RULES

FOR THE CLASSIFICATION AND CONSTRUCTION OF SEA-GOING SHIPS

ND No. 2-020101-174-E

RULE CHANGE NOTICE

ENTERS INTO FORCE:

01.01.2025

St. Petersburg
2024

RULES FOR THE CLASSIFICATION AND CONSTRUCTION OF SEA-GOING SHIPS

The present Rule Change Notice to the Rules for the Classification and Construction of Sea-Going Ships (hereinafter — RCN) (hereinafter — RCN) has been approved in accordance with the established approval procedure, comes into force on 1 January 2025 and contains earlier approved amendments published by the Urgent Rule Change Notices after entering into force of the previous version of the Rules for the Classification and Construction of Sea-Going Ships (these amendments are specified in the Revision History and highlighted in yellow).

REVISION HISTORY

PART I. CLASSIFICATION

Item	Applicability	Description	Remarks
Para 2.2.3.2	Icebreakers Ice class **Icebreaker6** Minimum shaft power	Requirement has been added for minimum shaft power of icebreaker with ice class **Icebreaker6**	
Para 2.2.29	Ships using natural gas as fuel Distinguishing mark **GFS**	There has been introduced the name of gas (natural gas) used as fuel by the ships assigned the distinguishing mark **GFS**	
Para 2.2.64	Ships and offshore installations Distinguishing mark for a ship and an offshore installation complying with cyber resilience requirements	New distinguishing mark **CYBER-A** has been introduced	
Para 2.4.1	Ships using gases or other low-flashpoint fuels	Reference to para 9.1.2 of Part XVII "Distinguishing Marks and Descriptive Notations in the Class Notation Specifying Structural and Operational Particulars of Ships" of the Rules for the Classification and Construction of Sea-going Ships, according to which the name of gas used as fuel or other low-flashpoint fuel shall be recorded in the Classification Certificate, has been introduced	

Item	Applicability	Description	Remarks
Table 2.5, item 1.5	Ships using gases as fuel Distinguishing mark **GFS**	Heading of the item and brief description of the distinguishing mark **GFS** have been supplemented by the name of gas (natural gas) used as fuel by the ships assigned this mark	
Table 2.5, item 1.32 (deleted)	Ships and offshore installations Distinguishing mark for a ship and an offshore installation complying with cyber resilience requirements	Item has been deleted due to transfer of the requirements to new item 2.40 in Table 2.5	
Table 2.5, item 2.40 (new)	Ships and offshore installations Distinguishing mark for a ship and an offshore installation complying with cyber resilience requirements	New distinguishing mark **CYBER-A** has been introduced	
Paras 3.2.9.1.35 and 3.2.9.1.36 (new)	Ships Documentation on ship's systems Welded joints of piping Non-destructive testing of welded joints of piping	List of documentation has been supplemented with the documents regulating requirements for welding and non-destructive testing of welded joints	

PART II. HULL

Item	Applicability	Description	Remarks
Para 1.2.3.3	Ships under construction Determination of minimum design temperature of ambient air	Limitation by minimum design temperature of ambient air for ships which operation involves sailing into the mouths of northern rivers has been deleted	

Item	Applicability	Description	Remarks
Para 2.4.4.6	Ships Hull Double bottom	Requirements formulation for calculation of design loads acting on structures inside the double bottom have been specified	
Para 3.12.2.2	Floating docks Structural layout of pontoons	Requirements for location of the non-tight bulkheads inside the pontoon as well as non-mandatory requirements have been deleted	

PART III. EQUIPMENT, ARRANGEMENTS AND OUTFIT

Item	Applicability	Description	Remarks
Chapter 7.10	Ships Hatchways of dry cargo holds	Chapter has been amended in accordance with the effective revision of the IACS unified requirement	IACS UR S21 (Rev.5 May 2023) **Entry-into-force date: 27.08.2024** (Urgent Rule Change Notice № 311-05-2029 от 27.08.2024)

Item	Applicability	Description	Remarks
Chapter 7.13 (deleted)	Bulk carriers, ore carriers and combination carriers Cargo hatch covers	Requirements transferred to Chapter 7.10 in accordance with the effective revision of the IACS unified requirement have been deleted. Existing Chapters 7.14 and 7.15 have been renumbered 7.13 and 7.14 accordingly	IACS UR S21 (Rev.5 May 2023) **Entry-into-force date: 27.08.2024** (Urgent Rule Change Notice № 311-05-2029 от 27.08.2024)
Para 8.8.1	Ships Pilot transfer arrangements, means of embarkation and disembarkation	Applicability of the requirements for ships of less than 500 gross tonnage and fishing vessels has been specified	
Para 8.8.3 (new)	Ships Means of embarkation and disembarkation	New para containing requirements for means of embarkation and disembarkation to be provided on board the ships has been introduced. Existing para 8.8.3 has been renumbered 8.8.4	
Para 8.8.3 (renumbered 8.8.4)	Ships Means of embarkation and disembarkation	Applicability of the requirements for ships of less than 500 gross tonnage and fishing vessels has been determined	

