(8) Provided the audible alarms re-activate automatically after a preset time, audible alarms may be by-passed or de-activated during machinery start-up.

Table VIII 4-3 has been amended as follows:

Table VIII 4-3
Monitoring of Propulsion Machinery – Steam Turbine
(Applicable to CAS, CAU, and CAB Ships. See also Table VIII 4-2)

System	Monitored/Controlled Parameter		A	D	Auto slow down	Auto Start	Auto shut down	Notes (see also bottom of table) [A = Alarm. D = Display. x =apply]
Sensors	Common or separate		c	c	c	s	s	c = common; s = separate
Lubricating oil	A1	Pressure at bearing inlets - low	x	x		x	x	For turbines, gears and thrust bearings.
	A2	Temp. at bearing inlet - high	x	x				For turbines, gears and thrust bearings.
	A3	Bearing temp. or bearing oil outlet temp. - high	x	x				For turbines, gears and thrust bearings.
	A4	Filter differential pressure - high	x					
	A5	Gravity tank and sump levels - low	x	x				
Lubricating oil cooling medium	B1	Pressure or flow - low	x	x		x		
	B2	Temp. at outlet - high	x					
	B3	Expansion tank level - low	x	x				
Sea water	C1	Pressure or flow - low	x	x		x		
	C2	Pump - auto starting and running		x				For ships fitted with sea inlet scoops
	C3	Scoop valve - open/ close		x				For ships fitted with sea inlet scoops.
Steam	D1	Pressure at throttle - low	x				x	
	D2	Pressure, ahead chest		x				
	D3	Pressure, astern chest		x				
	D4	Pressure, gland seal		x				
	D5	Gland seal exhaust fan - failure	x					
	D6	Astern guardian valve - position		x				
	D7	Astern guardian valve - fail to open	x					In response to throttle trip or maneuvering signal.
Condensate	E1	Condenser level - high	x	x			x	
	E2	Condenser level - low	x	x				
	E3	Condensate pump pressure - low	x			x		
	E4	Condenser vacuum - low	x	x			x	
	E5	Salinity - high	x	x				
Turbine	F1	Vibration Level - high	x		x			
	F2	Axial Displacement - large	x				x	
	F3	Speed		x				
	F4	Overspeed	x				x	
	F5	Shaft rollover - activated		x				

	F6	Shaft stopped - excess of set period	x					Shaft rollover to be activated manually or automatically
Power	G1	Throttle control system power failure	x					

Display = display of the analog or digital signal for the monitored parameter. The display of the signal is to provide indication of the monitored parameter in engineering units (such as degrees, PSI, RPM, etc.) or status indication. The engineering unit is to effectively display the relevant information concerning the monitored parameter. An alternative engineering unit which provides equivalent effectiveness, may be considered.

Auto slowdown = automatic slowdown of turbine, with activation of suitable alarm.

Auto start = automatic starting of standby pump in the system, with activation of suitable alarm.

Auto shutdown = automatic closing of ahead steam throttle valve, with activation of suitable alarm; but to allow admission of steam to astern turbine for braking purposes.

Table VIII 4-4 has been amended as follows:

Table VIII 4-4
Monitoring of Propulsion Machinery – Gas Turbine
(Applicable to CAS, CAU, and CAB Ships. See also Table VIII 4-2)

System	Monitored/Controlled Parameter		A	D	Auto Start	Auto shut down	Notes (see also bottom of table) [A = Alarm. D = Display. x =apply]
Sensors	Common/separate		c	c	s	s	c = common; s = separate
Fuel oil	A1	Pressure or flow - low	x	x			
	A2	Temperature - high and low (or viscosity - low and high)	x	x			For heavy fuel oil.
Lubricating oil	B1	Inlet pressure - low	x	x	x	x	For turbines, reduction gears and thrust bearings
	B2	Inlet temperature - high	x	x			For turbines, reduction gears and thrust bearings
	B3	Main bearing temp. or main bearing oil outlet temp. - high	x	x			For turbines, reduction gears and thrust bearings
	B4	Filter differential pressure - high	x				
	B5	Tank level - low	x	x			
Cooling medium	C1	Pressure or flow - low	x	x			
	C2	Temperature - high	x				
Starting	D1	Stored starting energy level - low	x				
	D2	Ignition failure	x				
Combustion	E1	Combustion or flame failure	x			x	
Exhaust gas	F1	Temperature - high	x	x		x	
Turbine	G1	Vibration level - high	x			x	
	G2	Rotor axial displacement - large	x			x	Auto shutdown may be omitted for rotors fitted with roller bearings
	G3	Overspeed	x			x	
	G4	Vacuum at compressor inlet - high	x			x	
Control System	H1	Control, alarm or safety system, power supply failure	x				

Display = display of the analog or digital signal for the monitored parameter. The display of the signal is to provide indication of the monitored parameter in engineering units (such as degrees, PSI, RPM, etc.) or status indication. The engineering unit is to effectively display the relevant information concerning the monitored parameter. An alternative engineering unit which provides equivalent effectiveness, may be considered.

Auto start = automatic starting of standby pump in the system, with activation of suitable alarm.

Auto shutdown = automatic closing of ahead steam throttle valve, with activation of suitable alarm; but to allow admission of steam to astern turbine for braking purposes.

Item		Alarm (1)	Display	Automatic starting of required standby essential auxiliary pump (1), (5), (6)	Remarks
Lube oil (2)	Pressure, inlet, low	×	Pressure	×	
	Pressure, low low	×			Turbine automatic shutdown (3)
	Temperature, inlet, high	×	Temperature		
	Differentilal pressure, filter, high	×			
	Level, tank, low	×			In gravity tank and sump
Bearings	Temperature, high	×	Temperature		Main bearings
Cooling Medium	Pressure or flow, low	×			
	Temperature, high	×			
Fuel	Pressure or flow, low	×	Pressure, or flow		
	Temperature or viscosity, low	×	Temperature, or viscosity		For heavy fuel
	Temperature or viscosity, high	×			For heavy fuel
Exhaust gas	Temperature, high	×	Temperature		Turbine automatic shutdown (4)
Turbine	Vibration level, high	×			Turbine automatic shutdown (4)
Rotor	Axial displacement, high	×			Turbine automatic shutdown (7)
Overspeed	Device activated	×			Turbine automatic shutdown
Starting	Automatic starting failure	×			
	Stored starting energy level, low	×			
Ignition and flame	Failure	×			Turbine automatic shutdown (4)
Compressor	Pressure, inlet, low	×			Turbine automatic shutdown (4)
Control system	Failure	×			

Notes:

(1) Required alarm or starting of standby pump is denoted by a (×).

(2) Individual alarms are required where separate systems (e.g., reduction gear, bearing, etc.) are installed.

(3) The automatic shutdown is to be activated after failure of the standby pump.

(4) Automatic shutdowns are required for **CAU** or **CAB** Ships.

(5) For **CAS** Ships, automatic starting is not required. For **CAS** or **CAU** Ships, starting of the standby pumps is to be possible from the centralized control and monitoring station; for **CAB** Ships having non integrated propulsion machinery, starting means from the centralized monitoring station are required.

(6) For **CAU** or **CAB** Ships, starting of required standby pumps is to be automatic and is to be alarmed.

(7) Automatic shutdown may be omitted for rotors fitted with rollers bearings.

Table VIII 4-5A has been amended as follows:

Table VIII 4-5A
Monitoring of Propulsion Machinery – Slow Speed (Crosshead) Diesel Engines
(Applicable to CAS, CAU or CAB Ships. See also Table VIII 4-2)

System	Monitored/Controlled Parameter		A	D	Auto slow down	Auto Start	Auto shut down	Notes (see also bottom of table) [A = Alarm. D = Display. x =apply]
Sensors	Common or separate		c	c	c	s	s	c = common; s = separate
Fuel oil	A1	Fuel oil after filter (engine inlet), pressure - low	x	x		x		
	A2	Fuel oil before injection pumps, temp. - high (or viscosity - low)	x					
	A3	Fuel oil before injection pumps, temp. - low (or viscosity - high)	x					
	A4	Leakage from high pressure pipes	x					
	A5	Fuel oil service tank, level – low	x					High level alarm is also required if without suitable overflow arrangements.
	A6	Common rail fuel oil pressure – low	x					
Lubricating oil	B1	Lube oil to main bearing and thrust bearing, pressure -low	x	x	x	x	x	
	B2	Lube oil to crosshead bearing, pressure - low	x	x	x	x	x	If of a different system
	B3	Lube oil to camshaft, pressure - low	x			x	x	If of a different system
	B4	Lube oil to camshaft, temp. - high	x					If of a different system
	B5	Lube oil inlet, temp. - high	x					
	B6	Thrust bearing pads temp. or bearing outlet temp. - high	x		x		x	
	B7	Oil mist in crankcase, mist concentration - high; or Engine main and crank bearing temperature - high; or Alternative arrangements (engine main and crank bearing oil outlet temperature – high)	x		x			For engines having a power of 2250 kW (3000 hp) and above or having a cylinder bore of more than 300 mm.
	B8	Each cylinder lubricator, flow rate - low.	x		x			
	B9	Lube oil tanks, level - low	x					Where separate lubricating oil systems are installed (e.g. camshaft, rocker arms, etc.), individual level alarms are required for all the tanks.
	B10	Common rail servo oil pressure – low	x					
Turbocharger	C1	Lube oil inlet, pressure - low	x					Unless provided with a self-contained lubricating

								oil system integrated with the turbocharger
	C2	Lube oil outlet (each bearing), temp. - high	x					Where outlet temperature from each bearing cannot be monitored due to the engine/turbocharger design, alternative arrangements may be accepted. Continuous monitoring of inlet pressure and inlet temperature in combination with specific intervals for bearing inspection in accordance with the turbocharger manufacturer's instructions may be accepted as an alternative.
	C3	Speed	x	x				Alarm Activation for High Speed only required for turbochargers of categories B and C
Piston cooling	D1	Coolant inlet, pressure - low	x		x	x		The slow down is not required if the coolant is oil taken from the main cooling system of the engine.
	D2	Coolant outlet (each cylinder), temp. - high	x		x			
	D3	Coolant outlet (each cylinder), flow - low	x		x			Where outlet flow cannot be monitored due to engine design, alternative arrangements may be accepted.
	D4	Coolant in expansion tank, level - low	x					
Sea water cooling	E1	Sea water cooling, pressure - low	x			x		
Cylinder fresh water cooling	F1	Water inlet, pressure - low	x		x	x		
	F2	Water outlet from each cylinder, temp. – high ; or common water outlet, temp. - high	x		x			Sensing at common water outlet is permitted for cylinder jackets fitted with common cooling space without intervening stop valves.
	F3	Oily contamination of engine cooling water system.	x					Where engine cooling water is used in fuel and lubricating oil heat exchangers.
	F4	Cooling water expansion tank, level - low	x					
Compressed air	G1	Starting air before main shutoff valve, pressure - low	x	x				
	G2	Control air, pressure - low	x					
	G3	Safety air, pressure - low	x					
Scavenge air	H1	Scavenge air receiver, pressure		x				

	H2	Scavenge air box, temp. - high (fire)	x		x			
	H3	Scavenge air receiver water level - high	x					
Exhaust gas	I1	Exhaust gas after each cylinder, temp. - high	x	x	x			
	I2	Exhaust gas after each cylinder, deviation from average, temp. - high	x					
	I3	Exhaust gas before each turbocharger, temp. - high	x	x				
	I4	Exhaust gas after each turbocharger, temp. - high	x	x				
Fuel valve coolant	J1	Coolant, pressure - low	x			x		
	J2	Coolant, temp. - high	x					
	J3	Coolant expansion tank, level - low	x					
Engine	K1	Speed/direction of rotation		x				
	K2	Rotation - wrong way	x					
	K3	Engine overspeed	x				x	
Power	L1	Control, alarm or safety system, power supply failure	x					

Display = display of the analog or digital signal for the monitored parameter. The display of the signal is to provide indication of the monitored parameter in engineering units (such as degrees, PSI, RPM, etc.) or status indication. The engineering unit is to effectively display the relevant information concerning the monitored parameter. An alternative engineering unit which provides equivalent effectiveness, may be considered.

Auto slowdown = automatic slowdown of turbine, with activation of suitable alarm.

Auto start = automatic starting of standby pump in the system, with activation of suitable alarm.

Auto shutdown = automatic closing of ahead steam throttle valve, with activation of suitable alarm; but to allow admission of steam to astern turbine for braking purposes.

Item (12)		Alarm (1)	Display	Automatic starting of required stand-by essential auxiliary pump with alarm (1), (11)	Remarks
Fuel oil system	Fuel oil after filter (engine inlet), pressure low	×	Pressure	×	(3)
	Fuel oil before injection pumps, temperature or viscosity low, and Fuel oil before injection pumps, temperature or viscosity, high	×			
	Leakage from high pressure pipes	×			
	Fuel oil in daily service tank, level low	×			See also 4.13
	Common rail fuel oil pressure low	×			
Lube oil system	Lube oil to main bearing and thrust bearing, pressure low	×	Pressure	×	Auto. engine slowdown/ shutdown (2), (3), (4)
	Lube oil to crosshead bearing, pressure low	×	Pressure	×	Auto. engine slowdown /shutdown (2), (3), (4), (5)
	Lube oil to camshaft, pressure low	×		×	Automatic engine shutdown (3), (4), (5)
	Lube oil to camshaft, temperature high	×			(5)
	Lube oil inlet, temperature high	×			
	Thrust bearing pads or Bearing outlet, excessive temperature high	×			Automatic engine slowdown/shutdown (2), (3), (13)
	Main, crank, crosshead bearing, oil outlet, temperature high or Oil mist concentration in crankcase, mist high	×			Automatic engine slowdown (2), (6), (13)
	Flow rate cylinder lubricator, flow low. Each apparatus	×			Automatic engine slowdown (2), (13)
	Lubricating oil tanks, level low	×			(7)
	Common rail servo- oil pressure low	×			
Turbo charger system	Lube oil inlet, pressure low	×			(15)
	Lube oil outlet (each bearing), temperature high	×			(15)
	Turbocharger speed		Speed		
Piston cooling system	Coolant inlet, pressure low	×		×	Automatic engine slowdown (2), (3), (8), (13)
	Coolant outlet (each cylinder), temperature high	×			Automatic engine slowdown (2), (13)
	Coolant outlet (each cylinder), flow low	×			Automatic engine slowdown (2), (13)
	Coolant in expansion tank, level low	×			
S. W. cooling	Sea water cooling, pressure low	×		×	(3)
Cylinder fresh cooling water system	Water inlet, pressure low	×		×	Automatic engine slowdown (2), (3), (13)
	Water outlet (for each cylinder), temperature high, or Water outlet (general), temperature high	×			Automatic engine slowdown (2), (9), (13)
	Oily contamination of engine cooling water system	×			(10)
	Cooling water in expansion tank, level low	×			

Table VIII 4-5A
Monitoring of Propulsion Machinery – Slow Speed (Crosshead) Diesel Engines
(Applicable to CAS, CAU or CAB Ships. See also Table VIII 4-2)(cont.)

Item (12)		Alarm (1)	Display	Automatic starting of required stand-by essential auxiliary pump with alarm (1), (11)	Remarks
Compressed Air system	Starting air before main shut-off valve, pressure low	×	pressure		
	Control air, pressure low	×			
	Safety air, pressure low	×			
Scavenge air system	Scavenge air receiver		Pressure		
	Scavenge air box, temperature high (fire)	×			Automatic engine slowdown (2), (13)
	Scavenge air receiver water, level high	×			
Exhaust gas system	Exhaust gas after each cylinder, temperature high	×	Temp.		Automatic engine slowdown (2), (13)
	Exhaust gas after each cylinder, deviation from average, temperature high	×			
	Exhaust gas before each T/C, temperature high	×	Temp.		
	Exhaust gas after each T/C, temperature high	×	Temp.		
Fuel valve coolant	Fuel valve coolant, pressure low	×		×	(3)
	Fuel valve coolant, temperature high	×			
	Fuel valve coolant in expansion tank, level low	×			
Engine	Engine speed/direction of rotation		Speed /rotation		
	Engine overspeed	×			Automatic engine shutdown. (3)
	Rotation, wrong way	×			
Power supply	Control, alarm or safety system, power supply failure	×			

Notes:

(1) Required alarm or starting of standby pump is denoted by a (×).

(2) A common sensor for alarm/display and automatic slowdown is acceptable.

(3) Separate sensors are required for: a) alarm/automatic starting of required standby pump, and b) automatic engine shutdown.

(4) Automatic engine shutdown is to be alarmed and effected upon loss of oil pressure. For **CAS** Ships, a slowdown will suffice, see 4.9.1.

(5) If separate lube oil systems are installed.

(6) For engines having a power of more than 2250 kW or a cylinder bore of more than 300 mm.

(7) Where separate lubricating oil systems are installed (e.g. camshaft, rocker arms, etc.), individual level alarms are required for the tanks.

(8) The slow down is not required if the coolant is oil tanken from the main cooling system of the engine.

(9) Where one common cooling space without individual stop valves is employed for all cylinder jackets.

(10) Where main engine cooling water is used in fuel and lubricating oil heat exchangers.

(11) For **CAS** Ships, automatic starting is not required. For **CAS** or **CAU**, starting of the standby pumps is to be possible from the centralized control and monitoring station; for **CAB** Ships having non-integrated propulsion machinery, starting means from the navigating bridge station are required. See 6.2.

(12) For **CAB** Ships having integrated propulsion machinery, exemption from the listed instrumentation and safety provisions will be considered.

(13) Automatic engine slowdown and/or shutdown is not applicable to **CAS** ships.

(14) Instead of automatic slowdown, manual slowdown will be acceptable provided visual/audible alarm with illumination sign "Reduced Power" is located in the navigating bridge.

~~(15) Not required for self-contained lubricating oil system.~~

Table VIII 4-5B has been amended as follows:

Table VIII 4-5B
Monitoring of Propulsion Machinery – Medium/High Speed (Trunk Piston) Diesel Engines
(Applicable to CAS, CAU or CAB Ships. See also Table VIII 4-2)

System	Monitored/Controlled Parameter		A	D	Auto slow down	Auto Start	Auto shut down	Notes (see also bottom of table) [A = Alarm. D = Display. x =apply]
Sensors	Common or separate		c	c	c	s	s	c = common; s = separate
Fuel oil	A1	Fuel oil after filter (engine inlet), pressure - low	x	x		x		
	A2	Fuel oil before injection pumps, temp. - high (or viscosity - low)	x					For heavy fuel oil burning engines only.
	A3	Fuel oil before injection pumps, temp. - low (or viscosity - high)	x					For heavy fuel oil burning engines only.
	A4	Leakage from high pressure pipes	x					
	A5	Fuel oil service tank, level – low	x					High level alarm is also required if without suitable overflow arrangements.
	A6	Common rail fuel oil pressure – low	x					
Lubricating Oil (diesel engine)	B1	Lube oil to main bearing and thrust bearing, pressure - low	x	x		x	x	
	B2	Lube oil filter differential, pressure - high	x	x				
	B3	Lube oil inlet, temp. - high	x	x				
	B4	Oil mist in crankcase, mist concentration – high; or Engine main and crank bearing temperature - high; or Alternative arrangements (engine main and crank bearing oil outlet temperature – high)	x				x	For engines having a power of 2250 kW (3000 hp) and above or having a cylinder bore of more than 300 mm. Single sensor (for each engine) having two independent outputs for initiating alarm and for shutdown will satisfy independence of alarm and shutdown.
	B5	Each cylinder lubricator, flow rate - low	x		x			If necessary for the safe operation of the engine.
	B6	Common rail servo oil pressure – low	x					
Lubricating Oil (other than diesel engine)	B7	Reduction gear lube oil inlet pressure - low	x	x	x	x	x	Shutdown is to affect all power input to gear
Sea water cooling	C1	Sea water cooling system pressure - low	x	x		x		
Cylinder fresh water	D1	Water inlet, pressure - low or flow - low	x	x	x	x		
	D2	Water outlet (general),	x	x	x			Two separate sensors are

cooling		temp. – high						required for alarm and slowdown.
	D3	Cooling water expansion tank, level - low	x					
Compressed air	E1	Starting air before shutoff valve, pressure - low	x	x				
	E2	Control air pressure - low	x	x				
Scavenge air	F1	Scavenge air receiver temp. - high	x					
Exhaust gas	G1	Exhaust gas after eachcylinder, temp. - high	x	x	x			For engine power > 500 kW/ cylinder
	G2	Exhaust gas after each cylinder, deviation from average, temp. - high	x					For engine power > 500 kW/ cylinder
Engine	H1	Speed		x				
	H2	Overspeed	x				x	
Power	J1	Control, alarm or safety system, power supply failure	x					
Turbocharger	K1	Turbocharger lube oil inlet pressure – low	x					Unless provided with a selfcontained lubricating oil system integrated with the turbocharger
	K2	Turbocharger lube oil outlet temp., eachbearing, - high	x					Where outlet temperature from each bearing cannot be monitored due to the engine/turbocharger design, alternative arrangements may be accepted. Continuous monitoring of inlet pressure and inlet temperature in combination with specific intervals for bearing inspection in accordance with the turbocharger manufacturer's instructions may be accepted as an alternative.
	K3	Speed of turbocharger	x	x				Alarm Activation for High Speed only required for turbochargers of categories B and C

Display = display of the analog or digital signal for the monitored parameter. The display of the signal is to provide indication of the monitored parameter in engineering units (such as degrees, PSI, RPM, etc.) or status indication. The engineering unit is to effectively display the relevant information concerning the monitored parameter. An alternative engineering unit which provides equivalent effectiveness, may be considered.

Auto slowdown = automatic slowdown of diesel engine, along with activation of suitable alarm.

Auto start = automatic starting of a standby pump, along with activation of suitable alarm.

Auto shutdown = automatic stopping of the diesel engines, along with activation of suitable alarm.

Item (12)		Alarm (1)	Display	Automatic starting of required stand-by essential auxiliary pump with alarm (1), (11)	Remarks
Fuel oil system	Fuel oil after filter (engine inlet), pressure low	*	Pressure	*	(3)
	Fuel oil before injection pumps, temperature or viscosity low, and Fuel oil before injection pumps, temperature or viscosity, high	*			(5)
	Leakage from high pressure pipes	*			
	Fuel oil in daily service tank, level low	*			See also 4.13
	Common rail fuel oil pressure low	*			
Lube oil system	Lube oil to main bearing and thrust bearing, pressure low	*	Pressure	*	Automatic engine shutdown. (3), (4)
	Lube oil filter differential, pressure high	*	Pressure		
	Lube oil inlet, temperature high	*	Temp.		
	Main, connecting rod bearing temperature or lube oil outlet, temperature high or Oil mist concentration in crankcase, mist high or equivalent device.	*			Automatic engine shutdown. (2), (6), (15)
	Flow rate cylinder lubricator, flow low. Each apparatus	*			Automatic engine slowdown. (2), (10), (13)
	Common rail servo oil pressure low	*			
Turbo charger	Turbo charger lube oil inlet, pressure low	*	Pressure		(7)
Reduction gear	Reduction gear lube oil inlet, pressure low	*	Pressure	*	Automatic engine shutdown. (3),(4)
S. W. cooling	Sea water cooling, pressure low	*	Pressure	*	(3)
Cylinder fresh cooling water system	Water inlet, pressure low or flow low	*	Press. or flow	*	Automatic engine slowdown. (2), (3), (13)
	Water outlet (general), temperature high	*	Temp.		Automatic engine slowdown. (8), (13)
	Cooling water in expansion tank, level low	*			
Compressed Air system	Starting air before main shut off valve, pressure low	*	Pressure		
	Control air, pressure low	*	Pressure		

Scavenge air system	Scavenge air receiver, temperature high	×			
Exhaust gas system	Exhaust gas after each cylinder, temperature high	×	Temp.		Automatic engine slowdown (2), (9), (13)
	Exhaust gas after each cylinder, de-viation from average, temperature high	×			(9)
Engine	Engine speed		Speed		
	Engine overspeed	×			Automatic engine shutdown (3)
Power supply	Control, alarm or safety system, power supply failure	×			

Notes:

(1) Required alarm or starting of standby pump is denoted by a (×).

(2) A common sensor for alarm/display and automatic slowdown is acceptable.

(3) Separate sensors are required for: a) alarm/automatic starting of required standby pump, and b) automatic engine shutdown.

(4) Automatic engine shutdown is to be alarmed and effected upon loss of oil pressure. For **CAS** ships, a slowdown will suffice, see 4.9.1.

(5) For heavy fuel oil burning engines only.

(6) Only for medium speed engines having a power of more than 2250 kW or a cylinder bore of more than 300 mm.

(7) If without integrated self-contained oil lubrication system.

(8) Two separate sensors are required for alarm and slowdown.

(9) For engine power > 500 kW/cyl.

(10) If necessary for the safe operation of the engine.

(11) For **CAS** Ships, automatic starting is not required. For **CAS** or **CAU**, starting of the standby pumps is to be possible from the centralized control and monitoring station; for **CAB** Ships having non-integrated propulsion machinery, starting means from the navigating bridge station are required. See 6.2.

(12) For **CAB** Ships having integrated propulsion machinery, exemption from the listed instrumentation and safety provisions will be considered.

(13) Automatic engine slowdown and/or shutdown is not applicable to **CAS** ships

(14) Instead of automatic slowdown, manual slowdown will be acceptable provided visual/audible alarm with illumination sign "Reduced Power" is located in the navigating bridge.

(15) Single sensor having two independent outputs for initiating alarm and for shutdown will satisfy independence of alarm and shutdown. An equivalent device could be interpreted as measures applied to engines where specific design features to preclude the risk of crankcase explosions are incorporated.

Table VIII 4-6 has been amended as follows:

Table VIII 4-6
Monitoring of Propulsion Machinery – Electric Propulsion
(Applicable to CAS, CAU, and CAB Ships. See also Table VIII 4-2)

System	Monitored/Controlled Parameter		A	D	Auto shut down	Notes (see also bottom of table) [A = Alarm. D = Display. x =apply]
Propulsion Generator	A1	Bearing lub oil inlet pressure - low	x	x	x	Prime mover automatic shutdown
	A2	Voltage - off-limits	x	x		To read all phases and at least one bus
	A3	Frequency - off-limits	x	x		
	A4	Current		x		To read all phases
	A5	Stationary windings temperature - high	x	x		To read all phases; for generators > 500kW
	A6	Main generator circuit breakers - open/close		x		
	A7	Generator running		x		
	A8	Failure of on-line generator	x			
	A9	Transfer of standby generator	x			
	A10	Generator cooling medium temperature - high	x	x		If applicable
	A11	Failure of generator cooling pump or fan motor	x			If applicable
	A12	Field voltage and current		x		For DC generator
	A13	Inter-pole winding temperature - high	x	x		For DC generator
Propulsion Motor - AC	B1	Bearing, lub. oil inlet pressure - low	x	x	x	
	B2	Armature voltage - off-limits	x	x		To read all phases and at least one bus
	B3	Field voltage		x		
	B4	Frequency - off-limits	x	x		
	B5	Armature current		x		To read all phases
	B6	Field current		x		For synchronous motors
	B7	Ground lights or similar		x		
	B8	Stationary windings temperature - high	x	x		To read all phases; for motors > 500kW
	B9	Motor circuit breakers - open/close		x		
	B10	Motor running		x		
	B11	Failure of on-line motor	x			
	B12	Transfer of standby motor	x			
	B13	Motor cooling medium temperature - high	x	x		If applicable
	B14	Failure of cooling pump or fan motor	x			If applicable
Propulsion Motor - DC	C1	Bearing lub oil inlet pressure - low	x	x	x	
	C2	Armature voltage - off-limits	x	x		
	C3	Field voltage		x		
	C4	Armature current		x		
	C5	Field current		x		
	C6	Ground lights or similar		x		
	C7	Motor circuit breakers - open/close		x		
	C8	Motor running		x		
	C9	Motor overspeed	x		x	
	C10	Failure of on-line motor	x			
	C11	Transfer of standby motor	x			
	C12	Motor cooling medium temperature	x	x		If applicable

		- high				
	C13	Failure of cooling pump or fan motor	x			If applicable
Propulsion SCR	D1	Voltage		x		
	D2	Current		x		
	D3	Overload (high current)	x			Alarms before protective device is activated
	D4	Open/close position for assignment switches		x		
	D5	SCR cooling medium temperature - high	x	x		If applicable
	D6	Failure of SCR cooling pump or fan motor	x			If applicable
	D7	Inter-phase reactor temperature, high	x	x		
Transformer	E1	Transformer winding temperature - high	x	x		For each phase

Display = display of the analog or digital signal for the monitored parameter. The display of the signal is to provide indication of the monitored parameter in engineering units (such as degrees, PSI, RPM, etc.) or status indication. The engineering unit is to effectively display the relevant information concerning the monitored parameter. An alternative engineering unit which provides equivalent effectiveness, may be considered.

Item		Alarm (1)	Display	Remarks
Propulsion Generator	Pressure, bearing, lube oil inlet, low	×	Pressure	Prime mover automatic shutdown
	Voltage, off – limits	×	Voltage	To read all phases and at least one bus (2)
	Frequency, off – limits	×	Frequency	
	Current		Current	To read all phases (2)
	Temperature, stationary windings, high	×	Temperature	To read all phases
	Main generator circuit breakers, open/close		Position	
	Generator running		Running	
	Failure of on – line generator	×		
	Transfer of standby generator	×		
	Generator cooling medium temperature, high	×	Temperature	If required
	Failure of gen. cooling pump or fan motor	×		If required
	Inter pole winding tempearture high	×	Temperature	For DC generotor
Propulsion AC motor	Pressure, bearing, lube oil inlet, low	×	Pressure	Automatic shutdown
	Voltage, armature, off – limits	×	Voltage	To read all phases and at least one bus
	Voltage, field		Voltage	
	Frequency, off – limits	×	Frequency	
	Current, armature		Current	To read all phases
	Current, field		Current	For synchronous motors
	Ground lights or similar		Status	
	Temperature, stationary windings, high	×	Temperature	To read all phases
	Motor circuit breakers, open/close		Position	
	Motor running		Running	
	Failure of on – line motor	×		
	Transfer of standby motor	×		
	Motor cooling medium temperature, high	×	Temperature	If required
	Failure of cooling pump or fan motor	×		If required
Propulsion DC motor	Pressure, bearing, lube oil inlet, low	×	Pressure	Automatic shutdown
	Voltage, armature, off-limits	×	Voltage	
	Voltage, field		Voltage	
	Current, armature		Current	
	Current, field		Current	
	Ground lights or similar		Status	
	Motor circuit breakers, open/close		Position	
	Motor running		Running	
	Motor overspeed	×		Automatic shutdown
	Failure of on-line motor	×		
	Transfer of standby motor	×		
	Motor cooling medium temperature, high	×	Temperature	If required
	Failure of cooling pump or fan motor	×		If required
Propulsion Semi – conductor Rectifier (SCR)	Voltage, SCR		Voltage	
	Current, SCR		Current	
	Overloading conditions, high current	×		Alarms before protective device is activated
	Open/close position for assignment switches		Position	
	SCR cooling medium temperature, high	×	Temperature	If required
	Failure of SCR cooling pump or fan motor	×		If required
	Inter-phase reator temperature,high	×	Temperature	
Transformer	Transformer winding temperature,high	×	Temperature	For each phase

Notes:

(1) Required alarm is denoted by a (×).

(2) For DC generators. Additionally, field voltmeters and ammeters are to be included.

Table VIII 4-7 has been amended as follows:

Table VIII 4-7
Monitoring of Generator Prime Mover for Electric Propulsion ~~auxiliary Prime Movers and Electrical Generators~~ ~~(6), (7)~~
(Applicable to CAS, CAU or CAB Ships)

System	Monitored/Controlled Parameter		A	D	Auto Start	Auto Shut down	Notes: [A = Alarm; D = Display; x = applies]
Trunk Piston Type Diesel Engines							
Fuel oil	A1	Fuel oil after filter (engine inlet), Pressure – low	x	x	x		
	A2	Fuel oil before injection pumps, temp. – high (or viscosity – low)	x				For heavy fuel oil burning engines only.
	A3	Fuel oil before injection pumps, temp. – low (or viscosity – high)	x				For heavy fuel oil burning engines only.
	A4	Leakage from high pressure pipes	x				
	A5	Fuel oil service tank, level – low	x				High level alarm is also required if without suitable overflow arrangements.
	A6	Common rail fuel oil pressure - low	x				
Lubricating oil	B1	Lube oil to main bearing, pressure – low	x	x	x	x	
	B2	Lube oil filter differential, pressure – high	x	x			
	B3	Lube oil inlet, temp. – high	x	x			
	B4	Oil mist in crankcase, mist concentration – high; or Engine main and crank bearing temperature - high; or Alternative arrangements (engine main and crank bearing oil outlet temperature – high)	x			x	For engines having a power of 2250 kW (3000 hp) and above or a cylinder bore of more than 300 mm. Single sensor (for each engine) having two independent outputs for initiating alarm and for shutdown will satisfy independence of alarm and shutdown.
	B5	Each cylinder lubricator, flow rate – low	x				If necessary for the safe operation of the engine.
	B6	Common rail servo oil pressure - low	x				
Sea cooling water	C1	Sea water cooling system pressure – low	x	x	x		
Cylinder fresh water cooling	D1	Water inlet, pressure – low or flow – low	x	x	x		
	D2	Water outlet (general), temp. – high	x	x			
	D3	Cooling water expansion tank, level – low	x				
Compressed	E1	Starting air before shutoff	x	x			

air		valve, pressure – low					
	E2	Control air pressure – low	x	x			
Exhaust gas	F1	Exhaust gas after each cylinder, temp. – high	x	x			For engine power > 500 kW/cylinder
Turbocharger	G1	Turbocharger oil inlet pressure - low	x				Unless provided with a self-contained lubricating oil system integrated with the turbocharger
	G2	Turbocharger oil outlet temp., each bearing, - high	x				Where outlet temperature from each bearing cannot be monitored due to the engine/ turbocharger design, alternative arrangements may be accepted. Continuous monitoring of inlet pressure and inlet temperature in combination with specific intervals for bearing inspection in accordance with the turbocharger manufacturer's instructions may be accepted as an alternative.
	G3	Speed of turbocharger	x				Alarm Activation for High Speed only required for turbochargers of categories B and C.
Engine	H1	Over speed	x			x	
Power Supply	I1	Main	x	x			
	I2	Emergency	x				
Gas Turbines							
Fuel oil	J1	Pressure or flow – low	x	x			
	J2	Temperature – high and low (or viscosity – low and high)	x	x			For heavy fuel oil.
Lubricating oil	K1	Inlet pressure – low	x	x	x	x	
	K2	Inlet temperature – high	x	x			
	K3	Bearing temp. or bearing oil outlet temp. – high	x	x			
	K4	Filter differential pressure – high	x				
	K5	Tank level – low	x	x			
Cooling medium	L1	Pressure or flow – low	x	x			
	L2	Temperature – high	x				
Starting	M1	Stored starting energy level – low	x				
	M2	Ignition failure	x			x	
Combustion	N1	Combustion or flame failure	x			x	
Exhaust gas	O1	Temperature – high	x	x		x	
Turbine	P1	Vibration level – high	x			x	
	P2	Rotor axial displacement – large	x			x	
	P3	Overspeed	x			x	

	P4	Vacuum at compressor inlet – high	x			x	
Power Supply	Q1	Main	x	x			
	Q2	Emergency	x				

Display = display of the analog or digital signal for the monitored parameter. The display of the signal is to provide indication of the monitored parameter in engineering units (such as degrees, PSI, RPM, etc.) or status indication. The engineering unit is to effectively display the relevant information concerning the monitored parameter. An alternative engineering unit which provides equivalent effectiveness, may be considered.

Auto start = automatic starting of a standby pump, along with activation of suitable alarm.

Auto shutdown = automatic stopping of the diesel engines and gas turbine, along with activation of suitable alarm.

Item			Alarm (1)	Display	Remarks
Diesel engine	Lube Oil	Pressure, lube oil inleft, low	*	Pressure	Automatic engine shutdown
		Temperature, inlet, high	*	Temperature	
		Common rail servo oil pressure low	*		
	Cooling Medium	Pressure or flow, low	*	Pressure, or flow	
		Temperature, outlet, high	*	Temperature	
		Level, expansion tank, low	*		If separate from main system
	Fuel Oil	Fuel oil leakage from pressure pipe	*		
		Temperature, high and low (or viscosity, high and low)	*		For heavey fuel oil only
		Level, in fuel oil daily service tank, low	*		See also 4.13
		Common fuel oil pressure low	*		
	Crankcase	Oil mist concentration, high	*		Automatic engine shutdown (2)
	Starting Medium	Pressure or level, low	*	Pressure, or level	
	Exhaust gas	Exhaust gas temperature after each cylinder, high	*		For engine having a power of more than 500 kw/cyl.
	Overspeed	Device activated	*		Auto. shutdown. See Part IV 3.4.8.
Steam turbine	Lube Oil	Pressure, lube oil inlet, low	*	Pressure	Automatic shutdown. See Part IV 2.7.2.
		Temperature, inlet, high	*	Temperature	
	Bearing	Temperature, high	*	Temperature	Main bearings
	Cooling Medium	Pressure or flow, low	*	Pressure, or flow	
		Temperature, outlet, high	*		
		Level, expansion tank, low	*		If separate from main system
	Sea Water	Pressure or flow, low	*	Pressure, or flow	If required
	Steam	Pressure, inlet, low	*	Pressure	
	Condenser	Vacuum, low	*	Vacuum	Auto. shutdown
	Cond. pump	Pump, pressure, low	*	Pressure	
	Rotor	Axial displacement, large	*		Auto. shutdown
	Overspeed	Device activated	*		Auto. shutdown. See Part IV 2.7.1.

~~Table VIII 4-7~~
~~Monitoring of auxiliary Prime-Movers and Electrical Generators~~ ~~(6), (7)~~
~~(Applicable to CAS, CAU or CAB Ships)(cont.)~~

~~Item~~			~~Alarm~~ ~~(1)~~	~~Display~~	~~Remarks~~
~~Gas turbine~~	~~Lube Oil~~	~~Pressure, lube oil inlet, low~~	~~×~~	~~Pressure~~	~~Automatic shutdown. See Part IV 2.8.2.~~
		~~Temperature, inlet, high~~	~~×~~	~~Temperature~~	
		~~Filter differential pressure, high~~	~~×~~		
	~~Bearing~~	~~Temperature, high~~	~~×~~	~~Temperature~~	~~Main bearings~~
	~~Cooling Medium~~	~~Pressure or flow, low~~	~~×~~	~~Pressure, or flow~~	
		~~Temperature, high~~	~~×~~		
	~~Fuel~~	~~Pressure, inlet, low~~	~~×~~	~~Pressure~~	
		~~Temperature, high and low (or viscosity, high and low)~~	~~×~~		~~For heavey fuel oil only~~
	~~Exhaust Gas~~	~~Temperature, high~~	~~×~~		
	~~Combustion~~	~~Combustion or flame failure~~	~~×~~		~~Auto. shutdown~~
	~~Turbine~~	~~Vibration level, high~~	~~×~~		~~Auto. Shutdown~~
	~~Rotor~~	~~Axial displacement, high~~	~~×~~		~~Auto. Shutdown.~~ ~~(8)~~
	~~Starting~~	~~Stored energy pressure or level, low~~	~~×~~	~~Pressure, or level~~	~~If separate from main system~~
		~~Ignition failure~~	~~×~~		~~Auto. shutdown~~
	~~Overspeed~~	~~Device activated~~	~~×~~		~~Auto. shutdown. See Part IV 2.8.1.~~
	~~Vacuum~~	~~Vacuum at compressor inlet, high~~	~~×~~		~~Auto. shutdown~~
~~Electrical generator~~ ~~(4), (5)~~		~~Pressure, bearing, lube oil inlet, low~~	~~×~~	~~Pressure~~	~~Prime mover automatic shutdown~~
		~~Voltage, off limits~~	~~×~~	~~Voltage~~	~~To read all phases and at least one bus~~ ~~(3)~~
		~~Frequency, off limits~~	~~×~~	~~Frequency~~	
		~~Current, high~~	~~×~~	~~Current~~	~~To read all phases~~ ~~(3)~~
		~~Generator running~~		~~Running~~	
		~~Failure of on line generator~~	~~×~~		
		~~Transfer of standby generator~~	~~×~~		
		~~Temperature, gen. stationary windings, high~~		~~Temperature~~	~~To read all phases. See Part VII 13.1.6 and 14.3.2.~~
		~~Generator cooling medium temperature, high~~	~~×~~	~~Temperature~~	~~If required~~

	~~Failure of gen. cooling pump or fan motor~~	~~×~~		~~If required~~

~~Notes:~~

~~(1) Required alarm is denoted by a (×).~~

~~(2) For engines having a power of more than 2250 kW or having a cylinder bore over 300 mm.~~

~~(3) For DC generators. Additionally, field voltmeters and ammeters are to be included.~~

~~(4) For **CAS** Ships, the standby generator is to be started and placed in service from a single location.~~

~~(5) For **CAU** or **CAB** Ships, starting of the standby generator is to be automatic.~~

~~(6) For compliance with 7.9 the instrumentation per this table is to be provided on the centralized control station associated with the main electrical power generating plant.~~

~~(7) For **CAS**, **CAU** and **CAB** Ships, see Table VIII 4-2 for the provisions, if any, of additional controls, safety provisions, alarms and displays.~~

~~(8) Auto. Shutdown may be omitted for rotors fitted with roller bearings.~~

Table VIII 4-8 has been amended as follows:

Table VIII 4-8
Monitoring of Main Oil Fired Boiler and Associated Machinery
(Applicable to CAS, CAU, and CAB Ships. See also Table VIII 4-2)

System	Monitored/Controlled Parameter		A	D	Auto Start	Auto Shut down	Notes: [A = Alarm; D = Display; x = applies]
Sensors	Common/separate		c	c	s	s	c = common sensor; s = separate sensor
Feed water	A1	Atmospheric drain tank level - high and low	x	x			
	A2	Dearator level - high and low	x	x			
	A3	Dearator pressure - high and low	x	x			
	A4	Feed water pump pressure - low	x	x	x		
	A5	Feed water temperature - high	x	x			
	A6	Feed water outlet salinity - high	x	x			
Boiler Drum	B1	Water level - high and low	x	x			
	B2	Water level - low-low	x			x	
Steam	C1	Pressure - high and low	x	x			
	C2	Superheater outlet temperature - high	x	x			
Air	D1	Forced draft pressure - failure	x			x	
	D2	Rotating air heater motor - failure	x				If provided
	D3	Air register - open/close		x			
	D4	Fire in boiler casing	x	x			
Fuel oil	E1	Pump pressure at outlet - low	x	x	x		
	E2	Heavy fuel oil temperature - high (or viscosity - low)	x	x			
	E3	Heavy fuel oil temperature – low (or viscosity – high)	x	x			
	E4	Master fuel oil valve - open/close		x			
Burner	F1	Burner valve - open/close		x			Individual
	F2	Atomizing medium pressure - off-limits	x	x			
	F3	Ignition or flame of burners - fails	x	x		x	For multiple burners, flame failure of a single burner is to shutdown the corresponding burner fuel valves. Shut down is to be achieved within 6 seconds following flame extinguishment.
	F4	Flame scanner - fails	x			x	For multiple burners fitted with individual flame scanner, failure of flame scanner is to shut down

							the corresponding burner fuel valves.
	F5	Uptake gas temperature - high	x				For fire detection
Power	G1	Control system power supply - fails	x	x		x	Automatic closing of fuel valve(s)

Display = display of the analog or digital signal for the monitored parameter. The display of the signal is to provide indication of the monitored parameter in engineering units (such as degrees, PSI, RPM, etc.) or status indication. The engineering unit is to effectively display the relevant information concerning the monitored parameter. An alternative engineering unit which provides equivalent effectiveness, may be considered.

Auto start = automatic starting of standby pump in the system, with activation of suitable alarm.

Auto shutdown = automatic closing of fuel valve, with activation of suitable alarm.

Item		Alarm (1)	Display	Automatic starting of required standby essential auxiliary pump (1), (4)	Remarks
Feed water	Level, atmospheric drain tank, high	×	Level		
	Level, atmospheric drain tank, low	×			
	Level, deaerator, high	×			
	Level, deaerator, low	×			
	Pressure, deaerator, high	×	Pressure		
	Pressure, deaerator, low	×			
	Pressure, feedwater, low	×			
	Pressure, feedwater pump, failure	(5)		×	
	Temperature, feedwater, high	×	Temperature		
	Salinity, outlet, high	×	Salinity		
Boiler drum	Level, water, high	×	Level		
	Level, water, low	×			
	Level, water, low – low	×			Automatic closing of fuel valve(s) (3)
Air supply	Forced draft pressure, low	×			Automatic closing of fuel valve(s) (3)
	Rotating air heater motor, failure	×			If provided
	Air register, open/close		Position		
	Fire in boiler casing	×	Fire		
Fuel oil	Pressure, pump outlet, low	×	Pressure		
	Pressure, motor, failure	(5)		×	
	Temperature or viscosity, heavy oil, high	×	Temperature, or Viscosity		
	Temperature or viscosity, heavy oil, low	×			
	Master fuel oil valve, open/close		Position		
Burner	Burner valve, open/close		Position		Individual
	Pressure, atomizing medium, off – limits	×	Pressure		
	Flame scanner, failure	×			Individual (2), (3)
Ignition	Ignition or flame, failure	×	Ignited		Individual (2), (3)
Uptake gas	Temperature, high	×			For fire deteciton
Steam	Pressure, high	×	pressure		
	Pressure, low	×			
	Temperature, superheated outlet, high	×	Temperature		
Control power	Control power, loss or failure	×	Power – Available		Automatic closing of fuel valve(s) (3)

Notes:

(1) Required alarm or starting of standby pump is denoted by a (×).

(2) This condition is to automatically close the individual burner valve. Additionally, if this condition occurs simultaneously in all burners, the master fuel valve is to close automatically.

(3) On flame failure of all burners in boilers fitted with an automatic ignition system, the initial burner is to be brought back into automatic service only in the low – firing position.

(4) For **CAS** Ships, automatic starting is not required. For **CAS** or **CAU** Ships, starting of the standby pumps is to be possible from the centralized control and monitoring station; for **CAB** Ships, starting means from the centrlaized monitoring station are required.

(5) For **CAU** or **CAB** Ships, starting of required standby pumps is to be alarmed.

Table VIII 4-9 has been amended as follows:

Table VIII 4-9
Monitoring for Auxiliary Oil Fired Boiler
(Applicable to CAS, CAU, and CAB Ships.)

System	Monitored/Controlled Parameter		A	D	Auto Shut down	Notes: [A = Alarm; D = Display; x = applies]
Feedwater	A1	Feedwater outlet salinity - high	x	x		
Boiler drum	B1	Water level - high	x			
	B2	Water level - low	x	x	x	
Steam	C1	Pressure - high and low	x	x		
	C2	Superheater outlet temperature - high	x	x		
Air	D1	Supply air pressure - failure	x		x	Alarm for draft fan failure is acceptable
	D2	Fire in boiler air supply casing	x			Excessive high temperature alarm at boiler air supply casing is acceptable
Fuel oil	E1	Pump outlet pressure – low	x	x		
	E2	Temperature - high and low (or viscosity - low and high)	x	x		For heavy fuel oil only
Burner	F1	Fuel oil valves - open/close		x		Individual valves. Applicable only to auxiliary boilers with multiple burners
	F2	Ignition or flame - fails	x	x	x	Individual
	F3	Flame scanner - fails	x		x	Individual
	F4	Uptake gas temp. - high	x			
Power	G1	Control system power supply – fails	x		x	

Display = display of the analog or digital signal for the monitored parameter. The display of the signal is to provide indication of the monitored parameter in engineering units (such as degrees, PSI, RPM, etc.) or status indication. The engineering unit is to effectively display the relevant information concerning the monitored parameter. An alternative engineering unit which provides equivalent effectiveness, may be considered.

Item		Alarm (1)	Display	Remarks
Feedwater	Salinity, outlet, high	×	Salinity	
Boiler drum	Level, water, high	×		
	Level, water, low	×	Level	Automatic closing of fuel valve(s)
Air supply	Supply air pressure, low	×		Automatic closing of fuel valve(s)
	Fire in boiler casing	×		
Fuel oil	Pressure, pump outlet, low	×	Pressure	
	Temperature or viscosity, heavy oil, high	×	Temperature, or Viscosity	Not required for distillate fuels
	Temperature or viscosity, heavy oil, low	×		
	Burner valve, open/close		Position	Individual
Ignition	Ignition or flame, failure	×	Ignited	Individual (2), (3)
	Flame scanner, failure	×		Individual (2), (3)
Uptake gas	Temperature, high	×		For fire detection
Steam	Pressure, high	×	Pressure	
	Pressure, low	×		
	Temperature, superheated outlet, high	×	Temperature	
Power	Control system power supply,failure	×		Automatic closing of fuel valve(s)

Notes:

(1) Required alarm is denoted by a (×).

(2) This condition is to automatically close the individual burner valve.

(3) On flame failure of all burners fitted with an automatic ignition system, the initial burner is to be brought back into automatic service only in the low – firing position.

Table VIII 4-10 has been added as follows:

Table VIII 4-10
Monitoring for Auxiliary Turbines and Diesel Engines
(Applicable to CAS, CAU, and CAB Ships.)

System	Monitored/Controlled Parameter			A	D	Auto Shut down	Notes: [A = Alarm; D = Display; x = applies]
Diesel Engine Steam Turbine	Lubricating oil	A1	Bearing oil inlet pressure - low	x	x	x	
		A2	Bearing inlet oil temperature - high	x	x		
		A3	Oil mist in crankcase, mist concentration – high; or engine main and crank bearing temperature – high; or alternative arrangements (engine main and crank bearing oil outlet temperature – high)	x		x	For engines having a power of 2250 kW (3000 hp) and above or having a cylinder bore more than 300 mm. Single sensor (for each engine) having two independent outputs for initiating alarm and for shutdown will satisfy independence of alarm and shutdown.
		A4	Common rail servo oil pressure - low	x			
	Cooling medium	A5	Pressure or flow - low	x	x		
		A6	Temperature at outlet - high	x	x		
		A7	Expansion tank level - low	x			
	Fuel oil	A8	Fuel oil leakage from injection pipe	x			
		A9	Fuel oil temp. – high and low (or viscosity – low and high)	x			For heavy fuel oil only
		A10	Service tank level - low	x			
		A11	Common rail fuel oil pressure - low	x			
	Starting medium	A12	Energy level - low	x	x		
	Exhaust	A13	Exhaust gas temperature after each cylinder - high	x			For engines having a power of more than 500 kW/cylinder.
	Speed	A14	Overspeed	x		x	
	Turbocharger	A15	High speed	x			Alarm Activation for High Speed only required for turbochargers of categories B and C
	Lub oil	B1	Bearing oil inlet pressure - low	x	x	x	
		B2	Bearing oil inlet temperature - high	x	x		
		B3	Bearing temperature or bearing oil outlet temperature - high	x	x		
	Lubricating Oil cooling medium	B4	Pressure or flow - low	x	x		
		B5	Temperature at outlet - high	x			
		B6	Expansion tank level -	x			

			low				
	Sea water	B7	Pressure or flow - low	x	x		
	Steam	B8	Pressure at inlet - low	x	x		
	Condensate	B9	Condenser vacuum - low	x	x	x	
		B10	Condensate pump pressure - low	x	x		
	Rotor	B11	Axial displacement - large	x		x	
		B12	Overspeed	x		x	
Gas Turbine	Lubricating oil	C1	Inlet pressure inlet -low	x	x	x	
		C2	Inlet temperature - high	x	x		
		C3	Bearing temp. or oil outlet temp. - high	x	x		
		C4	Filter differential pressure	x			
	Cooling medium	C5	Pressure or flow - low	x	x		
		C6	Temperature - high	x			
	Fuel oil	C7	Pressure, inlet - low	x	x		
		C8	Temp. - high and low (or viscosity - low and high)	x			For heavy fuel oil only
	Exhaust gas	C9	Temperature - high	x			
	Combustion	C10	Combustion or flame failure	x		x	
	Starting	C11	Ignition failure	x		x	
		C12	Stored starting energy level - low	x			
	Turbine	C13	Vibration level - high	x		x	
		C14	Axial displacement - high	x		x	Auto shutdown may be omitted for rotors fitted with roller bearings
		C15	Overspeed	x		x	
		C16	Vacuum at compressor inlet - high	x		x	

Display = display of the analog or digital signal for the monitored parameter. The display of the signal is to provide indication of the monitored parameter in engineering units (such as degrees, PSI, RPM, etc.) or status indication. The engineering unit is to effectively display the relevant information concerning the monitored parameter. An alternative engineering unit which provides equivalent effectiveness, may be considered.