PART VI. FIRE PROTECTION

Item	Applicability	Description	Remarks
Table 3.1.2.1, Footnote 10	Cargo ships Protection of cargo spaces with a fixed gas fire extinguishing system	References to IMO circular MSC.1/Circ.1395 have been updated to take into account the latest revision	IMO circular MSC.1/Circ.1395/ Rev.6
Para 3.8.2.5	Ships Carbon dioxide extinction station Device for control of carbon dioxide (fire extinguishing medium) mass in cylinders	Methods have been specified of determining carbon dioxide (fire extinguishing medium) mass in cylinders in the carbon dioxide extinction station	
Para 3.11.1.3, Formula 3.11.1.3	Ships equipped with aerosol fire extinguishing system Aerosol generators Formula for calculation of mass of the aerosol generating agent	In explication the explanation of the efficiency coefficient f has been specified to avoid misinterpretation of its value used for calculation of the aerosol fire extinguishing system	IMO circular MSC.1/Circ.1270
Para 4.3.2	Ships Warning of release of fire extinguishing medium	Spaces in which signals warning of release of fire extinguishing medium shall be given have been specified	
Para 5.1.4.5.1	Ships of 1000 and more gross tonnage Fire hoses and nozzles	Requirement for equipment of a ship carrying dangerous goods with additional fire hoses and nozzles has been transferred to para 7.2.5.2	
Para 7.1.1	Ships carrying packaged dangerous goods and dangerous goods in bulk	The notion "additional safety measures" has been specified	
Para 7.1.2	Ships carrying dangerous goods in bulk	Definition "IMSBC Code" has been amended in connection with implementation of IMO resolution MSC.539(107)	

Item	Applicability	Description	Remarks
Para 7.2.3.1	Ships carrying packaged dangerous goods and dangerous goods in bulk Fixed carbon dioxide or inert gas fire extinguishing system complying with the provisions of the FSS Code or fire extinguishing system, which gives equivalent protection for the cargoes carried	Requirements have been specified in compliance with regulation II-2/10.7.2 of SOLAS-74, as amended and IMO circular MSC.1/Circ.1395/Rev.6	
Table 7.2.4-1, Footnote 2	Ships carrying packaged dangerous goods Barges capable of containing flammable vapours or capable of discharging flammable vapours to a safe place outside the barge carrier compartment by means of ventilation ducts connected to the barges	Requirements have been specified to clarify their application	
Para 7.2.5.2	Ships carrying packaged dangerous goods and dangerous goods in bulk Fire hoses and nozzles	Requirement for equipment of a ship carrying dangerous goods with additional fire hoses and nozzles has been introduced (transferred from para 5.1.4.5.1)	
Para 7.2.5.5	Ships carrying packaged dangerous goods and dangerous goods in bulk Pressure water-spraying system	System name has been specified	
Para 7.2.6	Ships carrying packaged dangerous goods and dangerous goods in bulk Electrical equipment in cargo spaces and sources of heat	Requirements have been specified in compliance with regulation II-2/19.3.2 of SOLAS-74, as amended. References to Part XI "Electrical Equipment" have been updated	

Item	Applicability	Description	Remarks
Para 7.2.8	Ships carrying packaged dangerous goods and dangerous goods in bulk Ventilation of cargo spaces	Requirements have been specified in compliance with regulation II-2/19.3.4 of SOLAS-74, as amended	
Para 7.2.10	Ships carrying packaged dangerous goods and dangerous goods in bulk Outfit (sets of protective clothing resistant to chemical exposure and additional self-contained breathing apparatus)	Requirements have been specified in compliance with regulation II-2/19.3.6 of SOLAS-74, as amended to avoid ambiguous interpretation	
Para 7.3.13	Ships carrying packaged irradiated nuclear fuel, plutonium and high-level radioactive wastes (INF cargo) Shipboard emergency plan	Authority approving the shipboard emergency plan has been specified	

PART VII. MACHINERY INSTALLATIONS

Item	Applicability	Description	Remarks
Chapter 2.3	Sea-going ships Machinery and equipment Ambient conditions	Requirements for operation under the effects of acceleration have been updated	IACS UR M46 (Rev.3 Aug 2023)
Para 4.5.4	Self-propelled and non-self-propelled ships Machinery spaces Means of escape from machinery spaces	The wording of the requirements to the width of the ladders has been specified	