Chapter 5 Unattended Machinery Spaces – CAU Symbol

Section 5.3 has been amended as follows:

5.3 Station in Navigating Bridge

In addition to the controls, displays and alarms as required in ~~3.12~~ 2.7.2and 4.2, the station in the navigating bridge is to include the following: (see Table VIII ~~3-1~~2-1).

5.3.1 A fire control panel, or a fire indicating unit if the fire control panel is fitted in fire control station. See 4.14.3 and 5.12.3.

5.3.2 The means to detect and alarm excessive rise of water in the propulsion-machinery space bilges. The means to indicate when the influx of liquid is greater than the pump capacity or when the pump is operating more frequently than would normally by expected, are to be included.

5.3.3 A summary-alarm for the propulsion and its associated machinery (including oil fired boilers associated with propulsion). Any of the alarm conditions as listed in Tables VIII 4-3 through VIII 4-~~9~~10 is to activate the summary-alarm. Acknowledging of these alarms from the station in the navigating bridge is not to silence of the engineer's alarm required in 5.11.

5.3.4 For controllable-pitch propellers, the means to start/stop and display operational status of the associated hydraulic pumps.

5.3.5 For steam turbine driven ships, the following alarms and displays are to be provided:

(a) A reduction of steam pressure below a safe minimum level.

(b) An alarm to indicate that the propeller shaft has been stopped too long on a standby or stop maneuver.

Section 5.5 has been amended as follows:

5.5 Continuity of Power

5.5.1 Provision is to be made for automatic starting and connecting to the main switchboard of a standby generator of sufficient capacity to permit propulsion and steering and to ensure the safety of the ship with automatic restarting of the essential auxiliaries including, where necessary, sequential operations. This standby electric power is to be available in no more than 45 seconds. ~~The requirements in 7.9.2 through 7.9.5 are also to be complied with.~~ The following requirments are also to be complied with:

(a) Connection/Disconnection of Generators to/from Switchboard

(i) Simultaneous connection

Means are to be provided to prevent simultaneous connection of generators to a common switchboard bus.

(ii) Closing of circuit breaker

Closing of the generator circuit breakers can only be effected upon satisfactory synchronization/paralleling conditions. Automatic closure of the circuit breaker for the standby generator is to be limited to one attempt to minimize damage in the event the original power failure was caused by a short-circuit.

(iii) Automatic connection

After a blackout due to short-circuit conditions, the automatic connection of a generator to a reenergized switchboard is to be limited to no more than one attempt. Similarly, adequate arrangements are to be provided to prevent automatic starting and connection of the standby generator upon transient main bus voltage or frequency fluctuations, i.e., caused by short load peaks, high motor starting currents.

(iv) Disconnection of Running Generator

Where the standby generator has been started as a result of a prolonged main bus bar voltage or frequency fluctuation, the running generator is to be stopped and disconnected from the switchboard prior to connection of the standby generator.

(b) Load-shedding Arrangements

(i) In order to safeguarded electrical power supply for essential services, adequate load-shedding arrangements to disconnect non-essential services are to be provided in the following cases.

(1) Where the possibility exists that due to the automatic switching on of additional loads, whether manually or automatically initiated, the total load exceeds the rated generator capacity.

(2) When generators are operated in parallel to supply the load and when in case of failure of one of the running generators, the total load exceeds the combined capacity of the remaining generator(s).

(ii) When designing the protection system to trip the non-essential services in case of generator overload, due account is to be taken of loads with power factors deviating from rated values, the decreased efficiency of engines, etc.

(c) Automatic Starting of Loads

Where automatic means for the starting of loads are provided, an adequate automatic sequence starting system is to be provided to prevent overloading of the generating plant at the moment and during the procedure of power restoration after the occurrence of a blackout. The sequence starting system is to ensure the shortest possible starting delay for those loads which are most essential for the ship or its propulsion machinery.

5.5.2 To satisfy 5.5.1 the operation of propulsion machinery and essential services may be at reduced power.

Paragraph 5.11.1 has been amended as follows:

5.11.1 At least one alarm monitoring station is to be provided in the engineer's public spaces. Each such station is to be provided with alarms for fire, high bilge-water level in the propulsion-machinery space, and summary-alarms for the propulsion and its associated machinery (including propulsion oil fired boilers). Any of the alarm conditions as listed in Tables VIII 4-3 through VIII 4-~~9~~10, as applicable, are to activate the specific machinery summary-alarm. Additionally, alarm monitoring stations through a selector switch are to be provided in each individual engineer's stateroom and arranged so that at least one alarm monitoring station is active at all times. Selective switching is not to be provided for the fire alarms. The fire alarm is to be separate and distinct from the alarms of any other systems. Fire, high bilge-water level and the specific machinery summary-alarms are to be audible in the engineer's public spaces and staterooms until manually silenced at the centralized control and monitoring station in the propulsion-machinery space (centralized monitoring station for **CAB** ships). See 5.3.3 and 5.4 of this Part.

Section 5.13 has been amended as follows:

5.13 Communications

The communication system required by ~~2.9~~ 2.8.8is to include the engineer's accommodations area.

Chapter 6 Machinery Operated from Navigating Bridge – CAB Symbol

Sections 6.2~6.3 have been amended as follows:

6.2 Station in Navigating Bridge

Controls, alarms and displays as listed in 5.3 are to be provided on the station in the navigating bridge. See Table VIII ~~3-1~~2-1. Additionally, for ships having non-integrated propulsion machinery, the means for starting, stopping and transferring essential auxiliary pumps (see 4.6) are to be fitted at the station in the navigating bridge and may also be fitted in the centralized monitoring station.

6.3 Centralized Monitoring Station

6.3.1 The requirements in 5.4 are applicable except that the centralized station need not be provided with propulsion controls but is to include displays and alarms needed for the monitoring of the propulsion machinery and associated ship' service systems including the electrical power generating machinery, fired boilers associated with propulsion and electrical power generating machinery, and monitoring of propulsion-machinery space. The monitoring system is to provide the same degree of equivalency as if the propulsion-machinery space was manned. See Tables VIII 4-2 through VIII 4-~~9~~10 for required safety provisions, alarms and displays to be fitted at this station.

6.3.2 Additionally, the power supply transfer devices for the control and monitoring system, and safety systems disconnect devices are to be fitted at this station.

Chapter 7 Automatic or Remote Control Systems for Other Machinery/Systems

Sections 7.1~7.9 have been deleted as follows:

~~7.1 Auxiliary Oil Fired Boilers~~

~~The requirements contained in this section are applicable to auxiliary oil fired boilers associated with propulsion systems intended for automatic operation or operation from a remote control station. Except as noted herein, the requirements in 4.4 of Part V, and Chapter 1 and 2 of this Part, as applicable, are to be complied with.~~

~~7.1.1 Remote Override of Safety Provisions~~

~~Except when in local control, remote override of safety provisions is not permitted for the automatic closing of oil fired boilers' fuel valve(s) upon the conditions as specified in 4.4 of Part V.~~

~~7.1.2 Controls and Instrumentation on Remote Control Station~~

~~The associated remote control station is to be provided with the controls, safety provisions, alarms and displays as listed in Table VIII 4-9.~~

~~7.2 Incinerators~~

~~The requirements contained in this section are applicable to incinerators intended for automatic operation or operation from a remote control station. Except as noted herein, the requirements in 7.4 of Part V, and chapter 1 and 2 of this Part, as applicable, are to be complied with~~.

~~7.2.1 Remote Override of Safety Provisions~~

~~Except when in local control, remote override of safety provisions is not permitted for the automatic closing of incinerators' fuel valve(s) upon the conditions as specified in 7.4 of Part V, as applicable.~~

~~7.2.2 Automatic Controls~~

~~Incinerators fitted with automatic controls are to comply with the combustion control safety requirements in 5.8.4, as applicable.~~

~~7.2.3 Controls and Instrumentation on Remote Control Station~~

~~The associated remote control station is to be provided with the controls, safety provisions, alarms and displays as listed in Table VIII 7-1.~~

~~7.3 Inert Gas Generators~~

~~The requirements contained in this section are applicable to inert gas generators intended for automatic operation or operation from a remote control station. These requirements are in addition to those covered in 5.8.2(a) of Part VI. Except as noted herein, the requirements in Chapter 1, and 2 of this Part, as applicable, are to be complied with.~~

~~7.3.1 Remote Override of Safety Provisions~~

~~Except when in local control, remote override of safety provisions is not permitted for the automatic closing of fuel valve(s) upon the conditions as specified in 4.4 of Part V, as applicable.~~

~~7.3.2 Automatic Controls~~

~~Inert gas generators fitted with automatic controls are to comply with the combustion control safety requirements in 5.8.4.~~

~~7.3.3 Controls and Instrumentation on Remote Control Station~~

~~The associated remote control station is to be provided with the controls, safety action, alarms and displays as listed in Table VIII 7.2.~~

~~7.4 Auxiliary Gas or Steam Turbines~~

~~The requirements contained in this section are applicable to auxiliary gas or steam turbines intended for automatic operation or operation from a remote control station. Except as noted herein, the requirements in Chapter 1 and 2 of this Part, as applicable, are to be complied with.~~

~~7.4.1 Remote Override of Safety Provisions~~

~~With the exception of turbines intended for emergency services, remote override of safety provisions is not permitted for loss of lubricating oil condition or overspeed condition. See 2.7.1 and 2.7.2 of Part IV.~~

~~7.4.2 Controls and Instrumentation on Remote Control Station~~

~~The associated remote control station is to be provided with the controls, safety provisions, alarms and displays as listed in Table VIII 4.7.~~

~~7.5 Auxiliary Diesel Engines~~

~~The requirements contained in this section are applicable to auxiliary diesel engines intended for automatic operation or operation from a remote control station. Except as noted herein, the requirements in Chapter 1 and 2 of this Part, as applicable, are to be complied with.~~

~~7.5.1 Remote Override of Safety Provisions~~

~~With the exception of diesel engines intended for emergency services, remote override of safety provisions is not permitted for overspeed condition. See 3.4.8 and 3.8.2 of Part IV.~~

~~7.5.2 Controls and Instrumentation on Remote Control Station~~

~~The associated remote control station is to be provided with the controls, safety provisions, alarms and displays as listed in Table VIII 4.7.~~

~~7.6 Bilge and Ballast Machinery/Systems~~

~~The requirements contained in this section are applicable to bilge and ballast machinery/systems intended for automatic operation or operation from a remote control station. Except as noted herein, the requirements in chapter 1 and 2 of this part, as applicable, are to be complied with.~~

~~7.6.1 Bilges~~

~~In reference to 4.14.1 of this Part only one bilge water level system to detect excessive water influx or rise needs to be provided in manned propulsion machinery space, unless otherwise required in other parts of the Rules.~~

~~7.6.2 Local Control of Power Operated and Remote Controlled Valves~~

~~Power operated and remote controlled valves are to be capable of being operated locally. An individual hand operated mechanism is to be provided locally and readily available for operation, i.e., hand pump, cranking tool, etc.~~

~~7.7 Hazardous Liquid Cargo Handling Machinery/Systems~~

~~The requirements contained in this section are applicable to automatic or remote control systems associated with hazardous liquid cargo handling machinery/systems installed in ships carrying crude oil, liquefied gases and chemical cargo in bulk. These requirements are in addition to those covered in 12.1 to 12.9 of Part VII and Chapter 4 and 5 of Part III. Except as noted herein, the requirements in Chapter 1 and 2 of this part, as applicable, are to be complied with. For the purpose of this section, the controls and instrumentation in 7.7.3 is only limited to that associated with cargo transfer operations.~~

~~7.7.1 Safety Provisions~~

~~The cargo pump or compressor prime-movers are to automatically shutdown upon any of the following conditions:~~

~~(a) Activation of the safety provisions per Table VIII 7-3.~~

~~(b) Activation of required emergency shutdown valves.~~

~~(c) Where the level in the liquefied gas or chemical cargo tank falls below the level of the pump motor.~~

~~7.7.2 Emergency Shutdown~~

~~The cargo transfer remote control station is to be fitted with the emergency means to stop the cargo pump or compressor prime-movers, and ship/shore cargo transfer valve and where required, emergency shutdown valves.~~

~~7.7.3 Controls and Instrumentation on Cargo Transfer Remote Control Station~~

~~For the purpose of liquid cargo transferring, the associated remote control station is to be provided with the controls, safety provisions, alarms and displays as listed in Table VIII 7-3 as a minimum. As needed, other instrumentation necessary to maintain the cargo tanks within safe atmospheres and pressures/temperatures, during cargo transferring operations, are to be considered for inclusion on this station.~~

~~7.8 Cargo Refrigeration Machinery~~

~~The requirements contained in this section are applicable to automatic or remote control systems associated with cargo refrigeration machinery/systems installed in ships classed with RMS symbol or ships carrying liquefied gases and chemical cargo in bulk. These requirements are in addition to those covered in Part X and Chapter 4 and 5 of Part III. Except as noted herein, the requirements in Chapter 1 and 2 of this Part, as applicable, are to be complied with. For the purpose of this section, the instrumentation in 7.8.2 is only limited to that associated with cargo refrigeration machinery and excludes monitoring of refrigeration machinery spaces and cargo holds or tanks, monitoring of gas leakage, etc.~~

~~7.8.1 Safety Provisions~~

~~Activation of any of the following safety provisions is to automatically shutdown the compressor prime- movers:~~

~~(a) The safety provisions per Table VIII 7-4.~~

~~(b) Compressor suction pressure, low.~~

~~(c) Compressor discharge pressure, high.~~

~~(d) Low superheat temperature in the compressor suction line or low compressor discharge temperature.~~

~~7.8.2 Controls and Instrumentation on Remote Control Station~~

~~The associated remote control station is to be provided with the controls, safety provisions, alarms and displays as listed in Table VIII 7-4.~~

~~7.9 Main Electrical Power Generating Plant~~

~~These requirements are applicable to main electrical generating plants intended for automatic operation or operation from a remote control station. Except as noted herein, the requirements in Chapter 1 and 2 of this Part, as applicable, are to be complied with.~~

~~7.9.1 Connection/Disconnection of Generators to/from Switchboard~~

~~(a) Simultaneous connection~~

~~Means are to be provided to prevent simultaneous connection of generators to a common switchboard bus.~~

~~(b) Closing of circuit breaker~~

~~Closing of the generator circuit breakers can only be effected upon satisfactory synchronization/paralleling conditions. Automatic closure of the circuit breaker for the standby generator is to be limited to one attempt to minimize damage in the event the original power failure was caused by a short-circuit.~~

~~(c) Automatic connection~~

~~After a blackout due to short-circuit conditions, the automatic connection of a generator to a reenergized switchboard is to be limited to no more than one attempt. Similarly, adequate arrangements are to be provided to prevent automatic starting and connection of the standby generator upon transient main bus voltage or frequency fluctuations, i.e., caused by short load peaks, high motor starting currents.~~

~~(d) Disconnection of Running Generator~~

~~Where the standby generator has been started as a result of a prolonged main bus bar voltage or frequency fluctuation, the running generator is to be stopped and disconnected from the switchboard prior to connection of the standby generator.~~

~~7.9.2 Load-shedding Arrangements~~

~~(a) In order to safeguarded electrical power supply for essential services, adequate load-shedding arrangements to disconnect non-essential services are to be provided in the following cases.~~

~~(i) Where the possibility exists that due to the automatic switching on of additional loads, whether manually or automatically initiated, the total load exceeds the rated generator capacity.~~

~~(ii) When generators are operated in parallel to supply the load and when in case of failure of one of the running generators, the total load exceeds the combined capacity of the remaining generator(s).~~

~~(b) When designing the protection system to trip the non-essential services in case of generator overload, due account is to be taken of loads with power factors deviating from rated values, the decreased efficiency of engines, etc.~~

~~7.9.3 Automatic Starting of Loads~~

~~Where automatic means for the starting of loads are provided, an adequate automatic sequence starting system is to be provided to prevent overloading of the generating plant at the moment and during the procedure of power restoration after the occurrence of a blackout. The sequence starting system is to ensure the shortest possible starting delay for those loads which are most essential for the ship or its propulsion machinery.~~

~~7.9.4 Remote Override of Safety Provisions~~

~~In addition to the safety actions as outlined in this section, remote override of safety provisions is not permitted for the following:~~

~~(a) Shutdown of main generator prime-movers upon failure or loss of the oil lubricating system. See 2.7.2 and 3.8.2 of Part IV.~~

~~(b) Shutdown of main generator prime-movers upon activation of overspeed mechanism. See 2.7.1 and 3.4.8 of Part IV.~~

~~(c) Except when in local control, closing of fired boiler's fuel valve(s) associated with the main electrical power generating plant upon the conditions as specified in 4.4 of Part V.~~

~~7.9.5 Controls and Instrumentation on Remote Control Station~~

~~The associated remote control station is to be provided with the controls, safety provisions, alarms and displays as listed in Table VIII 7.5. This includes the instrumentation as required in 5.7 of Part VII including the controls for the connection/disconnection of generator circuit breakers.~~

Section 7.10 has been renumbered and amended as follows:

7.1~~0~~ Centralized System for Cargo and Ballast Water Handling

7.1~~0~~.1 The additional class notation **CCB** is assigned to ships carrying liquid cargo in bulk fitted with a centralized system for handling liquid cargo and ballast and complying with the requirements of this section.

7.1~~0~~.2 The documents listed in Table VIII 7-~~6~~1 are to be submitted to the Society for approval. The Society reserves the right to require additional plans or information in relation to the specific characteristics of the installations.

7.1~~0~~.3 Design and construction requirements

(a) The control station is to be located such as to allow visibility of the cargo tank deck area, and in particular of the cargo loading and unloading ramps.

(b) The station is preferably to be situated in the accommodation area; should this be impracticable, the control station is to be bounded by A-60 class fire-resisting bulkheads and provided with two escapes.

(c) It is be possible from the control station to convey orders to crew members on deck and to communicate with the navigating bridge, with cargo handling spaces, with the engine room and with the propulsion control room.

(d) Where the control station is located in the cargo area, two complete sets of protective clothing are always to be readily available together with three breathing apparatuses.

(e) It is to be possible to carry out the following operations from the control station:

(i) opening and closing of valves normally required to be operated for loading, unloading and transfer of cargo and ballast (however, the opening and closing of valves is not required for the ends of cargo loading and unloading arrangements)

(ii) starting and stopping of cargo pumps, stripping pumps and ballast pumps (alternative solutions may be considered in the case of pumps powered by turbines)

(iii) regulation, if foreseen, of the number of revolutions of cargo pumps, stripping pumps and ballast pumps.

(f) The control station is to be fitted with indicators showing:

(i) (open/closed) position of valves operated by remote control

(ii) state (off/on) of cargo pumps, stripping pumps and ballast pumps

(iii) number of revolutions of cargo pumps, stripping pumps and ballast pumps where they may be operated at adjustable speeds

(iv) delivery pressure of the hydraulic plant for the operation of cargo pumps, stripping pumps and ballast pumps

(v) delivery and suction pressure of cargo pumps, stripping pumps and ballast pumps

(vi) pressure of the ends of cargo loading and unloading arrangements

(vii) oxygen level, temperature and pressure of the inert gas, where the operation of the inert gas system is required or envisaged at the same time as loading/unloading

(viii) level in cargo and ballast tanks (relaxation of this requirement may be permitted for double bottom ballast tanks of reduced capacity and limited depth)

(ix) temperature in cargo tanks provided with heating or refrigeration.

(g) The cargo control station is to be fitted with visual and audible alarms signaling the following:

(i) high level, and where requested very high level, in cargo tanks

(ii) high pressure in cargo tanks, if required by the Rules

(iii) low delivery pressure of the hydraulic plant for the operation of pumps and valves

(iv) high vacuum in cargo tanks, if required by the Rules

(v) high pressure in the cargo and ballast lines

(vi) high and low temperature for cargo tanks fitted with heating and refrigerating systems

(vii) high oxygen level, high temperature, and high and low pressure of inert gas, if foreseen

(viii) high level in a bilge well in cargo and ballast pump rooms

(ix) high concentration of explosive vapours (exceeding 30% of the lower flammable limit) in spaces where cargo is handled

(x) high temperature of gas-tight seals with oil glands for runs of shafts, where these are foreseen through bulkheads or decks, for the operation of cargo and ballast pumps.

7.1~~0~~.4 Inspection and testing

(a) Equipment and systems are to be inspected and tested in accordance with the applicable requirements of the Rules relative to each piece of equipment of the system used for the centralized control.

(b) Following installation on board, remote control, indication and alarm systems are to be subjected to operational tests in the presence of the Surveyor.

Section 7.2 has been added as follows:

7.2 Valve Remote Control System

7.2.1 The valve remote control system is to comply with the following requirement in addition to the requirement of chapter 1 through chapter 3, as applicable.

(a) Valves are to be controlled from the remote-control station and operated properly.

(b) Means of indication of valve fully open/closed or valve status are to be provided at the remote control station. Generally, a red light indicates a valve is fully closed and a green light indicates a valve is fully open. The remote valve position indication is obtained from the closing signal transmitted by the pressure switch of the hydraulic piping as well as the valve position signal received from the volume indicator and flow meter.

(c) The valve remote control system is to be designed on the fail-safe principle. When an alarm is activated due to system failures, unless practically impossible, the valve is to continue to operate at the last ordered position under this kind of circumstance. The power failure (electrical, pneumatic and hydraulic), especially, shall not result in the change of valve position. Valves which are only allowed to be opened during operation are to return to their closing position while the failures mentioned above occur.

(d) The valve remote control system is to be completely independent of other safety system and alarm systems. When the valve remote control system malfunctions, other system shall continue to operate normally.

(e) The valve remote control system is to be designed so that any failure occurred during operation will not result in other failures and minimize the risk of hazards as far as possible.

(f) Means of failure detection and alarm are to be provided. (Power failures, pneumatic failures, hydraulic failures, liquid level, low pressure, and etc.)

(i) All alarms are to be both audible and visual. Red lights are generally adopted to indicate severe alarms while yellow lights are adopted for general failures. Audible alarms are to be of sufficient loudness.

(ii) Alarms of the valve remote control system are to be activated for all failures occurred simultaneously. Acknowledging of one particular alarm is not to interrupt acknowledging of other alarms.

(iii) Means of silencing audible alarms are to be provided and the alarm signal is to be silenced upon acknowledgement of the alarm (such as pressing the silencing button of this system). Silencing alarms is not to disable the visual signal, but altering the pattern of the signal (such as from steady light to flashing light) is allowed. Such visual signal is to be distinguishable. Meanwhile, the visual signal shall remain activated until the failure condition is rectified. The alarm channel is to recover to its normal working condition after the failure is rectified.

(iv) The indication and alarm of the valve remote control system are to be provided with self-diagnosis function and is capable of testing their own failure to avoid false alarm or alarm failure such as test buttons with lamps.

(v) Valve limiting switches are to be provided for electric or electric hydraulic valve remote control system. The actuators are to be stopped automatically when the valve switches triggers.

(vi) Under the emergency condition, the valve remote control system is to be provided with valve position indication devices which normally adopt mechanical types.

(vii) The valve remote control system operated in the hazardous area is to be of explosion proof type in accordance with CR Rules Part VII 1.10 for oil tanker, product oil tanker, chemical tanker and offshore platforms.

(viii) The valve remote control system is to be capable of opening/closing valves by using local hydraulic hand pump or other manual devices. All actuators are to be installed at locations which are easily accessible and comply with requirement specified in 4.5 of Part VI of this Rule.

(ix) For hydraulic or electric hydraulic system, the alarm is to be activated when the pressure of operating pump or the system is lower than 20% of the normal working pressure.

(x) The system is to be automatically supplied by a standby source of electrical power in the event of failure of main source of electrical power.

(xi) Computer-based system, PLC and software are to comply with the requirement as specified in Part VIII of CR Rules, as applicable.

(g) The hydraulic system is to comply with the requirement specified in 2.10 and 2.11 of this Part, as applicable, in addition to 4.5 of Part VI of this Rule.

(h) The pneumatic system is to comply with the requirement specified in 2.10 and 2.11 of this Part, as applicable.

7.2.2 Inspection and testing

(a) Equipment and systems are to be inspected and tested as follows:

(i) Visual inspection

Refer to item 1 of Table VIII 4-1.

(ii) High voltage test

Refer to item 8 of Table VIII 2-2.

(iii) Insulation resistance test

Refer to item 7 of Table VIII 2-2.

(iv) Functions tests , including but not limited to the following, shall be carried out to verify the function of the system complies with the requirement of approved documents.

(1) Remote open/close test (including indication of valve position)

(2) Emergency (local control) open/close test

(3) Power failure protection test (verifying if the valve position remains at original or preset open/closed position due to electrical, pneumatic, or hydraulic power failure)

(4) Alarm test (electric source, power source pressure, temperature, oil filter blockage, etc.)

(v) The piping system shall be tested in accordance with chapter 7 of Part VI of this Rule

Tables VIII 7-1~7-5 have been deleted as follows:

Table VIII 7-1
Remote Control Station for Incinerators

Item		Alarm (1)	Display	Provisions of device on station (1)	Remarks
Control and monitoring system	Remote controls			×	Necessary for remote operation (4)
	Control station in operation		Station		If required. See 2.2.3
	Alarm, disabled (override)		Disabled		If provided (3)
	Safety, activation	×			If provided (2)
	Safety disabled	×	Disabled		If provided (3)
	Safety disable (override) switch			×	If provided. See 2.5.6
Air supply	Supply air pressure, low	×			Automatic closing of fuel valve(s)
Fuel oil	Pressure, pump outlet, low	×	Pressure		
	Temperature or viscosity, heavy oil, high	×	Temperature, or		Not required for distillate fuels
	Temperature or viscosity, heavy oil, low	×	Viscosity		
	Burner valve, open/close		Position		Individual
Ignition	Ignition or flame, failure	×	Ignited		Individual (5), (6)
Furnace	Temperature, high	×			Automatic closing of fuel valve(s)
Exhaust	Temperature, high	×			

Notes:

(1) Required actuation device or alarm is denoted by a (×).

(2) Override of the automatic safety actions as described in this Table is not permitted. See 2.5.6 and 7.2.1.

(3) Deactivation means are to be arranged so that such action cannot be done inadvertently. Alternative means to indicate disabling of safety actions or alarms will be considered.

(4) Automatic closing of fuel valve(s) upon loss of control power.

(5) This condition is to automatically close the individual burner valve.

(6) On flame failure of all burners fitted with an automatic ignition system, the initial burner is to be brought back into automatic service only in the low-firing position.

~~Table VIII 7.2~~
~~Remote Control Station for Inert Gas Generators~~

~~Item~~		~~Alarm~~ ~~(1)~~	~~Display~~	~~Provisions of device on station~~ ~~(1)~~	~~Remarks~~
~~Control and monitoring system~~	~~Remote controls~~			~~x~~	~~Necessary for remote operation~~ ~~(4)~~
	~~Control station in operation~~		~~Station~~		~~If required. See 2.2.3~~
	~~Alarm, disabled (override)~~		~~Disabled~~		~~If provided~~ ~~(3)~~
	~~Safety, activation~~	~~x~~			~~If provided~~ ~~(2)~~
	~~Safety disabled~~	~~x~~	~~Disabled~~		~~If provided~~ ~~(3)~~
	~~Safety disable (override) switch~~			~~x~~	~~If provided. See 2.5.6~~
~~Air supply~~	~~Supply air pressure, low~~	~~x~~			~~Automatic closing of fuel valve(s)~~
~~Fuel oil~~	~~Pressure, pump outlet, low~~	~~x~~	~~Pressure~~		
	~~Temperature or viscosity, heavy oil, high~~	~~x~~	~~Temperature, or~~		~~Not required for distillate fuels~~
	~~Temperature or viscosity, heavy oil, low~~	~~x~~	~~Viscosity~~		
	~~Burner valve, open/close~~		~~Position~~		~~Individual~~
~~Ignition~~	~~Ignition or flame, failure~~	~~x~~	~~Ignited~~		~~Individual~~ ~~(5), (6)~~
~~Combustion chamber~~	~~Excessive smoke~~	~~x~~	~~Smoke~~		~~For fire detection~~
~~Inert gas~~	~~Pressure, low~~	~~x~~			
	~~Outlet temperature, high~~	~~x~~			~~Automatic closing of fuel valve(s)~~
	~~Oxygen content, high, percentage~~	~~x~~			

~~Notes:~~

~~(1) Required actuation device or alarm is denoted by a (x).~~

~~(2) Override of the automatic safety actions as described in this Table is not permitted. See 2.5.6 and 7.3.1.~~

~~(3) Deactivation means are to be arranged so that such action cannot be done inadvertently. Alternative means to indicate disabling of safety actions or alarms will be considered.~~

~~(4) Automatic closing of fuel valve(s) upon loss of control power.~~

~~(5) This condition is to automatically close the individual burner valve.~~

~~(6) On flame failure of all burners fitted with an automatic ignition system, the initial burner is to be brought back into automatic service only in the low – firing position.~~

~~Table VIII 7-3~~
~~Remote Control Station for Hazardous Liquid Cargo Transfer~~

~~Item~~		~~Alarm (1)~~	~~Display~~	~~Provisions of device on station (1)~~	~~Remarks~~
~~Control and monitoring system~~	~~Remote controls~~			~~×~~	~~Necessary for remote operation (4)~~
	~~Control station in operation~~		~~Station~~		~~If required. See 2.2.3~~
	~~Alarm, disabled (override)~~		~~Disabled~~		~~If provided (3)~~
	~~Safety, activation~~	~~×~~			~~If provided (2)~~
	~~Safety disabled~~	~~×~~	~~Disabled~~		~~If provided (3)~~
	~~Safety disable (override) switch~~			~~×~~	~~If provided. See 2.5.6~~
~~Liquid cargoes~~	~~Tank level, high~~	~~×~~			
	~~Tank level indication~~		~~Level~~		~~For each tank~~
	~~Tank valve position~~		~~Open/Close~~		~~For each valve~~
	~~Ship/shore transfer valve position~~		~~Open/Close~~		
	~~Pump motor running~~		~~Running~~		
	~~Pump discharge pressure~~		~~Pressure~~		
	~~Pump bearing temperature, high~~	~~×~~			~~(5)~~
	~~Pump casing temperature, high~~	~~×~~			~~(5)~~
	~~Pump room bulkhead gland temperature, high~~	~~×~~			~~(5)~~
	~~Hydraulic power control tank level, low~~	~~×~~			~~For hydraulic power operated valves~~
	~~Hydraulic power control pressure, low~~	~~×~~			~~For hydraulic power operated valves~~
	~~Hydrulic power control pump motor~~		~~Running~~		~~For hydraulic power operated valves~~
~~Emergency closing/ shutdown~~	~~Pumps and valves, switches~~			~~×~~	~~See 7.7.2~~

~~Notes:~~

~~(1) Required actuation device or alarm is denoted by a (x).~~

~~(2) Override of the automatic safety actions as described in this Table is not permitted. See 2.5.6 and 7.7.1.~~

~~(3) Deactivation means are to be arranged so that such action cannot be done inadvertently. Alternative means to indicate disabling of safety actions or alarms will be considered.~~

~~(4) This includes, but is not limited to, pumps and valves.~~

~~(5) Includes those pumps which may be installed in hazardous spaces, i.e., cargo pump rooms in crude oil cargo tankers.~~

~~Table VIII 7-4~~
~~Remote Control Station for Cargo Refrigeration Machinery~~

~~Item~~		~~Alarm (1)~~	~~Display~~	~~Provisions of device on station (1)~~	~~Remarks~~
~~Control and monitoring system~~	~~Remote controls~~			~~x~~	~~Necessary for remote operation (4)~~
	~~Control station in operation~~		~~Station~~		~~If required. See 2.2.3~~
	~~Alarm, disabled (override)~~		~~Disabled~~		~~If provided (3)~~
	~~Safety, activation~~	~~x~~			~~If provided (2)~~
	~~Safety disabled~~	~~x~~	~~Disabled~~		~~If provided (3)~~
	~~Safety disable (override) switch~~			~~x~~	~~If provided. See 2.5.6~~
~~Compressor/ refrigerant~~	~~Compressor running~~		~~Running~~		
	~~Suction pressure, low~~	~~x~~	~~Pressure~~		~~Automatic compressor shutdown~~
	~~Discharge pressure, high~~	~~x~~			~~Automatic compressor shutdown~~
	~~Suction superheated temperature, low~~	~~x~~	~~Temperature~~		~~Automatic compressor shutodwn (5)~~
	~~Discharge temperature, low~~	~~x~~			~~Automatic compressor shutdown (5)~~
	~~Discharge temperature, high~~	~~x~~			~~Automatic compressor shutdown~~
	~~Refrigerant receiver level, high~~	~~x~~			
~~Cooling~~	~~Cooling water pump running~~		~~Running~~		
	~~Cooling water temp. outlet condenser, high~~	~~x~~			

~~Notes:~~

~~(1) Required actuation device or alarm is denoted by a (x).~~

~~(2) Override of the automatic safety actions as described in this Table is not permitted. See 2.5.6 and 7.8.1.~~

~~(3) Deactivation means are to be arranged so that such action cannot be done inadvertently. Alternative means to indicate disabling of safety actions or alarms will be considered.~~

~~(4) This includes, but is not limited to, compressor and required pump motors.~~

~~(5) Either alarm or safety action is required, not both.~~

~~Table VIII 7-5~~
~~Remote Control Station for Main Electrical Power Generating Plant~~ ~~(1)~~

~~Item~~		~~Alarm~~ ~~(2)~~	~~Display~~	~~Provisions of device on station~~ ~~(2)~~	~~Remarks~~
~~Control and monitoring system~~	~~Remote controls~~			~~x~~	~~Necessary for remote operation~~ ~~(5)~~
	~~Control station in operation~~		~~Station~~		~~If required. See 2.2.3~~
	~~Alarm, disabled (override)~~		~~Disabled~~		~~If provided~~ ~~(4)~~
	~~Safety, activation~~	~~x~~			~~If provided~~ ~~(3)~~
	~~Safety disabled~~	~~x~~	~~Disabled~~		~~If provided~~ ~~(4)~~
	~~Safety disable (override) switch~~			~~x~~	~~If provided. See 2.5.6~~
~~A.C. generators and prime mover~~ ~~(6)~~	~~Synchroscope, lamps~~			~~x~~	~~Including selector switches~~
	~~Prime mover speed control~~			~~x~~	
	~~Wattmeter~~		~~Watts~~	~~x~~	
	~~Voltage regulator~~			~~x~~	
	~~Ground detection~~			~~x~~	
	~~Pilot lamp~~			~~x~~	
	~~Heater pilot lamp~~			~~x~~	
~~D.C. generator~~ ~~(6)~~	~~Ground detection~~			~~x~~	
	~~Pilot lamp~~			~~x~~	
~~Semi-conductor Rectifier (SCR)~~	~~Voltage, SCR~~		~~Voltage~~		
	~~Current, SCR~~		~~Current~~		
	~~Overloading conditions, high current~~	~~x~~			~~Alarms before protective device is activated.~~
	~~Open/close position for assignment switches~~		~~Position~~		
	~~SCR cooling medium temperature, high~~	~~x~~	~~Temperature~~		~~If required.~~
	~~Failure of SCR cooling pump or fan motor~~	~~x~~			~~If required.~~
~~Circuit breakers~~	~~Main circuit breakers position~~		~~Open/Close~~		~~Gen. & bus tie.~~
	~~Other circuit breakers position~~		~~Open/Close~~		~~For loads to be shed.~~

~~Notes:~~

~~(1) The instrumentation per this table is in addition to those required for **CAS, CAU** or **CAB** ships and is intended to apply in instances where centralized control of the main electrical power generating plant is desired. The instrumentation required for **CAS, CAU** or **CAB** ships (see Table VIII 4-7) is also to be included.~~

~~(2) Required actuation device or alarm is denoted by a (x).~~

~~(3) Override of the automatic safety actions as required in this Table is not permitted. See 2.5.6 and 7.9.4.~~

~~(4) Deactivation means are to be arranged so that such action cannot be done inadvertently. Alternative means to indicate disabling of safety actions or alarms will be considered.~~

~~(5) This includes, but is not limited to, the means to start/stop auxiliary pumps, to start generator prime – movers, to parallel generators, close/open required circuit breakers, and to assign SCR units (if provided).~~

~~(6) See 5.7 of Part VII.~~

Table VIII 7-6 has been renumbered as follows:

Table VIII 7-~~6~~1
Documents to be Submitted

No.	A/I (1)	Item
1	I	Schematic drawing of the installation
2	I	Plan of the location and arrangement of the control station
3	A	List of remote control devices
4	A	List of alarms
5	I	List of the equipment (sensors, transducers, etc.) and automation systems (alarm systems, etc.) envisaged with indication of the Manufacturer and of the type of equipment or system
6	A	Line diagram of power supply circuits of control and monitoring systems, including: • circuit table, in the case of electrical power supply • specification of service pressures, diameter and thickness of piping, materials used, etc. in the case of hydraulic or pneumatic power supply

Note:
(1) A = To be submitted for approval;
I = To be submitted for information.

Chapter 8 has been added as follows:

Chapter 8 Integrated Automation System

8.1 Definitions

8.1.1 IAS

An Integrated Automation System (IAS) is a combination of computer-based systems with redundant architecture,which are interconnected in order to allow communication between computer systems; between computer systems and monitoring, control, and ship management systems; and to allow centralized access to information and/or command/control. For example, an integrated system may consist of systems capable of performing passage execution (e.g., steering, speed control, traffic surveillance, voyage planning); machinery management and control (e.g., power management, machinery monitoring, fuel oil/lubrication oil transfer); cargo operations (e.g., cargo monitoring, inert gas generation, loading/ discharging); etc. Functions are integrated to reduce the need for hardware and software functions and to reduce interface requirements.

8.1.2 Module Technology

The IAS comprises different functions modules and the system can be expandable by adding more modules of different functions. The function module includes hardware module and software module. Module technology is based on the identical basic software platform, free flow of information. It reduces spare parts.

8.2 System Requirements

In addition to the relevant requirements in chapter 2 and chapter 3 the following is to be complied with:

8.2.1 Effective operation

Operation with an integrated automation system is to be at least as effective as it would be with individual stand-alone equipment or systems.

8.2.2 Integrated automation system failure

Failure of one part of the integrated automation system (individual module, equipment or subsystem) is to not affect the functionality of other parts, except for those functions directly dependent on the defective part.

8.2.3 Multi-function displays and controls

Where multi-function displays and controls are used, they are to be redundant and interchangeable. The number of units at control stations is to be sufficient to ensure that all functions may be provided with any one unit out of operation, taking into account any functions which are required to be continuously available

8.2.4 Hardware redundancy

Common hardware in an integrated automation system serving many subsystems (e.g., monitor, keyboard, microprocessor, etc.) is to be duplicated or otherwise provided with a means of backup.

8.2.5 Interfaces

Standard interfaces are to be used for the data exchange between the different systems. The network is to be designed in compliance with an international standard such as IEC 61158 or IEC 61784. See also 3.6.1.

8.2.6 Control redundancy

An alternative means of operation, independent of the integration, is to be available for all essential functions.

8.3 FMEA

Where the integration involves control functions for essential services or safety functions, including fire, passenger, crew, and ship safety, an FMEA is to be carried out. The FMEA is to demonstrate that the integrated system will 'fail-safe', and that essential services in operation will not be lost or degraded.

8.4 Documentation

Documentation is to be submitted to demonstrate that the installed integrated automation system has been designed, manufactured and tested in accordance with 1.2 and 8.2. This documentation is to be submitted by a single party responsible for the integration.

AMENDMENT TO "THE RULES FOR THE CONSTRUCTION AND CLASSIFICATION OF STEEL SHIPS 2019 AND AMENDMENTS THEREOF "

PART IX FIRE PROTECTION, DETECTION AND EXTINCTION

List of major changes in Part IX from 2019 edition

1.5.56	Revised
8.1.1(b)(ii)	Revised
14-1.3.1	Revised

Rules for the Construction and Classification of Steel Ships 2019 and amendments thereof have been partly amended as follows:

Chapter 1 General Requirements

Paragraph 1.5.56 has been amended as follows:

1.5.56 Vehicle carrier

Vehicle carrier means a cargo ship ~~with multi-deck Ro-Ro spaces designed for the carriage of empty cars and trucks~~ which only carries cargo in ro-ro spaces or vehicle spaces, and which is designed for the carriage of unoccupied motor vehicles without cargo, as cargo.

Chapter 8 Fire Fighting

Paragraph 8.4.1(b)(ii) has been amended as follows:

8.4.1 Machinery spaces containing oil-fired boilers or oil fuel units

(b) Additional fire-extinguishing arrangements*

* Refer to Unified Interpretation of SOLAS chapter II-2 on the number and arrangement of portable fire extinguishers on board ships (MSC.1/Circ.1275, as may be amended).

(ii) There are to be at least two portable foam extinguishers or equivalent in each firing space in each boiler room and in each space in which a part of the oil fuel installation is situated. There are to be ot less than one approved foam-type extinguisher of at least 135 litters capacity or equivalent in each boiler room. These extinguishers are to be provided with hoses on reels suitable for reaching any part of the boiler room. In the case of domestic boilers of less than 175 kW, or boilers protected by fixed water-based local application fire-extinguishing systems as required by 8.4.6 of this Part, an approved foam-type extinguisher of at least 135 litters capacity is not required.

Chapter 14-1 Ships not Engaged on International Voyages: Passenger Ships

Paragraph 14-1.3.1 has been amended as follows:

14-1.3.1 Ships of Grade I

All the requirements in Chapter 3 except 3.2.3 are to apply. Furniture is not to be provided in corridor and stairways as far as practicable.

AMENDMENT TO "THE RULES FOR THE CONSTRUCTION AND CLASSIFICATION OF STEEL SHIPS 2019 AND AMENDMENTS THEREOF "

PART XI MATERIALS

List of major changes in Part XI from 2019 edition

2.2.1(b)	Revised	10.3.6	Revised
3.1.1	Revised	Fig. XI 10-2	Revised
Table XI 3-2	Revised	Fig. XI 10-3	New
3.2.2(b)(iii)	Revised	Fig. XI 10-4	New
3.3.1(d)	New	Fig. XI 10-5	New
3.3.2(c)	Revised	Fig. XI 10-6	New
3.4.1(a)	Revised	10.3.7	New
3.5.1	Revised	10.3.8	New
3.5.3	Revised	Fig. XI 10-7	New
3.5.5(b)	Revised	Table XI 10-3	New
3.6.7	Revised	10.3.9	New
3.8.3	Revised	10.3.10	New
3.8.4	Revised	10.3.11	New
3.10.1	Revised	10.3.7	Renumbered and Revised
3.10.2	Revised	17.4.2	Revised
3.10.3	Revised	17.4.3	New
3.10.4	Revised	Table XI 17-1	New
Fig. XI 3-6	Revised	17.4.4	New
3.10.5	Revised	Fig. XI 17-1	New
Table XI 3-4	Revised	Table XI 17-2	New
Table XI 3-5	New	17.4.5	New
Table XI 3-6~3-15	Renumbered and Revised		
Table XI 3-16	New		
4.4.4(c)	Renumbered		
9.2	New		
9.2	Renumbered		
9.3	Renumbered		

Rules for the Construction and Classification of Steel Ships 2019 and amendments thereof have been partly amended as follows:

Chapter 2 Test Specimens and Mechanical Tests

Paragraph 2.2.1(b) has been amended as follows:

2.2 Tensile Tests

2.2.1 Tensile test specimens

(a) There are different types of tensile test specimens which are to be applied according to the materials to be tested as shown in Table XI 2-1.

(b) The tolerances on specimen dimensions are to be in accordance with ISO ~~6892-84~~ 6892-1 or other recognized standards as appropriate.

Chapter 3 Rolled Steels for Hull Construction

Paragraph 3.1.1 has been amended as follows:

3.1 General

3.1.1 Application

(a) Scope

This chapter gives the requirements for weldable normal, higher and extra high strength hot rolled steels, such as plates, wide flats, sections and bars, intended for use in hull construction.

(b) Thickness

(i) The requirements of this Chapter are primarily intended to apply to rolled steel products not exceeding the thickness limits given in Table XI 3-1 of this Chapter.

(ii) Steel plates supplied in EH47 strength grades (minimum yield stress 460 N/mm^2)

This chapter gives the requirements for steel plates in thickness greater than 50 mm and not greater than 100 mm intended for hatch coamings and upper decks of container ships. For YP47 steels outside scope of the said thickness range, special consideration is to be given by the Society.

(iii) Brittle crack arrest steels

The thickness range of brittle crack arrest steels is over 50 mm and not greater than 100 mm as specified in Table XI 3-5.

(c) Normal and higher strength corrosion resistant steels

The application of normal and higher strength corrosion resistant steels is to be in accordance with the requirement of IACS UR W and other relevant requirements.

(d) Brittle crack arrest steels

(i) The brittle crack designation can be assigned to YP36, YP40 and YP47 steels specified in this chapter, which meet the additional brittle crack arrest requirements and properties defined in this chapter.

(ii) The application of brittle crack arrest steels is to comply with 3.10 of this chapter, which covers longitudinal structural members in the upper deck region of container carriers (such as hatch side coaming, upper deck, hatch coaming top and the attached longitudinals, etc.).

Table XI 3-2 has been amended as follows:

Table XI 3-2
Deoxidation Practice for Rolled Steels

<table>
<tr><th colspan="3">Material Grade (t = thickness)</th><th>Deoxidation Practice</th></tr>
<tr><td rowspan="7">Normal Strength Steels</td><td rowspan="2">A</td><td>t ≤ 50 mm</td><td>Any method except rimmed steel(1)</td></tr>
<tr><td>t > 50 mm</td><td>Killed</td></tr>
<tr><td rowspan="2">B</td><td>t ≤ 50 mm</td><td>Any method except rimmed</td></tr>
<tr><td>t > 50 mm</td><td>Killed</td></tr>
<tr><td rowspan="2">D</td><td>t ≤ 25 mm</td><td>Killed</td></tr>
<tr><td>t > 25 mm</td><td rowspan="4">Killed and fine grain treated</td></tr>
<tr><td colspan="2">E</td></tr>
<tr><td>Higher Strength Steels</td><td colspan="2">AH32, DH32, EH32, FH32
AH36, DH36, EH36, FH36
AH40, DH40, EH40, FH40
EH47, EH36-BCA, EH40-BCA, EH47-BCA</td></tr>
<tr><td>Extra High Strength Steels</td><td colspan="2">A420, D420, E420, F420
A460, D460, E460, F460
A500, D500, E500, F500
A550, D550, E550, F550
A620, D620, E620, F620
A690, D690, E690, F690
A890, D890, E890
A960, D960, E960</td></tr>
</table>

Note:

(1) Grade A sections up to a thickness of 12.5 mm may be accepted in rimmed steel subject to the special approval of the Society.

Paragraph 3.2.2(b)(iii) has been amended as follows:

3.2 Approval and Manufacture

3.2.2 Method of manufacture

(a) Normal strength steels and higher strength steels

Steels are to be manufactured by the basic oxygen, electric furnace or open hearth processes or by other processes specially approved by the Society.

(b) Extra high strength steels

(i) The steels are to be manufactured, by the basic oxygen, basic electric arc furnace or by processes specially approved by the Society.

(ii) Vacuum degassing is to be used for any of the following:

(1) All steels with enhanced through-thickness properties, and

(2) All steels of grade H690, H890 and H960.

(iii) Nitrogen control for extra high strength steel

The steels are to contain nitrogen binding elements as detailed in the manufacturing specification. Also see note 4 in Table XI 3-~~5~~6 of this Chapter.

Paragraph 3.3.1(d) has been added as follows:

3.3 Chemical Composition

3.3.1 Normal strength steels and higher strength steels

(d) Brittle crack arrest steels

(i) Brittle crack arrest steels are defined as steel plate with the specified brittle crack arrest properties measured by either the brittle crack arrest toughness Kca or Crack Arrest Temperature (CAT).

(ii) In addition to the required mechanical properties of this chapter for YP36, YP40 and YP47, Brittle crack arrest steels are to comply with the requirements specified in Table XI 3-4 and Table XI 3-5 below.

(iii) The brittle crack arrest properties specified in Table XI 3-5 are to be evaluated for the products in accordance with the procedure approved by the Society. Test specimens are to be taken from each piece, unless otherwise agreed by the Society.

Paragraph 3.3.2(c) has been amended as follows:

3.3.2 Extra high strength steels

(c) The carbon equivalent value is to be calculated from the ladle analysis. Maximum values are specified in Table XI 3-~~6~~7 of this Chapter.

Paragraph 3.4.1(a) has been amended as follows:

3.4 Heat Treatment and Condition of Supply

3.4.1 Normal strength and higher strength steels

(a) The rolled steels are to be supplied in a condition complying with the requirements given in Table XI 3-~~7~~8 and Table XI 3-~~8~~9.

Paragraph 3.5.1 has been amended as follows:

3.5 Mechanical Properties

3.5.1 General requirements

(a) Normal strength and higher strength steels

(i) The mechanical properties for normal strength and higher strength steels are to comply with the requirements given in Table XI 3-~~9~~10 and Table XI 3-~~10~~11 of this Chapter.

(ii) Minimum average energy values are specified for Charpy V-notch impact test specimens taken in either the longitudinal or transverse directions (see 3.5.5(b)(i)(2) of this Chapter). Generally only longitudinal test specimens need to be prepared and tested except for special applications where transverse test specimens may be required by the purchaser or the Society. Transverse test results are to be guaranteed by the supplier.

(iii) The tabulated values are for standard specimens 10 mm $\times$ 10 mm. For plate thicknesses less than 10 mm, impact test may be waived at the discretion of the Society or subsize specimens, as specified in Chapter 2 of this Part, may be used.

(iv) The average value obtained from one set of three impact tests is to comply with the requirements given in Table XI 3-~~9~~10 and Table XI 3-~~10~~11 of this Chapter. One individual value only may be below the specified average value provided it is not less than 70% of that value.

(v) Generally, impact tests are not required when the nominal plate thickness is less than 6 mm.

(vi) For tensile test either the upper yield stress (R_{eH}) or where R_{eH} cannot be determined, the 0.2 percent proof stress (R_p 0.2) is to be determined and the material is considered to comply with the requirements if either value meets or exceeds the specified minimum value for yield strength (R_e).

(b) Extra high strength steels

(i) The mechanical properties for extra high strength steels are to comply with the requirememts given in Table XI 3-~~11~~12 of this Chapter. In the case of product forms other than plates and wide flats where longitudinal tests are agreed, the elongation values are to be 2 percentage units above those transverse requirements as listed in Table XI 3-~~11~~12 of this Chapter.