Item	Applicability	Description	Remarks
Appendix 1	Sea-going ships Ship machinery and equipment Spare parts	Supplemented by information on risk-based approach for determination of the spare parts to be carried onboard. Lists of minimum recommended spare parts have been updated	IACS Rec 26 (Rev.2 Nov 2023) IACS Rec 27 (Rev.2 Feb 2024) IACS Rec 28 (Rev.2 Feb 2024) IACS Rec 29 (Rev.2 Feb 2024) IACS Rec 30 (Rev.2 Feb 2024)

PART VIII. SYSTEMS AND PIPING

Item	Applicability	Description	Remarks
Table 1.3.2	Ships General Conveyed medium	Applicability to liquefied gases has been deleted. Applicability to other media has been extended.	UR P2.2 (Rev.5 October 2023)
Para 2.4.4.1	Ships Piping joints Threaded connections	Usage of threaded connections with diameter of not more than 25 mm in piping systems conveying flammable media	UR P2.7.3 (Rev.5 October 2023)
Table 2.4.5.11-2	Ships Piping joints Mechanical joints	Exclusion of the diameter restriction of compression type, bite type and flared type couplings for Classes I and II piping systems	UR P2.7.4 (Rev.5 October 2023)

Item	Applicability	Description	Remarks
Para 2.4.5.12.6	Ships Pipe joints Mechanical joints	Mandatory testing for Classes I and II piping systems	UR P2.7.4 (Rev.5 October 2023)
Para 9.10.1	Ships Ship service systems in cargo area Cargo pipe	Equivalent design with sealing flange joint has been defined. Requirements have been introduced for compensation of thermal expansion	UR F15.1.1 (Rev.7 Sep 2023)
Para 12.4.2	Ships Ventilation system Ventilation inlets	Alternative requirement for location of ventilation inlets	IMO circular MSC.1/Circ.1459
Para 21.2.3	Ships Tests Hydraulic tests of piping	Conditions have been introduced for replacement of hydrostatic testing by pneumatic leak testing	UR P2.9 (Rev.3 October 2023)

PART IX. MACHINERY

Item	Applicability	Description	Remarks
Table 1.2.3.1-3	Internal combustion engines Gas internal combustion engines	List of documents to be submitted for approval of Gas internal combustion engines have been specified	IACS UR M78 (Rev.2 Jan 2024)
Para 3.6.11	Sea-going ships Main turbine installations Slow-turning devices	Slow-turning device requirements for main turbine installations are specified	IACS UR M43 (Rev.1 Feb 2024)

Item	Applicability	Description	Remarks
Chapters 9.1, 9.2, 9.3, 9.12 and 9.13	Internal combustion engines Gas internal combustion engines	Requirements have been amended/supplemented to cover all types of diesel engines supplied with low pressure gaseous methane. ICE design requirements have been added	IACS UR M78 (Rev.2 Jan 2024)

PART XI. ELECTRICAL EQUIPMENT

Item	Applicability	Description	Remarks
Para 2.6.1.1	Sea-going ships Electrical equipment Lightning protection	Requirements for drawings of a lightning protection device have been introduced	
Chapter 6.9	Ships equipped with a helideck or a helicopter facility Lighting and illumination means of helidecks	Requirements for the lighting and illumination means of helidecks have been deleted	The requirements have been transferred to Section 6, Part XVII **Entry-into-force date: 11.07.2024** (Urgent Rule Change Notice № 311-05-2023 от 11.07.2024)

Item	Applicability	Description	Remarks
Para 16.8.1.2	Sea-going ships Cables and wires Cross-sectional area of the conductors	Minimum cross-sectional area of the conductors in power, control and signalling circuits, as well as instrumentation and internal communication circuits with the number of cores in the cable not less than four has been specified	
Para 20.4.3 (new)	Special purpose ships carrying more than 240 persons Electrical equipment which shall remain operational in the part of ship not affected by fire	New para with the reference to the requirements for passenger ships has been introduced. Existing paras 20.4.3 — 20.4.4 have been renumbered 20.4.4 — 20.4.5 accordingly	IMO circular MSC.1/Circ.1422 **Entry-into-force date: 13.08.2024** (Urgent Rule Change Notice № 311-05-2028 от 13.08.2024)

PART XIII. MATERIALS

Item	Applicability	Description	Remarks
Paras 2.6.3 and 2.6.4	Materials Coatings Primers not removed before welding	Calculation method of porosity during testing of primers not removed before welding has been amended. Calculation of absolute value of total pore area in mm^2 has been replaced by a relative value in %	
Para 3.8.5.2	Ships of all types Carbon, carbon-manganese and alloy steel castings	Requirements for the possibility to cast test blocks separately from casting have been introduced	IACS UR W8 (Rev.4 Mar 2024), para 6.2