(ii) Through thickness tensile test

(1) For steels designated with improved through thickness properties, through thickness tensile tests are to be performed in accordance with 3.8 of this Chapter.

(2) Subject to the discretion of Society, through thickness tensile strength may be required to be not less than 80% of the specified minimum tensile strength.

(iii) Impact test for a nominal thickness less than 6 mm are normally not required.

Paragraph 3.5.3 has been amended as follows:

3.5.3 Test frequency

(a) Normal strength and higher strength steels

(i) Tensile test

For each batch presented, except where specially agreed by the Society, one tensile test is to be made from one piece unless the weight of finished material is greater than 50 tonnes, in which case one test is to be made from a different piece from each 50 tonnes or fraction thereof. Additionally tests are to be made for every variation of 10 mm in the thickness or diameter of products from the same cast.

(ii) Impact test

(1) Steels other than Grades E, EH32, EH36, EH40, FH32, FH36 and FH40
Steels other than Grades E, EH32, EH36, EH40, FH32, FH36 and FH40 are to be in accordance with Table XI 3-~~7~~8 and Table XI 3-~~8~~9 of this Chapter.

(b) Impact test specimens

(i) Normal strength and higher strength steels

(1) One impact test is to be made for each batch in the frequency as given in Table XI 3-~~7~~8 and Table XI 3-~~8~~9 of this Chapter. One set of 3 test specimens is to be taken from the thickest product in each batch.

(2) The impact test specimens are to be of the Charpy V-notch type (Type N1 as specified in Table XI 2-3 of this Part) cut with their edge within 2 mm from the "as rolled" surface with their longitudinal axes either parallel or transverse to the final direction of rolling of the material. The notch is to be cut in a face of the test specimen which was originally perpendicular to the rolled surface. The position of the notch is not to be nearer than 25 mm to a flame cut or sheared edge (see 3.5.1(a)(ii) of this Chapter). Where the product thickness exceeds 40 mm, the impact test specimens are to be taken with their longitudinal axis at a quarter thickness position.

(ii) Extra high strength steels

Test specimens for mechanical properties are in accordance with Chapter 2 and 3.5.5(b)(i) of this Chapter.

(1) The Charpy V-notch impact test specimens for plates and wide flats over 600 mm in width are to be taken with their axes transverse to the final rolling direction and the results should comply with the appropriate requirements for transverse direction of Table XI 3-~~11~~12 of this Chapter. For other product forms, the impact tests are to be in the longitudinal direction, the results of the tests are to comply with the appropriate requirements for longitudinal direction of Table XI 3-~~11~~12 of this Chapter.

(2) Sub-surface test specimens will be taken in such a way that one side is not further away than 2 mm from a rolled surface, however, for material with a thickness in excess of 50 mm, impact tests are to be taken at the quarter thickness (t/4) location and mid-thickness (t/2).

Paragraph 3.5.5(b) has been amended as follows:

3.5.5 Test specimens

(b) Impact test specimens

(i) Normal strength and higher strength steels

(1) One impact test is to be made for each batch in the frequency as given in Table XI 3-~~7~~8 and Table XI 3-~~8~~9 of this Chapter. One set of 3 test specimens is to be taken from the thickest product in each batch.

(2) The impact test specimens are to be of the Charpy V-notch type (Type N1 as specified in Table XI 2-3 of this Part) cut with their edge within 2 mm from the "as rolled" surface with their longitudinal axes either parallel or transverse to the final direction of rolling of the material. The notch is to be cut in a face of the test specimen which was originally perpendicular to the rolled surface. The position of the notch is not to be nearer than 25 mm to a flame cut or sheared edge (see 3.5.1(a)(ii) of this Chapter). Where the product thickness exceeds 40 mm, the impact test specimens are to be taken with their longitudinal axis at a quarter thickness position.

(ii) Extra high strength steels

Test specimens for mechanical properties are in accordance with Chapter 2 and 3.5.5(b)(i) of this Chapter.

(1) The Charpy V-notch impact test specimens for plates and wide flats over 600 mm in width are to be taken with their axes transverse to the final rolling direction and the results should comply with the appropriate requirements for transverse direction of Table XI 3-~~11~~12 of this Chapter. For other product forms, the impact tests are to be in the longitudinal direction, the results of the tests are to comply with the appropriate requirements for longitudinal direction of Table XI 3-~~11~~12 of this Chapter.

(2) Sub-surface test specimens will be taken in such a way that one side is not further away than 2 mm from a rolled surface, however, for material with a thickness in excess of 50 mm, impact tests are to be taken at the quarter thickness (t/4) location and mid-thickness (t/2).

Paragraph 3.6.7 has been amended as follows:

3.6.7 Dimensional tolerances

(a) The maximum permissible under thickness tolerance for hull construction rolled steel plates and wide flats is –0.3 mm irrespective of nominal thickness.

(b) For rolled steel plates and wide flats intended for machinery structures, the under thickness tolerance may relax to as follows:

Nominal thickness t (mm)	Minus tolerance on nominal thickness (mm)
3 ≤ t < 5	0.3
5 ≤ t < 8	0.4
8 ≤ t < 15	0.5
15 ≤ t < 25	0.6
25 ≤ t < 40	~~0.8~~ 0.7
~~40 ≤ t~~	~~1.0~~
40 ≤ t < 80	0.9
80 ≤ t < 150	1.1
150 ≤ t < 250	1.2
250 ≤ t	1.3

Paragraph 3.8.3 has been amended as follows:

3.8.3 Test specimens for through thickness tensile test

(a) For plates, a test sample in a size sufficient for 6 test specimens is to be taken from the center of one end of each piece, or one representative piece of each batch, see Table XI 3-~~12~~13 of this Chapter for selection of "piece or batch". Where plates having a weight exceeding 20 ton, another 6 specimens are to be prepared from the opposite end for the same testing. Where appropriate, the end selected is to be representative of the top end of an ingot or the start of a continuous cast strand. 3 tensile test specimens are to be prepared from each of these test samples in a line transverse to the final direction of rolling as shown in Fig. XI 3-3 of this Chapter. Generally, the other 3 test specimens are prepared for possible retests.

(b) For wide flats, a similar test sample is to be taken from each batch of products derived from a single cast and in the same heat treatment condition. A batch is not to exceed 10 tons for thickness up to 25 mm and not to exceed 20 tons for thickness exceeds 25 mm, see Table XI 3-~~12~~13.

(c) The test specimens are to be machined in accordance with a recognized standard to the dimensions as shown in Table XI 3-~~13~~14 of this Chapter. Where the product thickness is not allow to prepare specimens of sufficient length suitable for the gripping jaws of the testing machine, the ends of the test specimens may be built up by suitable welding methods. The welding is not to impair the portion of the specimen within the parallel length.

Paragraph 3.8.4 has been amended as follows:

3.8.4 Test results for through thickness tensile test

(a) The 3 through thickness tensile test specimens are to be tested at ambient temperature.

(b) The test is considered invalid and further replacement test is required if the fracture occurs in the weld or heat affected zone.

(c) The 3 through thickness tensile test specimens, for acceptance, are to give a minimum average reduction of area value of not less than that shown in Table XI 3-~~14~~15 of this Chapter. Only one individual value may be below the minimum average but not less than minimum individual value shown for the appropriate grade. See Fig. XI 3-4 of this Chapter.

Paragraph 3.10 has been amended as follows:

3.10 Requirements for Use of Extremely Thick Steel Plates

3.10.1 Application

These requirements are to be applied to ships contracted for construction on or after 1 January 2014.

(a) General

(i) This requirement is to be complied with for container carriers incorporating extremely thick steel plates in accordance with 3.10.1(b) and 3.10.1(c) of this Chapter.

(ii) This section gives measures for identification and prevention of brittle fractures of container carriers to which extremely thick steel plates are applied for longitudinal structural members.

(iii) The application of the measures specified in 3.10.2, 3.10.3 and 3.10.4 of this Chapter is to be in accordance with 3.10.5.

(iv) Brittle fracture toughness of welded joints is to comply with IACS UR W11, UR W28 and UR W31 (Application of YP47 steel plates) where applicable in addition to this requirements.

(v) This section gives the basic concepts for application of extremely thick steel plates to longitudinal structural members in the upper deck region.

(vi) For the application of this section, the upper deck region means the upper deck plating, hatch side coaming plating, hatch coaming top plating and their attached longitudinals.

(b) Steel grade

(i) This requirement is to be applied to container carriers to which any of YP36, YP40 and YP47 steel plates having the thickness specified in 3.10.1(c) of this Chapter for the longitudinal structure members.

Note: YP36 YP40 and YP47 means the steel plates having the minimum specified yield points of 355, 390 and 460 N/mm^2, respectively.

(ii) In case YP47 steel plates are used for longitudinal structural members in the upper deck region, the steel plates are to be of EH47 grade as specified in this chapter.

(c) Thickness

(i) For steel plates with thickness of over 50 mm and not greater than 100 mm, the measures for prevention of brittle crack initiation and propagation specified in this requirement are to be taken.

(ii) For steel plates with thickness exceeding 100 mm, appropriate measures for prevention of brittle crack initiation and propagation are to be taken in accordance with the decision of the Society considering this requirement.

3.10.2 Non-destructive testing (NDT) during construction (Measure No.1 of 3.10.5 of this Chapter)

Where NDT during construction is required in 3.10.5 of this Chapter, the NDT is to be in accordance with 3.10.2(a) and 3.10.2(b) of this Chapter. Enhanced NDT as specified in 3.10.4(c)(v) of this Chapter is to be carried out in accordance with the appropriate standard.

(a) General

Ultrasonic testing (UT) in accordance with IACS ~~Rec. 20~~ UR W33 is to be carried out on all block-to-block butt joints of all upper flange longitudinal structural members in the cargo hold region. Upper flange longitudinal structural members include the topmost strakes of the inner hull/bulkhead, the sheer strake, main deck, coaming plate, coaming top plate, and all attached longitudinal stiffeners. These members are defined in Fig. XI 3-5 of this Chapter.

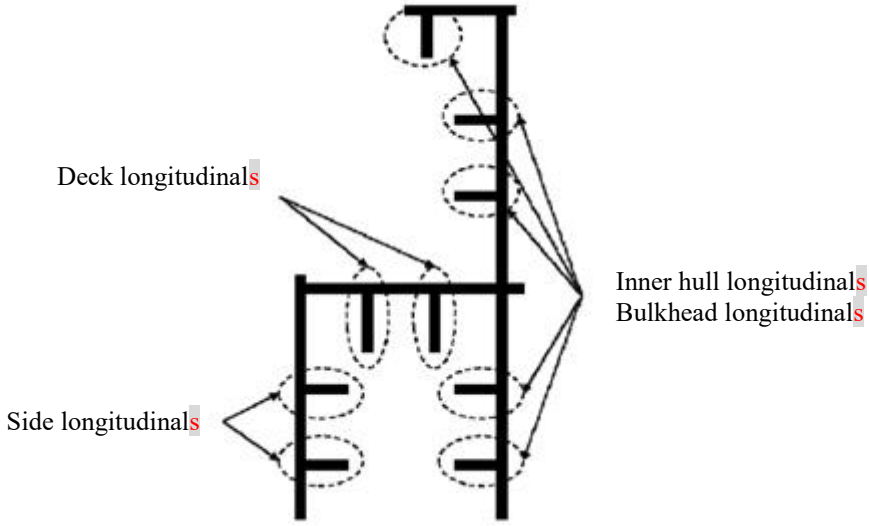


Fig. XI 3-5
Upper Flange Longitudinal Structural Members

(b) Acceptance criteria of UT

(i) Acceptance criteria of UT are to be in accordance with IACS ~~Rec.20~~ UR W33 practice.

(ii) The acceptance criteria may be adjusted under consideration of the appertaining brittle crack initiation prevention procedure and where this is more severe than that found in IACS ~~Rec.20~~ UR W33, the UT procedure is to be amended accordingly to a more severe sensitivity.

3.10.3 Periodic NDT after delivery (Measure No.2 of 3.10.5 of this Chapter)

Where periodic NDT after delivery is required, the NDT is to be in accordance with 3.10.3(a), 3.10.3(b) and 3.10.3(c) of this Chapter.

(a) General

The procedure of the NDT is to be in accordance with IACS ~~Rec.20~~ UR W33 requirements.

(b) Timing of UT

Where UT is carried out, the frequency of survey is to be in accordance with the requirements of the Society.

(c) Acceptance criteria of UT

Where UT is carried out, acceptance criteria of UT are to be in accordance with ~~Rec.20~~ UR W33 practice.

3.10.4 Brittle crack arrest design (Measure No.3, 4 and 5 of 3.10.5 of this Chapter)

(a) General

(i) The brittle crack arrest steel method detailed herein may be used when the measures No.3, 4 and 5 of 3.10.5 are applied and the steel grade material of the upper deck is not higher than YP40. Otherwise other means for preventing the crack initiation and propagation shall be agreed with the Society.

(ii) Measures for prevention of brittle crack propagation, ~~which is the same meaning as Brittle crack arrest design, are to be taken within the cargo hold region~~ are to be taken within the cargo hold region. A brittle crack arrest design means a design using these measures.

(iii) The ~~approach~~ measures given in ~~this section~~ 3.10.4 generally ~~applies~~ apply to the block-to-block joints but it should be noted that cracks can initiate and propagate away from such joints. Therefore, appropriate measures should also be considered in accordance with 3.10.4(b)(ii)(2) of this Chapter.

(iv) Brittle crack arrest steel is defined in 3.1 to 3.3 of this chapter as steel plate with measured crack arrest properties, K_{ca} at -10°C ≥ 6,000 N/mm$^{3/2}$ or other methods based on the determination of Crack Arrest Temperature (CAT).

~~Notes:~~

~~(1) The Crack Arrest Fracture Toughness K_{ca} is to be determined by the Standard ESSO Test shown in the Annex 2 of IACS UR S33 or other alternative method. Crack Arrest Temperature (CAT) may also be determined by the Double Tension Wide Plate Test or equivalent. The use of small scale test parameters such as the Nil Ductility Test Temperature (NDTT) may be considered provided that mathematical relationships of NDTT to K_{ca} or CAT can be shown to be valid.~~

~~(2) Where the thickness of the steel exceeds 80 mm the required K_{ca} value or alternative crack arrest parameter for the brittle crack arrest steel plate is to be specifically agreed by the Society.~~

(b) Functional requirements of brittle crack arrest design

The purpose of the brittle crack arrest design is ~~aimed at arresting~~ to arrest propagation of a crack at a proper position and to prevent large scale fracture of the hull girder.

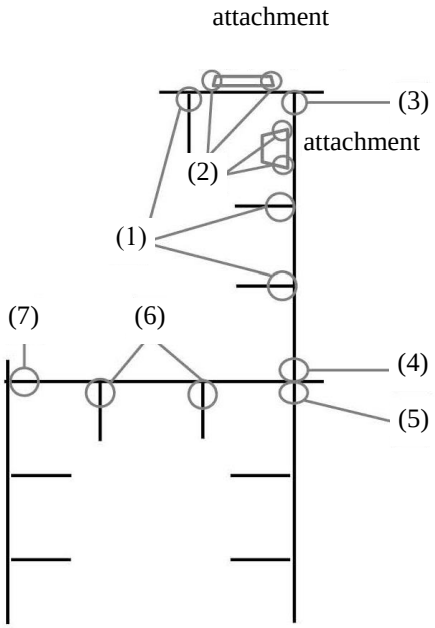
(i) ~~The point of a brittle crack initiation is to be considered in the block-to-block butt joints both of hatch side coaming and upper deck.~~
The locations of most concern for brittle crack initiation and propagation are the block-to-block butt weld joints either on hatch side coaming or on upper deck plating. Other locations in block fabrication where joints are aligned may also present higher opportunity for crack initiation and propagation along butt weld joints.

(ii) Both of the following cases are to be considered:

(1) where the brittle crack runs straight along the butt joint, and

(2) ~~where the brittle crack initiates or deviates away from the butt joint and runs into base metal.~~ where the brittle crack initiates in the butt joint but deviates away from the weld and into the plate, or where the brittle crack initiates from any other weld (see Fig. XI 3-6) and propagates into the plate.

Fig. XI 3-6 has been amended as follows:



Note:
(1) Fillet weld between hatch side coaming plating, including top plating, and longitudinals;
(2) Fillet weld between hatch side coaming plating, including top plating and longitudinals, and attachments. (e.g., Fillet weld between hatch side top plating and hatch cover pad plating.);
(3) Fillet weld between hatch side coaming top plating and hatch side coaming plating;
(4) Fillet weld between hatch side coaming plating and upper deck plating;
(5) Fillet weld between upper deck plating and inner hull/bulkheads;
(6) Fillet weld between upper deck plating and longitudinal; and
(7) Fillet weld between sheer strakes and upper deck plating.

Fig. XI 3-6
Other Weld Areas

(c) Concept examples of brittle crack arrest design

The following are considered to be acceptable examples of ~~brittle crack arrest design~~ measures that can be used on a brittle crack arrest-design to prevent brittle crack propagations. The detail design arrangements are to be submitted ~~for approval by the Society~~ to the Society for approval. Other ~~concept designs~~ measures may be considered and accepted for review by the Society.

Brittle crack arrest design for 3.10.4(b)(ii)(2) of this Chapter:

(i) Brittle crack arresting steel is to be used for the upper deck plating along the cargo hold region in a way suitable to arrest a brittle crack initiating from the coaming and propagating into the structure below.

Brittle crack arrest design for 3.10.4(b)(ii)(1) of this Chapter:

(ii) Where the block to block butt welds of the hatch side coaming and those of the upper deck are shifted, this shift is to be greater than or equal to 300 mm. Brittle crack arrest steel is to be provided for the hatch side coaming plating.

(iii) Where crack arrest holes are provided in way of the block-to-block butt welds at the region where hatch side coaming weld meets the deck weld, the fatigue strength of the lower end of the butt weld is to be assessed. Additional countermeasures are to be taken for the possibility that a running brittle crack may deviate from the weld line into upper deck or hatch side coaming. These countermeasures are to include the application of brittle crack arrest steel in hatch side coaming plating.

(iv) Where ~~A~~arrest ~~I~~insert ~~P~~plates of brittle crack arrest steel or ~~W~~weld ~~M~~metal ~~I~~inserts with high crack arrest toughness properties are provided in way of the block-to-block butt welds at the region where

hatch side coaming weld meets the deck weld, additional countermeasures are to be taken for the possibility that a running brittle crack may deviate from the weld line into upper deck or hatch side coaming. These countermeasures are to include the application of brittle crack arrest steel in hatch side coamings plating.

(v) The application of enhanced NDT particularly time of flight diffraction (TOFD) technique using stricter defect acceptance in lieu of standard UT technique specified in 3.10.2 of this Chapter can be an alternative to (ii), (iii) and (iv) above.

(d) Selection of brittle crack arrest steels

(i) The brittle crack arrest steels fitted in the upper deck region of container ships are to comply with Table XI 3-16 where suffixes BCA1 and BCA2 are defined in 3.3 of this chapter.

(ii) The brittle crack arrest steel property is to be selected for each individual structural member with thickness above 50 mm according to Table XI 3-16.

(iii) When brittle crack arrest steels as specified in Table XI 3-16 are used, the weld joints between the hatch coaming side and the upper deck are to be partial penetration weld details approved by the Society.

In the vicinity of ship block joints, alternative weld details may be used for the deck and hatch coaming side connection provided additional means for preventing the crack propagation are implemented and agreed by the Society in this connection area.

3.10.5 Measures for extremely thick steel plates

The thickness and the yield strength shown in the Table XI 3-~~15~~17 below ~~of this Chapter~~ apply to the hatch coaming ~~structure~~ top plating and side plating, and are the controlling parameters for the application of countermeasures. These controlling parameters are not applicable for upper deck.

If the as built thickness of the hatch coaming structure is below the values contained in the table, countermeasures are not necessary regardless of the thickness and yield strength of the upper deck.

Table XI 3-4 has been amended as follows:

Table XI 3-4
Chemical Composition for Higher Strength Steels and Brittle Crack Arrest Steels

Material Grade	Chemical Composition[4],[5],[6] (%)															
	C (max.)	Si (max.)	Mn	P (max.)	S (max.)	Al (acid soluble) (min.)	Nb	V	Ti	Cu (max.	Cr (max.)	Ni (max.)	Mo (max.)	N (max.)	C_{eq}[5] (max.)	P_{cm}[8] (max.)
							total content (max.): 0.12									
AH32, DH32, EH32 AH36, DH36, EH36 AH40, DH40, EH40	0.18	0.50	0.90 ~ 1.60[1]	0.035	0.035	0.015[2],[3]	0.02~ 0.05[3]	0.05~ 0.10[3]	0.02	0.35	0.2	0.40	0.08	-	-	-
FH32, FH36, FH40	0.16		0.90 ~ 1.60	0.025	0.025							0.80		0.009[7]		
EH47[9]	0.18	0.55	0.90~ 2.00	0.020	0.020				0.02[3]		0.25	1.0		-	0.49	0.22
EH36-BCA[9] EH40-BCA[9]	0.18	0.50	0.90~ 2.00	0.020	0.020	0.015[2],[3]	0.02~ 0.05[3] [4]	0.05~ 0.10[3] [4]	0.02[4]	0.50	0.25	2.0	0.08	2.0	0.47 0.49	-
EH47-BCA[9]	0.18	0.55	0.90 ~ 1.60	0.020	0.020	0.015[2],[3]	0.02~ 0.05[3]	0.05~ 0.10[3]	0.02[4]	0.50	0.25	2.0	0.08	2.0	0.55	0.24

Notes:

(1) Up to a thickness of 12.5 mm, the minimum Manganese content may be reduced to 0.70%.

(2) The total Aluminium content may be determined instead of the acid soluble content. In such cases, the total Aluminimum content is to be not less than 0.020%.

(3) The steel is to contain Aluminium, Niobium, Vanadium or other suitable grain refining elements, either singly or in any combination. When used singly the steel is to contain the specified minimum content of the grain refining element. When used in combination, the specified minimum content of each grain refining element is not applicable.

(4) When any grade of higher strength steel is supplied in thermo-mechanically ~~cont~~rolled ~~processed~~ condition, variations in the specified chemical composition may be allowed or required by the Society.

(5) When required, the carbon equivalent value (Ceq) is to be calculated from the ladle analysis using the following formula:

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

This formula is applicable only to steels which are basically of the carbon-manganese type and gives a general indication of the weldability of the steel.

(6) Where additions of any other element have been made as part of the steelmaking practice, the content is to be indicated.

(7) 0.0012 if Al is present.

~~(8) The chemical composition of EH47 is to be as deemed appropriate by the Society.~~

(8) Cold cracking susceptibility Pcm value is to be calculated using the following formula:

$$P_{cm} = C + \frac{Si}{30} + \frac{Mn}{20} + \frac{Cu}{20} + \frac{Ni}{60} + \frac{Cr}{20} + \frac{Mo}{15} + \frac{V}{10} + 5B(\%)$$

(9) Variations in the specified chemical composition may be allowed subject to approval of the Society.

Table XI 3-5 has been added as follows:

Table XI 3-5
Requirement of brittle crack arrest properties for brittle crack arrest steels

Suffix to the steel grade(1)	Thickness range (mm)	Brittle crack arrest properties(2)(6)	
		Brittle Crack Arrest Toughness Kca at -10°C ($N/mm^{3/2}$) (3)	Crack Arrest Temperature CAT (°C)(4)
BCA1	$50 < t \leq 100$	6,000 min.	-10 or below
BCA2	$80 < t \leq 100$(7)	8,000 min.	(5)

Notes:

(1) Suffix “BCA1” or “BCA2” is to be affixed to the steel grade designation (e.g. EH40-BCA1, EH47-BCA1, EH47-BCA2, etc.).

(2) Brittle crack arrest properties for brittle crack arrest steels are to be verified by either the brittle crack arrest toughness Kca or Crack Arrest Temperature (CAT).

(3) Kca value is to be obtained by the brittle crack arrest test specified in Annex 3 of IACS UR W31.

(4) CAT is to be obtained by the test method specified in Annex 4 of IACS UR W31.

(5) Criterion of CAT for brittle crack arrest steels corresponding to Kca=8,000 $N/mm^{3/2}$ is to be approved by the Society

(6) Where small-scale alternative tests are used for product testing (batch release testing), these test methods are to be approved by the Society.

(7) Lower thicknesses may be approved at the discretion of the Society.

Table XI 3-6~3-15 have been renumbered and revised as follows:

Table XI 3-~~6~~7
Maximum C_{eq}, CET and P_{cm} Values for Extra High Strength Steels

Steel grade	Delivery condition	Carbon Equivalent (%)							
		C_{eq}						CET	P_{cm}
		Plates			Sections	Bars	Tubulars	All	
		t ≤ 50 (mm)	50 < t ≤ 100 (mm)	100 < t ≤ 250 (mm)	t ≤ 50 (mm)	t ≤ 250 or d ≤ 250 (mm)	t ≤ 65 (mm)		
A420 D420 E420 F420	N/NR	0.46	0.48	0.52	0.47	0.53	0.47	N.A.	
	TMCP	0.43	0.45	0.47	0.44	N.A.			
	QT	0.45	0.47	0.49	N.A.		0.46	N.A.	
A460 D460 E460 F460	N/NR	0.50	0.52	0.54	0.51	0.55	0.51	0.25	N.A.
	TMCP	0.45	0.47	0.48	0.46	N.A.		0.30	0.23
	QT	0.47	0.48	0.50	N.A.		0.48	0.32	0.24
A500 D500 E500 F500	TMCP	0.46	0.48	0.50			N.A.	0.32	0.24
	QT	0.48	0.50	0.54			0.50	0.34	0.25
A550 D550 E550 F550	TMCP	0.48	0.50	0.54			N.A.	0.34	0.25
	QT	0.56	0.60	0.64			0.56	0.36	0.28
A620 D620 E620 F620	TMCP	0.50	0.52	N.A.			N.A.	0.34	0.26
	QT	0.56	0.60	0.64			0.58	0.38	0.30
A690 D690 E690 F690	TMCP	0.56	N.A.				N.A.	0.36	0.30
	QT	0.64	0.66	0.70			0.68	0.40	0.33
A890 D890 E890	TMCP	0.60	N.A.	N.A.			N.A.	0.38	0.28
	QT	0.68	0.75					0.40	N.A.
A960 D960 E960	QT	0.75	N.A.					0.40	

Notes:

(1) Alternative limits may be specially accepted by the Society.

(2) Application of which formula of carbon equivalent (C_{eq}, CET or P_{cm}) is subject to agreement between the manufacturer and purchaser.

Table XI 3-~~7~~8
Conditions of Supply and Impact Test Requirements for Normal Strength Steels

Grade	Deoxidation Practice	Products	Thickness (mm)	Condition of Supply(1)	Batch for Impact Test (2) (ton)
A	Rimmed	Sections	t ≤ 12.5	Any	Not required
	Any method except rimmed	Sections	t ≤ 50	Any	Not required
		Plates	t ≤ 50	Any	Not required
	Killed		50 < t ≤ 100	N, TMCP	(3)
				CR, AR*	50
B	Any method except rimmed	Sections	t ≤ 25	Any	Not required
			25 < t ≤ 50	Any	50
		Plates	t ≤ 25	Any	Not required
			25 < t ≤ 50	Any	50
	Killed		50 < t ≤ 100	N, TMCP	
				CR, AR*	25
D	Killed	Plates Sections	t ≤ 25	Any	50
	Killed and fine grain treated	Section	t ≤ 35	Any	50
			35 < t ≤ 50	N, CR, TMCP	
				AR*	25
		Plates	t ≤ 35	Any	50
			35 < t ≤ 50	N, CR, TMCP	
			50 < t ≤ 100	N, TMCP	
				CR	25
E	Killed and fine grain treated	Section	t ≤ 50	N, TMCP	25
				AR*, CR*	15
		Plates	t ≤ 100	N, TMCP	Each piece

Notes:

(1) Symbols used in "Condition of supply" are as follows:
- Any : Any conditions, including as rolled, controlled rolled, TMCP rolled and any other heat treatments.
- N : Normalized condition.
- TMCP : Thermo-mechanically controlled processed rolling as approved by the Society.
- CR : Controlled rolled condition as an alternative to normalizing.
- AR* : As rolled condition subject to the special approval of the Society.
- CR* : Controlled rolled condition subject to the special approval of the Society.

(2) One set of 3 impact specimens is to be taken from each batch of the specified mass in tons or fraction thereof.

(3) See note 5 of Table XI 3-~~9~~10 of this Chapter.

Table XI 3-~~8~~9
Conditions of Supply & Impact Test Requirements for Higher Strength Steels

Grade	Deoxidation Practice	Grain Refining Elements	Products	Thickness (mm)	Condition of Supply[1]	Batch for Impact Test (ton) [2]
AH32 AH36	Killed and fine grain treated	Nb and/or V	Sections	t ≤ 12.5	Any	50
				12.5 < t ≤ 50	N, CR, TMCP	
					AR*	25
			Plates	t ≤ 12.5	Any	50
				12.5 < t ≤ 50	N, CR, TMCP	
				50 < t ≤ 100	N, TMCP	
					CR	25
		Al alone or with Ti	Sections	t ≤ 20	Any	50
				20 < t ≤ 50	N, CR, TMCP	
					AR*	25
			Plates	t ≤ 20	Any	50
				20 < t ≤ 35	AR*	25
				20 < t ≤ 50	N, CR, TMCP	50
				50 < t ≤ 100	N, TMCP	
					CR	25
AH40	Killed and fine grain treated	Any	Sections	t ≤ 12.5	Any	50
				12.5 < t ≤ 50	N, CR, TMCP	
			Plates	t ≤ 12.5	Any	
				12.5 < t ≤ 50	N, CR, TMCP	
				50 < t ≤ 100	N, TMCP	
					QT	Each length as heat-treated
DH32 DH36	Killed and fine grain treated	Nb and/or V	Sections	t ≤ 12.5	Any	50
				12.5 < t≤ 50	N, CR, TMCP	
					AR*	25
			Plates	t ≤ 12.5	Any	50
				12.5 < t ≤ 50	N, CR, TMCP	
				50 < t ≤ 100	N, TMCP	
					CR	25
		Al alone or with Ti	Sections	t ≤ 20	Any	50
				20 < t ≤ 50	N, CR, TMCP	
					AR*	25
			Plates	t ≤ 20	Any	50
				20 < t ≤ 25	AR*	25
				20 < t ≤ 50	N, CR, TMCP	50
				50 < t ≤ 100	N, TMCP	
					CR	25
DH40	Killed and fine grain treated	Any	Sections	t ≤ 50	N, CR, TMCP	50
			Plates	t ≤ 50	N, CR, TMCP	
				50 < t ≤ 100	N, TMCP	
					QT	Each length as heat-treated

EH32 EH36	Killed and fine grain treated	Any	Sections	t ≤ 50	N, TMCP AR*, CR*	25 15
			Plates	t ≤ 100	N, TMCP	Each piece
EH40	Killed and fine grain treated	Any	Sections	t ≤ 50	N, TMCP, QT	25
			Plates	t ≤ 100	N, TMCP	Each piece
					QT	Each length as heat-treated
FH32 FH36	Killed and fine grain treated	Any	Sections	t ≤ 50	N, QT, TMCP	25
					CR*	15
			Plates	t ≤ 100	N, TMCP	Each piece
					QT	Each length as heat-treated
FH40	Killed and fine grain treated	Any	Sections	t ≤ 50	N, TMCP, QT	25
			Plates	t ≤ 100	N, TMCP	Each piece
					QT	Each length as heat-treated
EH47	Killed and fine grain treated	Any	Plates	50 < t ≤ 100	TMCP(3)	Each piece

Notes:

(1) Symbols used in "Condition of supply" are as follows:

Any : Any conditions, including as rolled, controlled rolled, TMCP rolled and any other heat treatments.

N : Normalized condition.

TMCP : Thermo-mechanically controlled processed rolling as approved by the Society.

CR : Controlled rolled condition as an alternative to normalizing.

AR* : As rolled condition subject to the special approval of the Society.

CR*: Controlled rolled condition subject to the special approval of the Society.

QT : Quenched and tempered condition.

(2) One set of 3 impact specimens is to be taken from each batch of the specified mass in tons or fraction thereof. For grades A32 and A36 steels a relaxation in the number of impact tests may be permitted. (See Note (3) of Table XI 3-~~10~~11 of this Chapter.)

(3) Other conditions of supply are to be specially considered by the Society.

Table XI 3-~~9~~10
Mechanical Properties Requirements for Normal Strength Steels

Material Grade	Tensile Test			Impact Test			
	Min. Yield Stress R_{eH} (N/mm^2)	Tensile Strength R_m (N/mm^2)	Min. Elongation on $L=5.65\sqrt{A}$ (%)	Test Temp. (°C)	Minimum Average Impact Energy[3] (J) Long. (trans.), t = thickness in mm		
					t ≤ 50	50 < t ≤ 70	70 < t ≤ 100
A	235	400~520[1]	22[2]	+20	–	34[5] (24)[5]	41[5] (27)[5]
B				0	27[4] (20[4])	34 (24)	41 (27)
D				–20	27 (20)		
E				–40			

Notes:

(1) For all thicknesses of Grade A steel sections, the upper limit for the specified tensile strength range may be exceeded at the discretion of the Society.

(2) For full thickness flat tensile test specimens with a width of 25 mm and a gauge length of 200 mm, the elongation is to comply with the following minimum values (%):

Thickness(mm) / Material Grade	≤ 5	> 5 ≤ 10	> 10 ≤ 15	> 15 ≤ 20	> 20 ≤ 25	> 25 ≤ 30	> 30 ≤ 40	> 40 ≤ 50
A, B, D, E	14	16	17	18	19	20	21	22

(3) See 3.5.1(a)(ii) & (iii) of this Chapter.

(4) Charpy V-notch impact tests are generally not required for Grade B steel with thickness of 25 mm or less.

(5) Impact tests for Grade A steel over 50 mm in thickness are not required when the material is produced using fine grain practice and furnished normalizing. TMCP rolling may be accepted without impact testing at the discretion of the Society.

Table XI 3-~~10~~11
Mechanical Properties Requirements for Higher Strength Steels

Material Grade	Tensile Test			Impact Test			
	Min. Yield Stress R_{eH} (N/mm^2)	Tensile Strength R_m (N/mm^2)	Min. Elongation on $L = 5.65\sqrt{A}$ (%)	Test Temp. (°C)	Minimum Average Impact Energy[2] (J) Long. (trans.), t = thickness in mm		
					t ≤ 50	50 < t ≤ 70	70 < t ≤ 100
AH32	315	440~570	22[1]	0	31[3] (22[3])	38 (26)	46 (31)
DH32				–20	31 (22)		
EH32				–40			
FH32				–60			
AH36	355	490~630	21[1]	0	34[3] (24[3])	41 (27)	50 (34)
DH36				–20	34 (24)		
EH36				–40			
FH36				–60			
AH40	390	510~660	20[1]	0	39 (26)	46 (31)	55 (37)
DH40				–20			
EH40				–40			
FH40				–60			
EH47	460	570~720	17	–40	Not applicable	[4]	

Notes:

(1) For full thickness flat tensile test specimens with a width of 25 mm and a gauge length of 200 mm, the elongation is to comply with the following minimum values (%):

Thickness(mm) / Material Grade	≤ 5	> 5 ≤ 10	> 10 ≤ 15	> 15 ≤ 20	> 20 ≤ 25	> 25 ≤ 30	> 30 ≤ 40	> 40 ≤ 50
H32	14	16	17	18	19	20	21	22
H36	13	15	16	17	18	19	20	21
H40	12	14	15	16	17	18	19	20

(2) See 3.5.1(a)(ii) & (iii).

(3) For Grades AH32 and AH36 steels, a relaxation in the number of impact tests for acceptance purposes may be permitted by special agreement with the Society provided that satisfactory results obtained from occasional check tests.

(4) Minimum average impact energy (J) for specimen taken in longitudinal direction is to be in accordance with the following:

Thickness	50 < t ≤ 70	70 < t ≤ 85	85 < t ≤ 100
Minimum average impact energy (J)	53	64	75

Note: Minimum average impact energy for specimen taken in transverse direction is to be at the discretion of the Society.

Table XI 3-~~11~~12
Mechanical Properties Requirements for Extra High Strength Steels

Material Grade		Tensile Test						Impact Test	
		Min. Yield Stress R_{eH}[(1)] (N/mm^2) Nominal thickness[(4)] in mm			Tensile Strength R_m (N/mm^2) Nominal thickness[(4)] in mm		Min. Elongation on $L=5.65\sqrt{A}$ Lon.(tran.)[(2)(3)] (%)	Test Temp. (°C)	Min. Average Impact Energy Lon.(tran.) (J)
		3 ≤ t ≤ 50	50 ≤ t ≤ 100	100 ≤ t ≤ 250	3 ≤ t < 100	100 ≤ t ≤ 250			
420N/NR 420TMCP 420QT	A	420	390	365	520~680	470~650	21 (19)	0	42 (28)
	D							-20	
	E							-40	
	F							-60	
460N/NR 460TMCP 460QT	A	460	430	390	540~720	500~710	19 (17)	0	46 (31)
	D							-20	
	E							-40	
	F							-60	
500TMCP 500QT	A	500	480	440	590~770	540~720	19 (17)	0	50 (33)
	D							-20	
	E							-40	
	F							-60	
550TM 550QT	A	550	530	490	640~820	590~770	18 (16)	0	55 (37)
	D							-20	
	E							-40	
	F							-60	
620TM 620QT	A	620	580	560	700~890	650~830	17 (15)	0	62 (41)
	D							-20	
	E							-40	
	F							-60	
690TM 690QT	A	690	650	630	770~940	710~900	16 (14)	0	69 (46)
	D							-20	
	E							-40	
	F							-60	
890TM 890QT	A	890	830	Not applicable	940~1100	Not applicable	13 (11)	0	69 (46)
	D							-20	
	E							-40	
960QT	A	960	Not applicable	Not applicable	980~1150	Not applicable	12 (10)	0	69 (46)
	D							-20	
	E							-40	

Notes:

(1) For tensile test either the upper yield stress (ReH) or where ReH cannot be determined, the 0.2 percent proof stress (Rp 0.2) is to be determined and the material is considered to comply with the requirements if either value meets or exceeds the specified minimum value for yield strength (Re).

(2) For full thickness flat test specimens with a width of 25 mm and a gauge length of 200 mm the elongation is to comply with the minimum values shown as follows:

Thickness(mm) / Material Grade	≤ 5	> 5 ≤ 10	> 10 ≤ 15	> 15 ≤ 20	> 20 ≤ 25	> 25 ≤ 30	> 30 ≤ 40	> 40 ≤ 50	> 50 ≤ 70
A / D / E /F 420	11		13	14	15	16	16	17	18
A / D / E /F 460	11		12	13	14	15	15	16	17
A / D / E /F 500	10		11	12	13	14	14	15	16
A / D / E /F 550	10								
A / D / E /F 620	9		11	12	12	13	13	14	15
A / D / E /F 690	9**		10**	11**	11	12	12	13	14

* The tabulated elongation minimum values are the requirements for testing specimen in transverse direction. 890 and 960 specimens and specimens which are not included in this table are to be proportional specimens with a gauge length of $L = 5.65\sqrt{A}$

** For 690 plates with thickness ≤ 20 mm, round specimen in accordance with Chapter 2 of this Part may be used instead of the flat tensile specimen. The minimum elongation for testing specimen in transverse direction is 14%.

(3) In the case that the tensile specimen is parallel to the final rolling direction, the test result shall comply with the requirement of elongation for longitudinal (L) direction.

(4) For plates and sections for applications, such as racks in offshore platforms etc., where the design requires that tensile properties are maintained through the thickness, a decrease in the minimum specified tensile properties is not permitted with an increase in the thickness.

Table XI 3-~~12~~13
Piece or Batch Size Dependent on Product and Sulphur Content

Product	S > 0.005%	S ≤ 0.005%
Plates	Each piece	Each batch of maximum 50 ton of products
Wide flats of nominal thickness ≤ 25 mm	Each batch of maximum 10 ton of products	Each batch of maximum 50 ton of products
Wide flats of nominal thickness > 25 mm	Each batch of maximum 20 ton of products	Each batch of maximum 50 ton of products

Note: Each batch of steel products is to be of similar thickness (thicknesses do not differ by more than 5 mm), originating from the same heat treatment charge and the same heat of steel.

Table XI 3-~~13~~14
Through Thickness Tensile Test Specimens

Product Thickness t (mm)	Test Specimen Diameter d (mm)	Test Specimen Parallel Length L (mm)
15 ≤ t ≤ 25	6	t ≥ L ≥ 2.0d
25 < t	10	

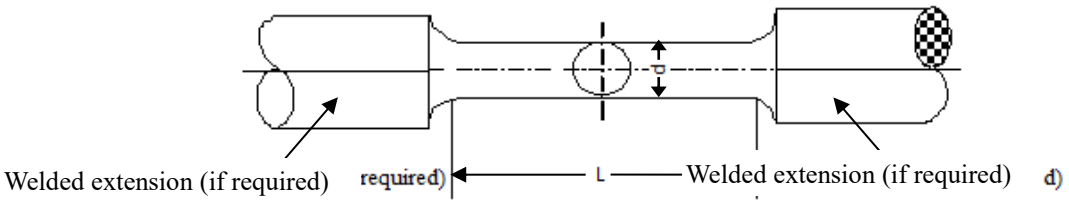


Table XI 3-~~14~~15
Reduction of Area Acceptance Values

Grade	Z25	Z35
Minimum average	25%	35%
Minimum individual	15%	25%

Table XI 3-~~15~~17
Measures for Extremely Thick Steel Plates

Yield Strength (kgf/mm^2)	Thickness (mm)	Option[3]	Measures			
			1	2	3+4	5
36	$50 < t \leq 85$	-	N.A.	N.A.	N.A.	N.A.
	$85 < t \leq 100$	-	X	N.A.	N.A.	N.A.
40	$50 < t \leq 85$	-	X	N.A.	N.A.	N.A.
	$85 < t \leq 100$	A	X	N.A.	X	X
		B	X[6]	N.A.[7]	N.A.	X
47 (FCAW) [4]	$50 < t \leq 100$	A	X	N.A.	X	X
		B	X[6]	N.A.[7]	N.A.	X
47 (EGW) [5]	$50 < t \leq 100$	-	X	N.A.	X	X

Measures:
1. NDT other than visual inspection on all target block joints (during construction) See 3.10.2 of this Chapter.
2. Periodic NDT other than visual inspection on all target block joints (after delivery) See 3.10.3 of this Chapter.
3. Brittle crack arrest design against straight propagation of brittle crack along weldline to be taken (during construction) See 3.10.4(c)(ii), (iii) or (iv) of this Chapter.
4. Brittle crack arrest design against deviation of brittle crack from weldline (during construction) See 3.10.4(c)(i) of this Chapter.
5. Brittle crack arrest design against propagation of cracks from other weld areas such as fillets and attachment welds. (during construction) See 3.10.4(c)(i) of this Chapter.

Notes:
(1) "X" means "To be applied".
(2) "N.A." means "Need not to be applied".
(3) Selectable from option "A" and "B".
(4) FCAW means Flux Cored Arc Welding.
(5) EGW means Electro-Gas Welding.
(6) See 3.10.4(c)(v) of this Chapter.
(7) May be required at the discretion of the Society.

Table XI 3-16 has been added as follows:

Table XI 3-16
Brittle Crack Arrest Steel Requirement in Function of Structural Members and Thickness

Structural Members plating(1)	Thickness (mm)	Brittle crack arrest steel requirement
Upper deck	$50 < t \leq 100$	Steel grade YP36 or 40 with suffix BCA1
Hatch coaming side	$50 < t \leq 80$	Steel grade YP 40 or 47 with suffix BCA1
	$80 < t \leq 100$	Steel grade YP 40 or 47 with suffix BCA2

Note:

(1) Excluding their attached longitudinals

Chapter 4 Rolled Steels for Boilers, Pressure Vessels and Low Temperature Service

Paragraph 4.4.4(c) has been amended as follows:

4.4.4 Equivalent materials

The rolled steels for hull construction of Grades D, E, DH32/36/40, EH32/36/40 and FH32/36/40 specified in Chapter 3 of this Part are also applicable for the low temperature service, provided that:

(a) The steels are killed and fine grain treated, heat-treated by normalized or quenched and tempered or produced by TMCP.

(b) The test specimens are taken in the frequency complying with the requirements of Note 4 in Table XI 4-6.

(c) Minimum average absorbed energy of impact tests is not to be less than 41J (27J for transverse test specimens) at the test temperature of respective grade specified in Table XI 3-~~7~~8.

Chapter 9 Stainless Steels and Clad Steels

Section 9.2 has been added as follows:

9.2 Stainless Steel castings for propellers

9.2.1 General

(a) The requirements of this section are applicable to the manufacture, inspection and repair procedures of cast steel propellers, blades and bosses.

(b) Where the use of alternative alloys is proposed, particulars of chemical composition, mechanical properties and heat treatment are to be submitted for approval.

(c) These requirements may also be used for the repair of propellers damaged in service, subject to prior agreement with the Society.

9.2.2 Manufacture and Foundry Approval

The requirements of manufacture are to be in accordance with 1.2 of this Part, where applicable.

(a) All propellers, blades and bosses are to be manufactured by foundries approved by the Society.The castings are to be manufactured and tested in accordance with the requirements of the Rules.

(b) Application for approval

It is the manufacturer's responsibility to assure that effective quality, process and production controls during manufacturing are adhered to within the manufacturing specification. The manufacturing specification shall be submitted to the Society at the time of initial approval, and shall at least include the following particulars: description of the foundry facilities, steel material specification, runner and feeder arrangements, manufacturing procedures, non-destructive testing and repair procedures.

(c) Scope of the approval test

The scope of the approval test is to be agreed with the Society. This should include the presentation of cast test coupons of the propeller materials in question for approval testing in order to verify that the chemical composition and the mechanical properties of these materials comply with the Rules.

(d) Inspection facilities

The foundry is to have an adequately equipped laboratory, manned by experienced personnel, for the testing of moulding materials chemical analyses, mechanical testing, microstructural testing of metallic materials and non-destructive testing. Where testing activities are assigned to other companies or other laboratory, additional information required by the Society is to be included.

9.2.3 Quality of castings

(a) Freedom from defects

All castings are to have a workmanlike finish and are to be free from imperfections defects which would be prejudicial to their proper application in service. Minor casting defects which may still be visible after machining such as small sand and slag inclusions, small cold shuts and scabs shall be trimmed off by the manufacturer in accordance with 9.2.12 of this chapter.

(b) Removal of defects

Casting defects which may impair the serviceability of the castings, e.g. major non-metallic inclusions, shrinkage cavities, blow holes and cracks, are not permitted. They may be removed by one of the methods described in 9.2.12 of this chapter and repaired within the limits and restrictions for the severity zones. Full description and documentation must be available for the Surveyor.

9.2.4 Dimensions, dimensional and geometrical tolerances

(a) The verification of dimensions, the dimensional and geometrical tolerances is the responsibility of the manufacturer. The report on the relevant examinations is to be submitted to the Surveyor, who may require checks to be made in his presence.

(b) Static balancing is to be carried out on all propellers in accordance with the approved drawing. Dynamic balancing may be necessary for propellers running above 500 rpm.

9.2.5 Chemical composition

Typical cast steel propeller alloys are grouped into 4 types depending on their chemical composition as given in Table XI 9-5 below, The chemical composition is to comply with the requirements of Table XI 9-5 or the approved specification, as appropriate.

Table XI 9-5
Typical chemical composition for steel propeller castings

Alloy type	C max. (%)	Mn max. (%)	Cr (%)	Mo (1) max. (%)	Ni (%)
Martensitic (12Cr 1Ni)	0.15	2.0	11.5-17.0	0.5	Max. 2.0
Martensitic (13Cr 4Ni)	0.06	2.0	11.5-17.0	1.0	3.5-5.0
Martensitic (16Cr SNi)	0.06	2.0	15.0-17.5	1.5	3.5-6.0
Austenitic (19Cr 11Ni)	0.12	1.6	16.0-21.0	4.0	8.0-13.0

Notes:
(1) Minimum values are to be in accordance with recognised national or international standards.

9.2.6 Heat treatment

Martensitic castings are to be austenitized and tempered. Austenitic castings should be solution treated.

9.2.7 Mechanical properties

The mechanical properties are to comply with the values given in Table XI 9-6 below or the approved specification, as appropriate.

Table XI 9-6
Mechanical Properties for Steel Propeller Castings

	Tensile Test				Impact Test
Alloy type	Proof stress $R_{p0.2}$ ($R_{p1.0}$) min. (N/mm^2)	Tensile strength Rm min. (N/mm^2)	Elongation A5 min. (%)	Reduction of area Z min.(%)	Charpy V-notch (1) Energy min.(j)
Martensitic (12Cr 1 Ni)	0.2% 440	590	15	30	20
Martensitic (13Cr 4Ni)	550	750	15	35	30
Martensitic (16Cr SNi)	540	760	15	35	30
Austenitic 19Cr 11 Ni	180(205) (2)	440	30	40	-

Notes:
(1) Tests to be made at 0°C for general service and at -10°C when intended for ships with ice class notation.
(2) In case where 1.0% proof stress is applied, the proof stress is not less than 205 N/mm^2

9.2.8 Mechanical tests

(a) Where possible, the test coupons attached on blades are to be located in an area between 0.5R to 0.6R, where R is the radius of the propeller.

(b) The test bars are not to be detached from the casting until the final heat treatment has been carried out. Removal is to be by non-thermal procedures.

(c) Separately cast test bars may be used subject to prior approval of the Society. The test bars are to be cast from the same heat as the castings represented and heat treated with the castings represented.

(d) At least one set of mechanical tests is to be made on material representing each casting in accordance with chapter 2 of Part XI.

(e) As an alternative to 9.2.8(d), where a number of small propellers of about the same size, and less than 1m in diameter, are made from one cast and heat treated in the same furnace charge, a batch testing procedure may be adopted using separately cast test samples of suitable dimensions. At least one set of mechanical tests is to be provided for each multiple of five castings in the batch.

9.2.9 Definition of skew, severity zones

Definition of skew, severity zones as specified in 10.3.6 of this Part, where applicable.

9.2.10 Non-destructive testing

(a) The requirements of visual teting, radiographic and ultrasonic testing as specified in 10.3.7 of this Part, where applicable.

(b) Liquid penetrant testing

Liquid penetrant testing procedure is to be submitted to the Society and is to be in accordance with ISO 3452-1:2013 or a recognized standard. The acceptance criteria are specified in 9.2.11.

For all propellers, separately cast blades and hubs, the surfaces covered by severity Zones A, B and C are to be liquid penetrant tested. Testing of Zone A is to be undertaken in the presence of the Surveyor, whilst testing of Zone B and C may be witnessed by the Surveyor upon his request.

If repairs have been made either by grinding or by welding, the repaired areas are additionally to be subjected to the liquid penetrant testing independent of their location and/or severity Zone. Weld repairs are, independent of their location, always to be assessed according to Zone A.

(c) Magnetic particle testing

Magnetic particle testing may be used in lieu of liquid penetrant testing for examination of martensitic stainless steels castings.

Magnetic particle testing procedure is to be submitted to the Society and is to be in accordance with ISO 9934-1:2016 or a recognized standard.

9.2.11 Acceptance criteria for liquid penetrant testing and magnetic particle testing

Acceptance criteria for liquid penetrant testing as specified in 10.3.8 of this Part, where applicable.

9.2.12 Repair of defects

(a) Defective castings are to be repaired in accordance with the requirements given in 9.2.12(b) to 9.2.12(e) and, where applicable, the requirements of 9.2.3 of this chapter .

(b) In general the repairs are to be carried out by mechanical means, e.g. by grinding, chipping or milling. The resulting grooves are to be blended into the surrounding surface so as to avoid any sharp contours. Complete elimination of the defective material is to be verified by liquid penetrant testing, or magnetic particle testing if applicable.

(c) Weld repairs are to be undertaken only when they are considered to be necessary and have prior approval of the Surveyor.

(d) 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 liquid penetrant testing. Welds having an area less than 5 cm^2 are to be avoided.

(e) In addition, the requirements of 10.3.9 (c) ~ (f) of this Part in force are to be complied with.

9.2.13 Welding repair procedure

(a) Before welding is started, manufacturer shall submit to the Society a detailed welding procedure specification covering the weld preparation, welding parameters, filler metals, preheating and post weld heat treatment and inspection procedures.

(b) All weld repairs are to be carried out in accordance with qualified procedures, and, by welders who are qualified to a recognized standard. Welding Procedure Qualification Tests are to be carried out in accordance with IACS UR W27 Appendix A and witnessed by the Surveyor.Defects to be repaired by welding are to be ground to sound material according to 9.2.9 of this Part. The welding grooves are to be prepared in such a manner which will allow a good fusion of the groove bottom. The resulting ground areas are to be examined in the presence of the Surveyor by liquid penetrant testing in order to verify the complete elimination of defective material.

(c) Welding is to be done under controlled conditions free from draughts and adverse weather.

(d) Metal arc welding with electrodes or filler wire used in the procedure tests is to be used. The welding consumables are to be stored and handled in accordance with the manufacturer s recommendations.

(e) Slag, undercuts and other imperfections are to be removed before depositing the next run.

(f) The martensitic steels are to be furnace re-tempered after weld repair. Subject to prior approval, however, local stress relieving may be considered for minor repairs.

(g) On completion of heat treatment the weld repairs and adjacent material are to be ground smooth. All weld repairs are to be liquid penetrant tested.

9.2.12 Marking

Markings are to be carry out according to the requirements of 10.3.12 of this Part.

Section 9.2 has been renumbered as follows:

9.2~~3~~3 Stainless Clad Steels

Section 9.3 has been renumbered as follows:

9.3~~4~~4 Intercrystalline Corrosion Tests of Stainless Steel

Chapter 10 Copper and Copper Alloys

10.3 Copper Alloy Castings for Propellers

Paragraph 10.3.6 has been amended as follows:

10.3.6 Definition of skew, severity zones

(a) Definition of skew

The skew of a propeller is defined as follows:

The maximum skew angle of a propeller blade is defined as the angle, in projected view of the blade, between a line drawn through the blade tip and the shaft centreline and a second line through the shaft centreline which acts as a tangent to the locus of the mid-points of the helical blade section, see Fig XI 10-2.

High skew propellers have a skew angle greater than 25°, low skew propellers a skew angle of up to 25°.

Fig. XI 10-2 has been amended as follows:

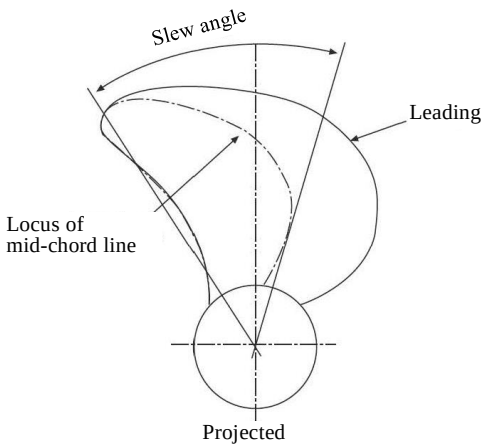


Fig. XI 10-2
Definition of Skew Angle

(b) Severity zones

In order to relate the degree of inspection to the criticality of defects in propeller blades and to help reduce the risk of failure by fatigue cracking after repair, propeller blades are divided into the three severity zones designated. A, B and C.

Zone A is the region carrying the highest operating stresses and which, therefore, requires the highest degree of inspection. Generally, the blade thicknesses are greatest in this area giving the greatest degree of restraint in repair welds and this in turn leads to the highest residual stresses in and around any repair welds. High residual tensile stresses frequently lead to fatigue cracking during subsequent service so that relief of these stresses by heat treatment is essential for any welds made in this zone. Welding is generally not permitted in Zone A and will only be allowed after special consideration by the Society. Every effort should be made to rectify a propeller which is either defective or damaged in this area without recourse to welding even to the extent of reducing the scantlings, if this is acceptable. If a repair using welding is agreed, postweld stress relief heat treatment is mandatory.

Zone B is a region where the operation stresses may be high. Welding should preferably be avoided but generally is allowed subject to prior approval from the Society.

Complete details of the defect / damage and the intended repair procedure are to be submitted for each instance in order to obtain such approval.

Zone C is a region in which the operation stresses are low and where the blade thicknesses are relatively small so that repair welding is safer and, if made in accordance with an approved procedure is freely permitted.

(i) Low-skew propellers

Zone A is in the area on the pressure side of the blade, from and including the fillet to 0.4R, and bounded on either side by lines at a distance 0.15 times the chord length C_r from the leading edge and 0.2 times C_r from the trailing edge, respectively (see Fig. XI 10-3). Where the hub radius (R_b) exceeds 0.27R, the other boundary of Zone A is to be increased to $1.5R_b$.

Zone A also includes the parts of the separate cast propeller hub which lie in the area of the windows as described in Fig. XI 10-5 and the flange and fillet area of controllable pitch and built-up propeller blades as described in Fig. XI 10-6.

Zone B is on the pressure side the remaining area up to 0.7R and on the suction side the area from the fillet to 0.7R (see Fig. XI 10-2).

Zone C is the area outside 0.7R on both sides of the blade. It also includes the surface of the hub of a monoblock propeller and all the surfaces of the hub of a controllable pitch propeller other than those designated Zone A above.

Fig. XI 10-3 has been added as follows:

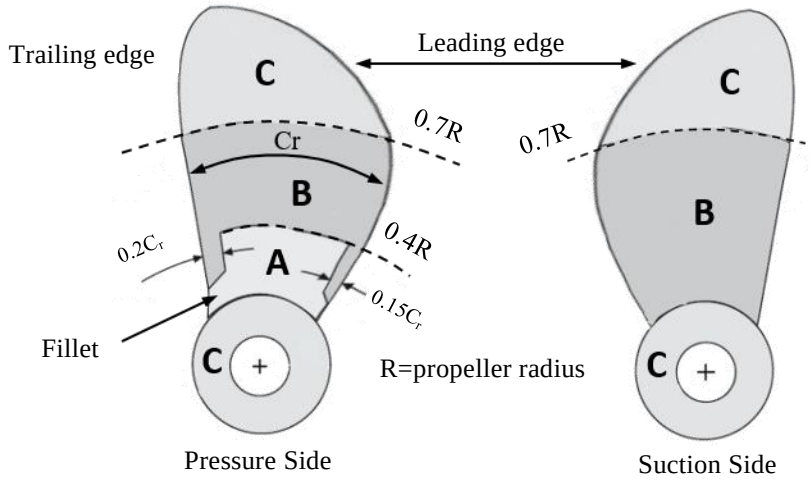


Fig. XI 10-3
Severity Zones for Integrally Cast Low Skew Propellers

(ii) High-skew propellers

Zone A is the area on the pressure face contained within the blade root-fillet and a line running from the junction of the leading edge with the root fillet to the trailing edge at 0.9 R and at passing through the mid-point of the blade chord at 0.7 R and a point situated at 0.3 of the chord length from the leading edge at 0.4 R. It also includes an area along the trailing edge on the suction side of the blade from the root to 0.9 R and with its inner boundary at 0.15 of the chord lengths from the trailing edge. Zone B constitutes the whole of the remaining blade surfaces. Zone A and B are illustrated in Fig. XI 10-4.

Fig. XI 10-4 has been added as follows:

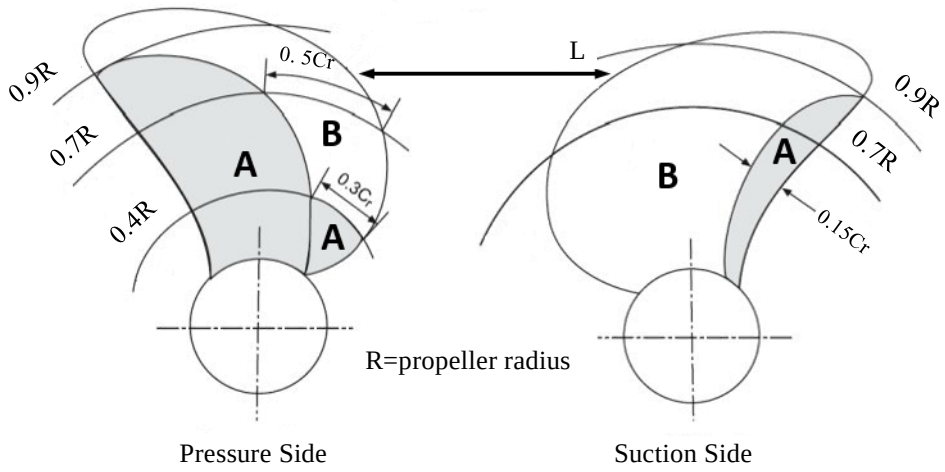


Fig. XI 10-4
Severity Zones in Blades with Skew Angles greater than 25º

Fig. XI 10-5 has been added as follows:

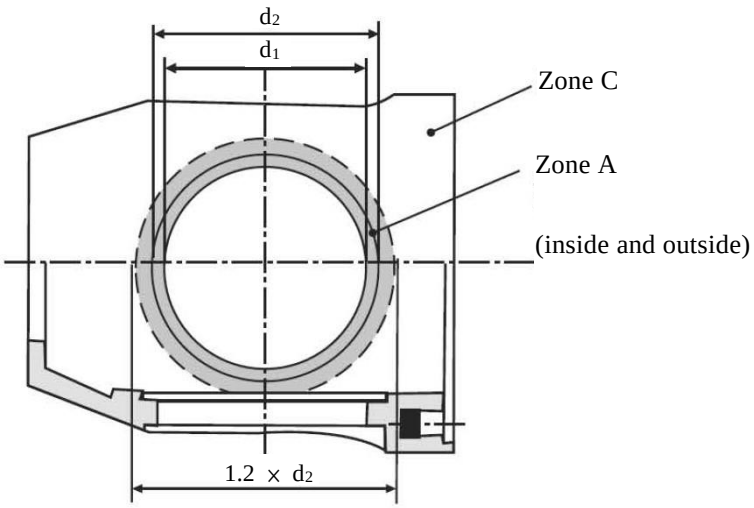
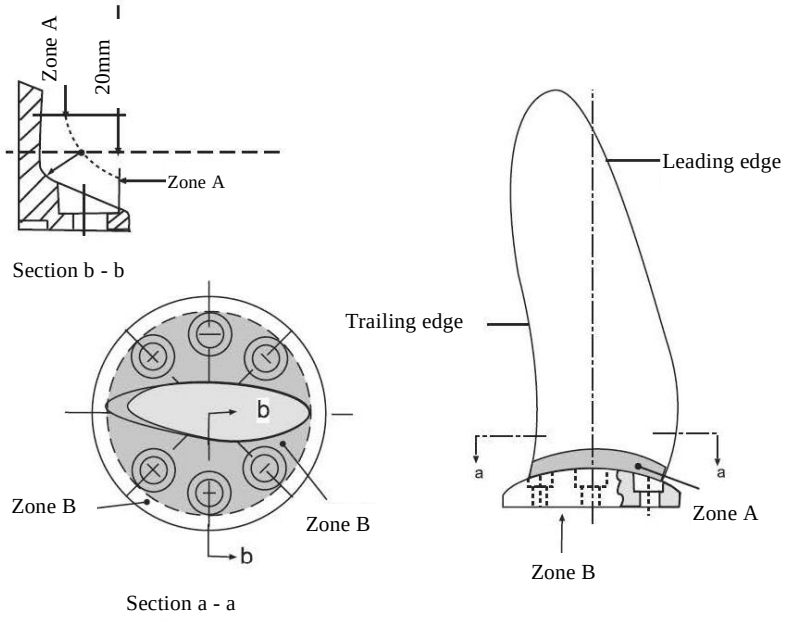


Fig. XI 10-5
Severity Zones for Controllable Pitch Propeller Boss

Fig. XI 10-6 has been added as follows:



Note: The remaining surface of the propeller blades is to be divided into the severity zones as given for solid cast propellers (refer to Fig. XI 10-3 and Fig. XI 10-4)

Fig. XI 10-6
Severity Zones for Controllable Pitch and Built-up Propeller

~~10.3.6 Repair of defects~~

~~(a) In the event of finding unacceptable defects in a propeller casting, the defects may be removed by machining, chipping or grinding, etc. After removal of the defects, adequate non-destructive examinations are to be carried out to ensure that all defects have been completely removed.~~

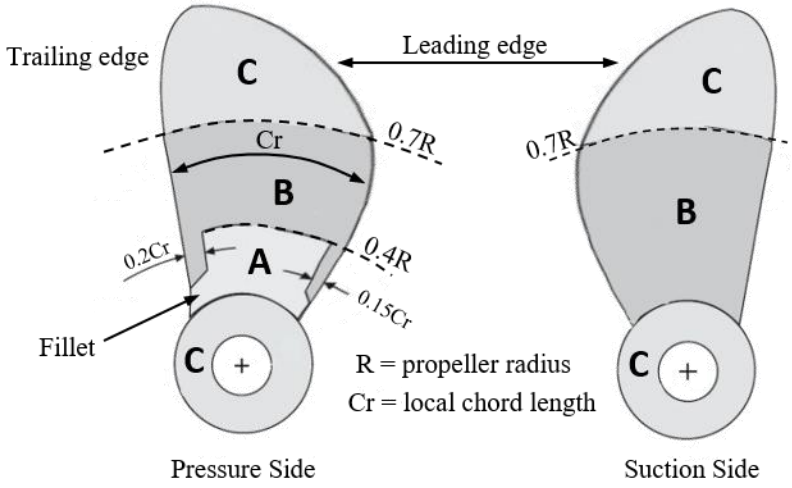
~~(b) Weld repairs of defective propeller castings are to be undertaken only when they are considered to be necessary and approved by the Surveyor. In general, welds having an area less than 5 cm² are to be avoided. All weld repairs are to be carried out in accordance with approved procedures and practices, and are to be to the satisfaction of the Surveyor.~~

~~(c) For the purpose of weld repairs, the blades of propellers, including CPP blades, are divided into three severity Zones A, B and C as shown in Fig. XI 10-2.~~

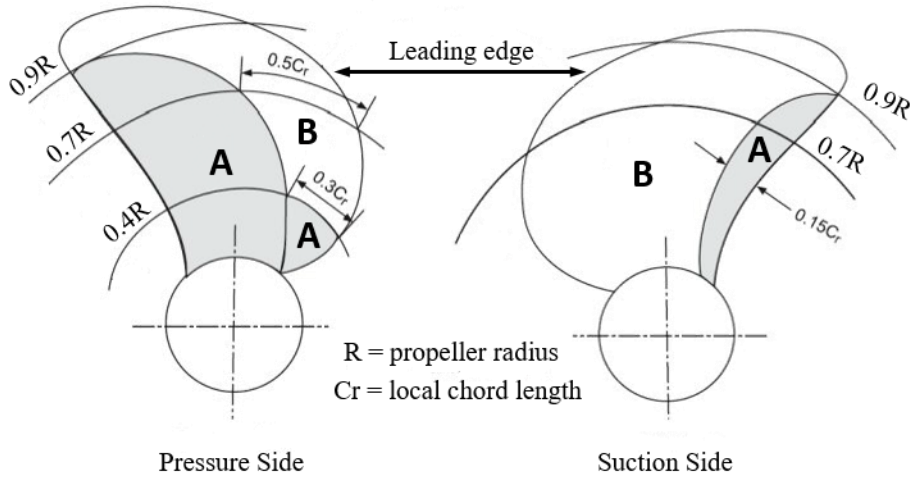
~~(i) Weld repair is not permitted in Zone A unless otherwise special approval.~~

~~(ii) Prior approval by the Surveyor is required for any weld repair in Zone B. Full details of the repair procedure are to be submitted for each case.~~

~~(iii) Repair by welding is allowed in Zone C provided in compliance with the requirements of 10.3.5(b) above.~~



(a) Blades with propeller skew angles less the 25°



(b) Blades with propeller skew angles greater the 25°

~~Fig. XI 10-2~~
~~Severity Zones of Weld Repairs for Propeller Castings~~

~~(d) After weld repairs, the portions repaired by welding are to be subjected to the stress relieving heat treatment. On completion of heat treatment, the weld repairs and adjacent metal are to be ground smooth and examined by the non-destructive testing such as dyepenetrant inspection, to confirm that the repaired portions are free from harmful defects.~~

~~(e) Where propeller castings from which defects were removed are used in that condition or where such defects were repaired by welding, the employment of repaired castings is to be approved by the Surveyor.~~

~~(f) The manufacturer is to maintain full records detailing the weld procedure, stress relieving heat treatment, final inspection results, and extent and location on drawings of repairs made to each casting. These records are to be confirmed by the Surveyor.~~

Paragraph 10.3.7 has been added as follows:

10.3.7 Non-destructive testing

(a) Qualification of personnel involved in NDT

Refer to UR W35 Requirements for NDT Suppliers, sections 2.3, 2.4 and 2.5.

(b) Visual testing

All finished castings are to be 100% visually inspected by the manufacturer. Castings are to be free from cracks, hot tears or other imperfections which, due to their nature, degree or extent, will interfere with the use of the castings. A general visual examination is to be carried out by the Surveyor.

(c) Liquid penetrant testing

Liquid penetrant testing procedure is to be submitted to the Society and is to be in accordance with ISO 3452-1:2013 or a recognized standard. The acceptance criteria are specified in 10.3.8.

The severity Zone A is to be subjected to a liquid penetrant testing in the presence of the Surveyor.

In Zones B and C the liquid penetrant testing is to be performed by the manufacturer and may be witnessed by the Surveyor upon his request.

If repairs have been made either by grinding, straightening or by welding the repaired areas are additionally to be subjected to the liquid penetrant testing independent of their location and/or severity zone.

(d) Radiographic and ultrasonic testing

When required by the Society or when deemed necessary by the manufacturer, further nondestructive testing (e.g. radiographic and/or ultrasonic testing) are to be carried out. The acceptance criteria or applied quality levels are to be agreed between the manufacturer and the Society in accordance with a recognized standard.

Note: due to the attenuating effect of ultrasound within cast copper alloys, ultrasonic testing may not be practical in some cases, depending on the shape/type/thickness, and graingrowth direction of the casting.

In such cases, effective ultrasound penetration into the casting should be practically demonstrated on the item. This would normally be determined by way of back-wall reflection, and/or target features within the casting.

Paragraph 10.3.8 has been added as follows:

10.3.8 Acceptance criteria for liquid penetrant testing

(a) Definitions of liquid penetrant indications

(i) Indication

In the liquid penetrant testing an indication is the presence of detectable bleed-out of the penetrant liquid from the material discontinuities appearing at least 10 minutes after the developer has been applied.

(ii) Relevant indication

Only indications which have any dimension greater than 1.5 mm shall be considered relevant for the categorization of indications.

(iii) Non-linear indication

an indication with a largest dimension less than three times its smallest dimension (i.e. $l < 3$ w).

(iv) Linear indication

an indication with a largest dimension three or more times its smallest dimension (i.e. $l \geq 3$ w).

(v) Aligned indications

(1) Non-linear indications form an alignment when the distance between indications is less than 2mm and at least three indications are aligned. An alignment of indications is considered to be a unique indication and its length is equal to the overall length of the alignment.

(2) Linear indications form an alignment when the distance between two indications is smaller than the length of the longest indication.

(vi) Illustration of liquid penetrant indication is given in Fig. XI 10-7.

Fig. XI 10-7 has been added as follows:

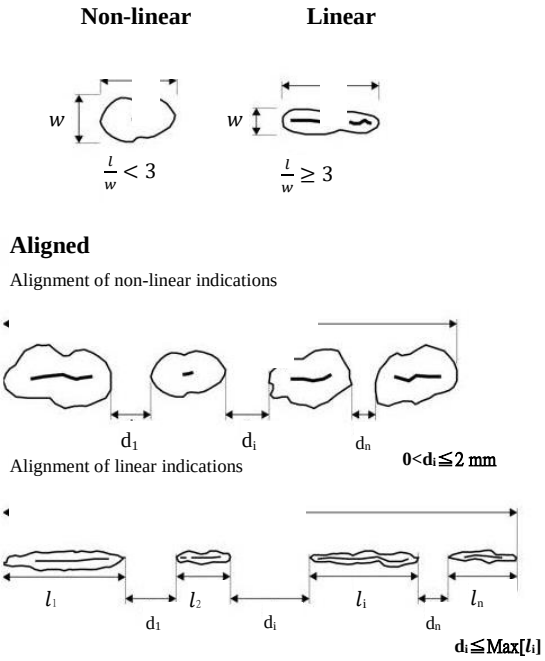


Fig. XI 10-7
Shape of Indications

(b) Acceptance standard

The surface to be inspected is to be divided into reference areas of 100 cm^2. Each reference area may be square or rectangular with the major dimension not exceeding 250 mm.

The area shall be taken in the most unfavourable location relative to the indication being evaluated.

The relevant indications detected shall with respect to their size and number, not exceed the values given in the Table XI 10-3.

Areas which are prepared for welding are independent of their location always to be assessed according to Zone A. The same applies to the welded areas after being finished machined and/or grinded.

Table XI 10-3 has been added as follows:

Table XI 10-3
Allowable Number and Size of Relevant Indications in a Reference Area of 100cm², Depending on Severity Zones(1)

Severity zones	Max. total number of indications	Type of indication	Max. number of each type(1) (2)	Max. acceptable value for "a" or "I" of indications [mm]
A	7	Non-linear	5	4
		Linear	2	3
		Aligned	2	3
B	14	Non-linear	10	6
		Linear	4	6
		Aligned	4	6
C	20	Non-linear	14	8
		Linear	6	6
		Aligned	6	6

Notes:

(1) Singular non-linear indications less than 2 mm for Zone A and less than 3 mm for the other zones are not considered relevant. The total number of non-linear indications may be increased to the max.

(2) Total number, or part thereof, represented by the absence of linear or aligned indications.

Paragraph 10.3.9 has been added as follows:

10.3.9 Repair of defects

(a) Definition

Indications exceeding the acceptance standard of Table XI 10-3, cracks, shrinkage cavities, sand, slag and other non-metallic inclusions, blow holes and other discontinuities which may impair the safe service of the propeller are defined as defects and must be repaired.

(b) Repair procedures

In general the repairs shall be carried out by mechanical means, e. g. by grinding, chipping or milling. Welding may be applied subject to the agreement of the Society if the requirements of 10.3.9(c), (d) and/or (e) below will be complied with.

After milling or chipping grinding is to be applied for such defects which are not to be welded. Grinding is to be carried out in such a manner that the contour of the ground depression is as smooth as possible in order to avoid stress concentrations or to minimise cavitation corrosion. Complete elimination of the defective material is to be verified by liquid penetrant testing.

Welding of areas less than 5 cm^2 is to be avoided.

(c) Repair of defects in Zone A

In Zone A, repair welding will generally not be allowed unless specially approved by the Society.

In some cases the propeller designer may submit technical documentation to propose a modified Zone A based on detailed hydrodynamic load and stress analysis for consideration by the Society.

Grinding may be carried out to an extent which maintains the blade thickness of the approved drawing.

The possible repair of defects which are deeper than those referred to above is to be considered by the Society.

(d) Repair of defects in Zone B

Defects that are not deeper than dB = (t/40) mm (t = min. local thickness in mm according to the Rules) or 2 mm (whichever is greatest) below min. local thickness according to the Rules of the Society should be removed by grinding.

Those defects that are deeper than allowable for removal by grinding may be repaired by welding.

(e) Repair of defects in Zone C

In Zone C, repair welds are generally permitted.

(f) Repair documentation

The foundry is to maintain records of inspections, welding, and any subsequent heat treatment, traceable to each casting.

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 to the Society for approval.

Paragraph 10.3.10 has been added as follows:

10.3.10 Welding repair procedure

Please refer to 2.7 of Part XII.

Paragraph 10.3.11 has been added as follows:

10.3.11 Straightening

(a) Application of load

For hot and cold straightening purposes, static loading only is to be used.

(b) Hot straightening

Weld repaired areas may be subject to hot straightening, provided it can be demonstrated that weld properties are not impaired by the hot straightening operations.

Straightening of a bent propeller blade or a pitch modification should be carried out after heating the bent region and approximately 500 mm wide zones on either side of it to the suggested temperature range given in Table XII 2-5.

The heating should be slow and uniform and the concentrated flames such as oxy-acetylene and oxy-propane should not be used. Sufficient time should be allowed for the temperature to become fairly uniform through the full thickness of the blade section. The temperature must be maintained within the suggested range throughout the straightening operation. A thermocouple instrument or temperature indicating crayons should be used for measuring the temperature.

(c) Cold straightening

Cold straightening should be used for minor repairs of tips and edges only. Cold straightening on CU 1, CU 2 and CU 4 bronze should always be followed by a stress relieving heat treatment, see Table XII 2-5.

Paragraph 10.3.7 has been renumbered and amended as follows:

10.3.~~7~~12 Marking

Each propeller which has satisfactorily complied with the requirements of this Chapter is to be clearly stamped with the following markings:

(a) Name or mark of the manufacturer.

(b) Material grade.

(c) Heat number, casting number or another mark enabling the full history of the casting process to be traced back.

(d) Name or mark of the purchaser, if required.

(e) The Society's mark and the Surveyor's certificate number and date of final inspection.

(f) Skew angle for high skew propeller.

(g) Ice class symbol, where applicable.

Chapter 17 Side Scuttles

Paragraph 17.4.2 has been amended as follows:

17.4.2 ~~Hydrostatic~~ On-board tests

~~Each side scuttle is to be tested hydrostatically without fitting plug and deadlight at a pressure not less than 0.07 MPa, and to withstand the test without leaking or any other defect.~~

To ensure that the side scuttle and packing are watertight when fitted, a hose test or equivalent is to be carried out by the shipbuilder to the satisfaction of the Surveyor. The hose test is to consist of hosing the side scuttle by means of at least 12.5 mm nominal size hose held at a distance of not more than 1.5 m from the side scuttle and with a water pressure of a least 250 kPa.

Paragraph 17.4.3 has been added as follows:

17.4.3 Shop test

An equivalent hydraulic test is to be carried out by the manufacturer before despatch by means of batch tests (approximately 10 % of the delivery batch, with a minimum of two side scuttles). The side scuttle is to be tested by being subjected to the hydraulic pressures given in Table XI 17-1, under the following conditions:

(a) Procedure 1: With glass pane and open deadlight except for Type A, with diameters of 350 mm and 400 mm, where at a test pressure of 150 kPa the deadlight is to be closed.

(b) Procedure 2: Without glass pane and with closed deadlight.

The rationale behind procedure 1 is that practice has shown that for normal side scuttles of Type A, with a diameter of 350 mm, 400 mm or 450 mm, when subjected to a test pressure of 150 kPa, the deflection between the fixed points is so heavy that leakage occurs. A closed deadlight would support the glassholder and diminish the deflection.

Table XI 17-1 has been added as follows:

Table XI 17-1
Test Pressures for Watertightness

Side scuttle type	Test pressure(kPa)	
	Procedure 1	Procedure 2
A	150	100
B	75	50
C	35	---

Paragraph 17.4.4 has been added as follows:

17.4.4 Mechanical strength test

(a) Prototype test

A prototype side scuttle without glass pane and with closed deadlight is to be subjected to a mechanical strength test by a punch method using the test pressures given in Table XI 17-2, see Fig. XI 17-1.

Fig. XI 17-1 has been added as follows:

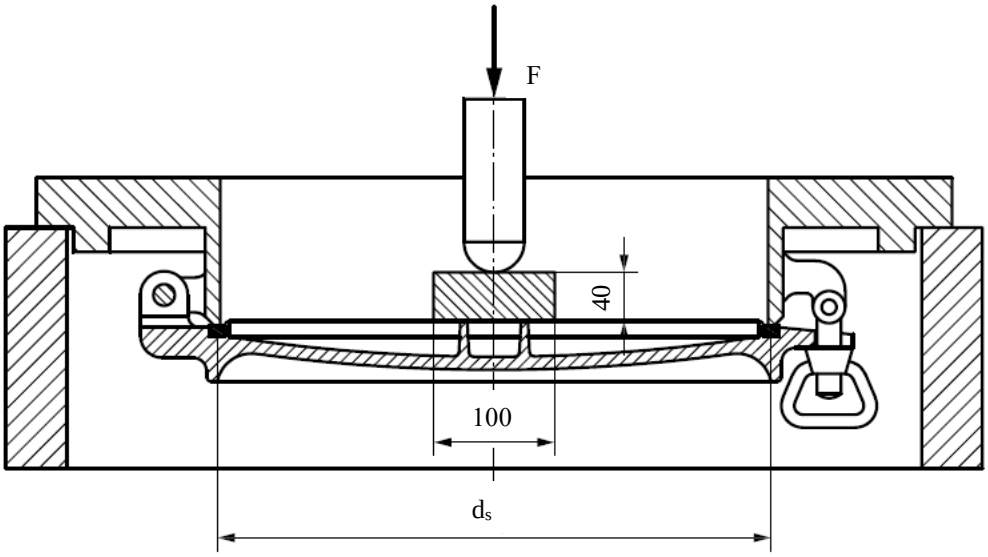


Fig. XI 17-1
Prototype Test

(b) Test performance

(i) The punch is to be placed that side of the deadlight which could be subjected to direct contact with the sea. If the construction of the deadlight makes it necessary, a plate of 100 mm diameter and 10 mm thickness may be placed between the punch and the deadlight.

(ii) When subjected to the pressure given in Table XI 17-2, the permanent deformation of the deadlight is not to exceed 1% of the nominal size of the side scuttle.

Table XI 17-2 has been added as follows:

Table XI 17-2
Test Pressures for Mechanical Strength

Side scuttle type	Test pressure(kPa)
A	240
B	120

Note: The test pressures in Table XI 17-2 are the values assumed for the calculation of the proof loads to be applied by the punch test.

Paragraph 17.4.5 has been added as follows:

17.4.5 Fire resistance test

Side scuttles for fire-resistant constructions (series P) shall have been subjected to prototype testing for fire resistance, see ISO 5797.

AMENDMENT TO "THE RULES FOR THE CONSTRUCTION AND CLASSIFICATION OF STEEL SHIPS 2019 AND AMENDMENTS THEREOF "

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

List of major changes in Part XV from 2019 edition

13.4	New
14.3.3(d)	Revised
24.1.4	Deleted
24.1.5~6	Renumbered
24.11.7	Revised
24.12.1	Revised
24.12.2	Revised
24.12.4	Revised
Fig. XV 24-11	Revised
24.12.9	Revised
24.12.10~13	New
Fig. XV 24-12	New
25.4.2	New

Rules for the Construction and Classification of Steel Ships 2019 and amendments thereof have been partly amended as follows:

Chapter 13 Superstructures and Deckhouses

Section 13.4 has been added as follows:

13.4 Aluminum Superstructures and Deckhouses

13.4.1 Scantlings

Where deckhouses are constructed of aluminum alloys, the required plate thickness and stiffener section modulus, SM, are first to be determined as required for mild steel superstructures and deckhouses, and are then to be increased by the material factor, $(235/ Y_{aw})^{0.50}$ or $235/Y_{aw}$, as indicated below.

For all deck and bulkhead plating and stiffeners, the required thickness and section modulus for aluminum alloy plate and shapes are obtained from the following equations:

Plating:

$$t_{al} = t_s \left(\frac{Y_S}{Y_{aw}}\right)^{0.5} \quad \text{mm}$$

Stiffeners:

$$SM_{al} = \frac{Y_S}{Y_{aw}} SM_S \quad \text{cm}^3$$

Where:

t_{al}	=	minimum thickness of aluminum plate.
t_s	=	required plate thickness for steel obtained from 12.4
SM_{al}	=	minimum section modulus of aluminum stiffeners.
SM_S	=	minimum section modulus of steel stiffeners, as determined from Chapter 10 and Chapter 11 for deck stiffeners and 13.2.3 for bulkhead stiffeners
Y_S	=	235 N/mm^2
Y_{aw}	=	minimum yield strength of the welded aluminum alloy under consideration at 0.20% offset in N/mm^2

In addition, the aluminum stiffeners are to have a depth not less than that given below:

$$d_{al} = 3SM_S \frac{d_S}{SM_{al}}$$

where

d_{al}	=	minimum required depth for aluminum stiffeners.
d_S	=	minimum required depth for steel stiffeners; not to be less than 100 mm depth for fronts and 80 mm for sides and ends.

Chapter 14 Bulwarks, Freeing Ports, Side Scuttles, Shell Doors and Gangways

Paragraph 14.3.3(d) has been amended as follows:

14.3.3 Applcation of Side Scuttles

~~(d) Side scuttles exposed to direct impact from waves, or that are to spaces within the first tier of side shell or superstructures, first tier deckhouses on the freeboard deck which have unprotected deck openings leading to spaces below the freeboard deck inside, or deckhouses considered buoyant in stability calculations, are to be Type A side scuttles, Type B side scuttles or equivalent thereto.~~

(d) The side scuttles as mentioned in (i) or (ii) as below, are to be type A, type B or equivalent thereof:

(i) Side scuttles exposed to direct impact from waves;

(ii) Side scuttles to the following spaces:

(1) within the first tier of side shell or superstructures;

(2) within the first tier deckhouses on the freeboard deck which have unprotected deck openings leading to spaces below the freeboard deck inside; or

(3) within the deckhouses considered buoyant in stability calculations.

Chapter 24 Rudders

Paragraph 24.1.4 has been deleted as follows:

~~24.1.4 Equivalence~~

~~(a) The Society may accept alternatives to requirements given in this Chapter, provided they are deemed to be equivalent.~~

~~(b) Direct analyses adopted to justify an alternative design are to take into consideration all relevant modes of failure, on a case by case basis. These failure modes may include, amongst others: yielding, fatigue, buckling and fracture. Possible damages caused by cavitation are also to be considered.~~

~~(c) If deemed necessary by the Society, lab tests, or full scale tests may be requested to validate the alternative design approach.~~

Paragraphs 24.1.5 and 24.1.6 have been renumbered as follows:

24.1.~~5~~4 Special consideration for frequently steering

(a) For rudders intended for ships which may be frequently steered at a large helm angle when sailing at their maximum speed, such as fishing vessels, the diameters of rudder stocks and pintles, and the section modulus of main pieces, are not to be less than 1.1 times as required in this Chapter.

(b) For rudders intended for ships which may require quick steering, the diameter of rudder stocks is to be properly increased beyond the requirements in this Chapter.

24.1.~~6~~5 Design and arrangement requirements

(a) Sleeves and bushes

Bearings located up to well above the designed maximum load line are to be provided with sleeves and bushes.

(b) Rudder carriers

Suitable rudder carriers are to be provided according to the form and the weight of the rudder, and care is to be taken to provide efficient lubrication at the support.

(c) Prevention of jumping

A suitable arrangement is to be provided to prevent the rudder from jumping due to wave shocks.

Paragraph 24.11.7 has been amended as follows:

24.11.7 Section modulus

Steering nozzle is to have section modulus not less than:

$$SM = d^2bV^2Q \qquad cm^3$$

where:

d	=	Nozzle inner diameter	m
b	=	Nozzle length	m
V	=	Design speed in ahead condition	knots
Q	=	Reduction factor conditional on material type	
	=	1.0 for mild steel	
	=	0.78 for H32 strength steel	
	=	0.72 for H36 strength steel	
	=	0.68 for H40 strength steel	

Paragraph 24.12.1 has been amended as follows:

24.12 Azimuthal Thruster

24.12.1 Plans and documents

The following plans and documents are to be submitted to the Society as applicable:

~~(a) General~~ Overall arrangement of the thruster unit

~~(b) Structural items (nozzle, bracing, etc.)~~
Detailed nozzle drawing with nozzle profile type indicated

~~(c) Structural connection to hull~~
Detailed plans of thruster connection, bolted or welded, to the hull

~~(d) Propeller drawings~~
Nozzle strut drawings including details of the connections to the propeller gear housing and the nozzle duct

~~(e) Bearing details~~ Material list and properties of all structure components

(f) ~~Propeller and intermediate shafts~~
Manufacturer specified/calculated maximum load on the unit for crash stop condition

~~(g) Gears~~

~~(h) Rotating mechanism of the thruster~~

~~(i) Thruster control system~~

~~(j) Piping systems connected to thruster~~

~~(k) Manufacturer specified/calculated maximum load on the unit for crash stop condition~~

Note: For specific requirements of machinery components, see Part II, Part IV, Part VI, etc. of the Rules as applicable.

Paragraph 24.12.2 has been amended as follows:

24.12.2 Application scope

(a) Requirements in this section are applicable to Azimuthal Thrusters (also referred as integrated nozzle propellers), as illustrated in Fig. XV 24-11 of this Chapter, with the following restrictions:

~~The inner diameter of thruster's nozzle is of 5 meters or less.~~

(i) The inner diameter of thruster's nozzle is of 5 meters or less

(ii) Azimuthal thrusters designed for propulsion and maneuvering

(b) Azimuthal thrusters outside of the above application scope are subject to special consideration with all supporting documents and calculations submitted to the Society for review.

The submitted documents and calculations include, but are not limited to, the following items:

(i) The drawings and plans of the thruster with indications of design operating angles and the torque considered necessary to operate the thruster at the design operating angle

(ii) The calculated thruster section modulus

(iii) The calculated maximum water induced pressure of the thruster under design speed (both ahead and astern conditions) and at the design operating angle, and

(iv) The calculated maximum shear and bending of thruster support structure under design speed (both ahead and astern conditions) and at the design operating angle

Paragraph 24.12.4 has been amended as follows:

24.12.4 Design force

The design force, F, for azimuthal thrusters is the maximum load for crash stop condition or as obtained from the following equation, whichever is greater:

$$F = 132\, K_1\, K_2\, K_3\, A V^2 \quad N$$
$$= F_1 + F_2$$
$$F_1 = 132\, K_1\, K_2\, K_3\, A_{eq} V^2$$
$$F_2 = 132\, K_1\, K_2\, K_3\, A_{tb} V^2$$

where:

F_1 = Design force associated with the turning movement of the thruster nozzle

F_2 = Design force associated with the turning movement of other component of the thruster

where:

K_1 = Factor depending on the aspect ratio λ of the rudder area.

	=	$\frac{1}{3}(\lambda + 2)$ where $\lambda = \frac{d_m{}^2}{A}, \lambda \leq 2$	
d_m	=	Mean external diameter of the nozzle	m
	=	$0.5(d_f + d_a)$	
d_f, d_a	=	Fore and aft nozzle external diameter as shown in Fig. XV 24-11(a) of this Chapter	m
b	=	Nozzle length as shown in Fig. XV 24-11(a) of this Chapter	m
A	=	$A_{eq} + A_{tb}$	m^2
A_{eq}	=	Nominal projected area of nozzle cylinder, not to be taken less than $1.35\ d_m \times b$.	
A_{tb}	=	Effective projected areas of the azimuthal thruster components forward of the nozzle*	m^2
d_o	=	Outer diameter of steering tube as shown in Fig. XV 24-11(a) of this Chapter	m
K_2	=	1.9 for ahead condition	
	=	1.5 for astern condition	
K_3	=	1.15, as specified in 24.2.1 of this Chapter	
V	=	As defined in 24.2.1. of this Chapter	

Note: Effective projected areas forward of the azimuthal thruster nozzle are the parts that actually contribute to generate lift force as the thruster turns. For example a torpedo shaped component, the projected profile area is to be proportionally reduced in order to be taken as the effective projected area. If this resultant effective projected area is too small to compare with the overall effective projected area, it may be discounted.

Fig. XV 3-16 has been amended as follows:

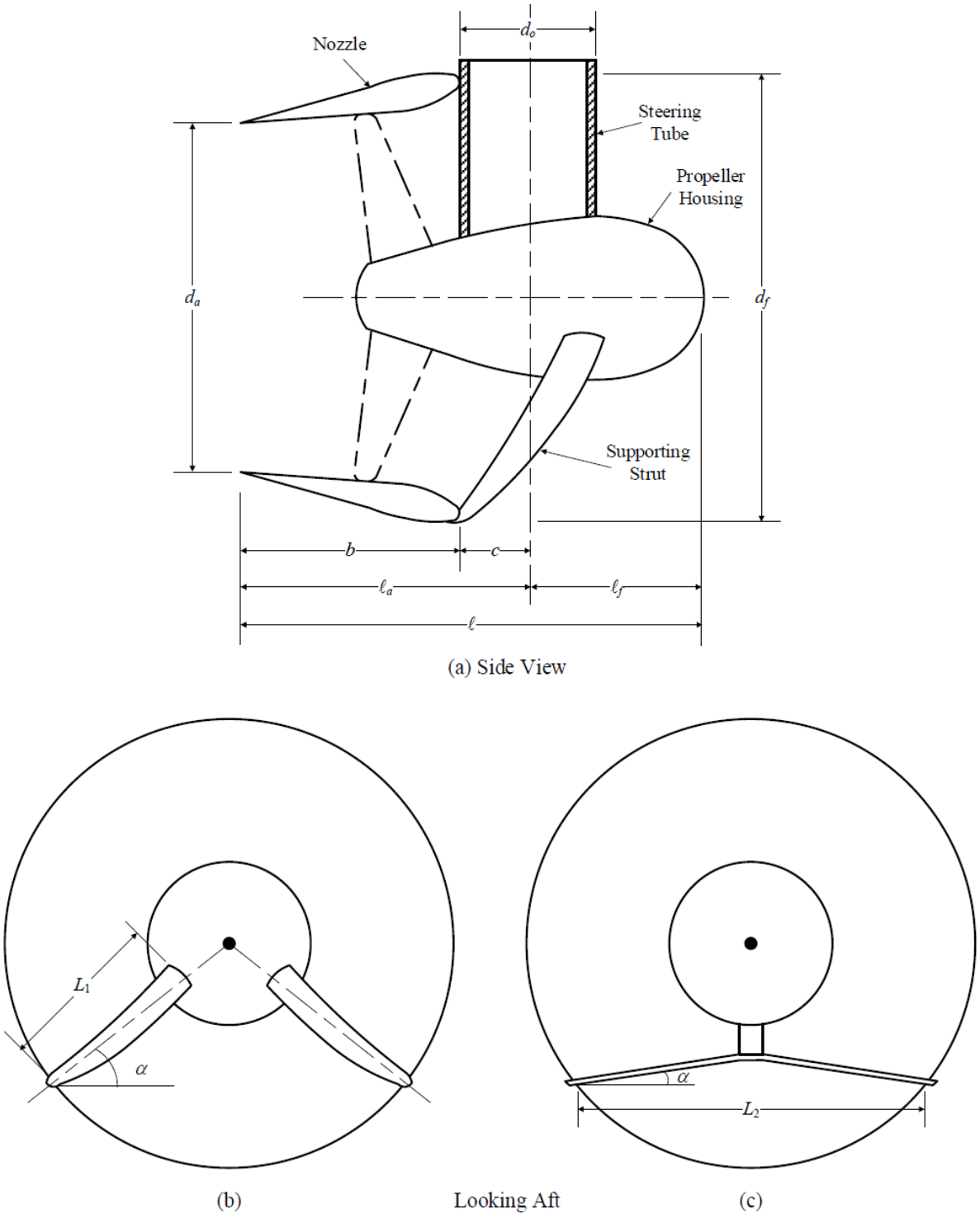


Fig. XV 24-11
~~An Example of Azimuthal Thruster~~An Illustration of Azimuthal Thruster

Paragraph 24.12.9 has been amended as follows:

24.12.9 Section modulus

Section modulus of azimuthal thruster nozzles is to be not less than:

$$SM = 1.1\, d^2 b V^2 Q \qquad cm^3$$

where:

d	=	Nozzle inner diameter	m
b	=	Nozzle length	m
V	=	Design speed in ahead condition	knots
Q	=	Reduction factor conditional on material type	
	=	1.0 for mild steel	
	=	0.78 for H32 strength steel	
	=	0.72 for H36 strength steel	
	=	0.68 for H40 strength steel	

Paragraphs 24.12.10~24.12.13 have been added as follows:

24.12.10 Thruster Nozzle Top Connections

The structure where nozzle top and the steering tube are connected is to comply with the following requirements as the case may be.

(a) Welded Connection

Refer to 24.12.13 of this Chapter.

(b) Bolted Connection

The following are to be complied with:

(i) Flange couplings are to be supported by an ample bodies of metal worked out from both sides, which provide the structural continuity to bear the anticipated loads. In certain cases, stress analysis may be required to verify that the stress level within the flanges is not greater than 80% of the yield strength.

(ii) Flange thickness is to be comply with 24.8.1(b) or 24.8.2 (c) of this Chapter, as applicable.

(iii) The coupling bolts are to be of fitted bolts and meet the scantling requirements specified in 24.8.1(a) or 24.8.2(a) of this Chapter, as applicable.

(iv) Effective means are to be fitted for locking the nuts in place.

(v) The smallest distance from the edge of the bolt holes to the edge of the flange is not to be less than 2/3 of the bolt diameter.

24.12.11 Nozzle Strut

(a) General

(i) Structural transitions of strut connected to nozzle and propeller housing are to avoid abrupt changes and the fillet radius is not to be less than 75 mm unless the stress in the radius area is verified to be acceptable by direct analysis.

(ii) The width and thickness of strut plating are to have a gradual transition for smooth load carrying.

(iii) Material properties of the nozzle strut and the structure components it is in direct contact are to be compatible (Material properties of dissimilar parts and components in direct contact with each other are to be submitted for review of compatibilities, such as galvanic potential).

(b) Plate Thickness

The minimum plate thickness of the strut is not to be less than obtained from the following:

$$t = \sqrt{\frac{3F_{eqv} \cdot L_{eqv}}{2b_{avg} \cdot \sigma_F}} \quad mm$$

but not to be taken less than 7.5 mm

where

F_{eqv} = equivalent load perpendicular to strut applied at ½ L_{eqv}, in kN

= pA_{strut}, where α is greater than 15° as shown in Fig. XV 24-11(b) of this Chapter

= W_p weight of transmission shaft, gear, and bearings, in kN, where α is less than or equal to 15° as shown in Fig. XV 24-11(c) of this Chapter

A_{strut} = equivalent area of nozzle supporting strut, in m^2

= L_1 b_{avg}, as shown in Fig. XV 24-11(b) of this Chapter

= L_2 b_{avg}, as shown in Fig. XV 24-11(c) of this Chapter

L_{eqv} = equivalent length of nozzle supporting strut, in m

= L_1, as shown in Fig. XV 24-11(b) of this Chapter

= L_2, as shown in Fig. XV 24-11(c) of this Chapter

b_{avg} = average width of nozzle strut plate, in m

σ_F = minimum yield stress of the local material, in N/mm^2

p is as defined in 24.12.6 of this Chapter

24.12.12 Direct Analysis

Direct calculations may be accepted in lieu of applying prescriptive formulas presented in 24.12.4 to 24.12.11 of this Chapter, provided that the following are complied with and satisfied:

(a) Additional Information to Submit

Where the design is based on direct calculations such as FEM, the full analysis is to be submitted for review including:

(i) Software used;

(ii) FE model;

(iii) Loading conditions and load cases including but not limited to normal, heavy duty, and crash stop;

(iv) Applied loads and boundary conditions;

(v) Stress and deflection results, and

(vi) Any other data and information associated with the analysis.

(b) Acceptance Criteria

The results of analysis verify the following:

(i) The maximum nominal stress is not exceed 50% of the yield strength. For the crash stop load case, the maximum local stress in the nozzle and its connection is not to exceed 80% of the yield strength;

(ii) The relative radial displacement, s_{rel} , between nozzle inner shell and propeller tip is not to exceed the following:

$s_{rel} = 0.1 s_{cl}$ mm

where
s_{cl} = design clearance (the smallest distance) between nozzle inner shell and propeller tip without any loads applied

24.12.13 Welding and Non-destructive Testing (NDT)

Welding on azimuthal thruster is to be in accordance with the requirements of welding for hull construction as specified in Part XII of the Rules as applicable.The required extent of NDT is to be indicated on the drawings and plans.NDT is to be performed in accordance with the requirements for non-destructive inspection of hull welds as specified in Part XII of the Rules where applicable and any additional requirements specified by the manufacturer.

(a) Nozzle Welding

(i) The inner and outer nozzle shell plating is to be welded to the internal stiffening ring webs with double continuous welds as far as practicable. Plug/slot welding is prohibited for the inner shell, but may be acceptable for the outer shell plating, provided that the nozzle ring web spacing is not greater than 350 mm.

(ii) Volumetric and surface examination are to be performed on weldments of the inner and outer shell plating, as well as the internal ring web welds as appropriate.

(b) Connection Welding

Where the connections between nozzle and the hull/steering tube, strut and nozzle/propeller housing are welded (see Fig. XV 24-11 and Fig. XV 24-12 of this Chapter), the following requirements are to be complied with:

(i) Scantlings of the welded connection and welding type/size are to be specially considered and detailed stress analysis may be required to be submitted.

(ii) Welding at the portion of the thruster assembly that penetrates the hull is to be of full penetration and in accordance with the requirement of welding for hull construction as specified in Part XII of the Rules, as applicable.

(ii) Volumetric or surface examination is to be performed on the welds of brackets and the shell penetration.

Fig. XV 24-12 has been added as follows:

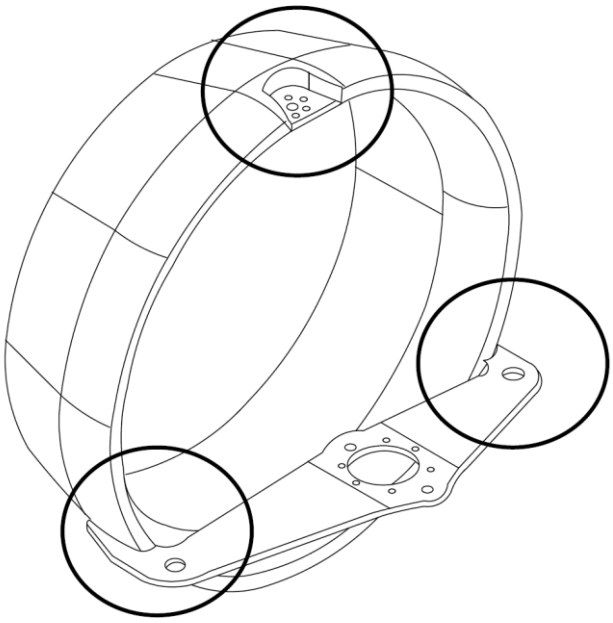


Fig. XV 24-12

Chapter 25 Equipment

Paragraph 25.4.2 has been added as follows:

25.4 Chain Cables

25.4.1 Chain cables for anchors are to be stud link chains of Grades E1, E2 or E3, specified in 13.1.3 of Part XI. In the case of superior holding ability anchor, the Grade E1 chain is not to be used.

25.4.2 Wire rope may be used in place of chain cable for bower anchors on ships with less than 40 m in length and subject to the following conditions:

(a) The length of the wire rope is to be equal to 1.5 times the corresponding tabular length of chain cable (column 6 of Table XV 25-1) and their strength is to be equal to that of tabular chain cable of Grade E1 (Chatper 13 Part XI, Table 13-3).

(b) A short length of chain cable is to be fitted between the wire rope and anchor having a length of 12.5 m or the distance between anchor in stowed position and winch, whichever is less.

(c) All surfaces being in contact with the wire need to be rounded with a radius of not less than 10 times the wire rope diameter (including stem).

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