Item	Applicability	Description	Remarks
Para 3.8.5.3	Ships of all types Carbon, carbon-manganese and alloy steel castings	Arrangement plans of test blocks and positions of casting specimen have been deleted. Specific requirements stating that test block thickness shall be not less than the ruling section diameter have been deleted. Specifications for castings for stern tube, stern frame, anchors and rudder horn have been deleted	IACS UR W8 (Rev.4 Mar 2024), para 6.3
Para 3.8.5.6 (deleted)	Ships of all types Carbon, carbon-manganese and alloy steel castings	Arrangement plans of test blocks and positions of casting specimen have been deleted	IACS UR W8 (Rev.4 Mar 2024)
Para 3.8.6.1	Ships of all types Carbon, carbon-manganese and alloy steel castings	Requirements for provision of at least two cast on test blocks from the heaviest section have been deleted Requirements for test block of large castings made of two or more casts have been introduced	IACS UR W8 (Rev.4 Mar 2024), para 6.4 and 6.5
Para 3.12.8.2.3	Ships of all types Steel castings for propellers	Definitions of indications during liquid penetrant testing have been updated	IACS UR W27 (Rev.3 Sep 2023), para 10.1
Figure 3.12.8.2.3.1	Ships of all types Steel castings for propellers	Figure of defining non-linear and linear indications during liquid penetrant testing has been updated	IACS UR W27 (Rev.3 Sep 2023), Figure 1
Para 3.12.9.5.2.6	Ships of all types Steel castings for propellers	Requirements for weld repair of martensitic steels have been updated	IACS UR W27 (Rev.3 Sep 2023), para 12.7

Item	Applicability	Description	Remarks
Figure 4.2.4	Ships of all types Copper alloy propeller castings	Requirements for the dimensions of test blocks for tensile tests have been amended	IACS UR W24 (Rev.5 Sep 2023), Figure 1,
Para 4.2.7.3.1.2.1	Ships of all types Copper alloy propeller castings	Definitions of indications during liquid penetrant testing have been updated	IACS UR W24 (Rev.5 Sep 2023), para 10.1
Figure 4.2.7.3.1.2.1	Ships of all types Copper alloy propeller castings	Figure of defining non-linear and linear indications during liquid penetrant testing has been updated	IACS UR W24 (Rev.5 Sep 2023), Figure 7
Para 4.2.8.3	Ships of all types Copper alloy propeller castings	Requirements for the depth of defects (depth in zone B) have been added	IACS UR W24 (Rev.5 Sep 2023), para 11.4
Table 4.2.8.5.1-2	Ships of all types Copper alloy propeller castings	Temperate of heat treatment for CU2 and CU4 alloys has been amended	IACS UR W24 (Rev.5 Sep 2023), Table 5
Paras 6.5.4.4 and 6.5.4.5	Materials Coatings Primers not removed before welding	Standard value of porosity area has been amended. Para has been updated in regards to test results validity only for thicknesses recorded during testing	

PART XIV. WELDING

Item	Applicability	Description	Remarks
Para 2.8.1	Ships under construction Clad steel Misalignment of edges during assembly	Permissible values for edges misalignment during assembly of double-layer clad steel sheets subject to welding have been defined	
Chapter 2.15 (new)	Ships under construction Metal structures Laser welding Laser-arc hybrid welding	New requirements have been introduced regarding: qualification of welders, welding consumables, approval of welding processes, quality control and non-destructive testing of weld	
Para 3.3.1	Ships Non-destructive testing Welded joints Rigid contour	Requirements for the scope of NDT of weld joints for type ships have been deleted Requirements for specifying the areas subject to NDT during welding of structural elements into a rigid contour have been added	p. 5.2, IACS UR W33 (Rev.1 May 2020)
Para 3.3.9	Ships under repair and conversion Non-destructive testing Welded joints	References to the requirements for non-destructive testing of welds performed during ships repair and conversion have been amended	

PART XVI. STRUCTURE AND STRENGTH OF FIBER-REINFORCED PLASTIC SHIPS

Item	Applicability	Description	Remarks
Para 5.5.17 (deleted)	Fiber-reinforced plastic ships The after-end structure	The requirement to perform check calculations of vibration parameters of ship hull structures in terms of ensuring their strength has been deleted	

PART XVII. DISTINGUISHING MARKS AND DESCRIPTIVE NOTATIONS IN THE CLASS NOTATION SPECIFYING STRUCTURAL AND OPERATIONAL PARTICULARS OF SHIPS

Item	Applicability	Description	Remarks
Para 2.1.3	Technical documentation	Reference to the list of technical documentation specified in Part I "Classification" for assignment of distinguishing mark **Escort tug** has been introduced	
Para 2.1.3.1 (deleted)	Technical documentation	List of technical documentation for assignment of distinguishing mark **Escort tug** previously transferred to Part I "Classification" has been deleted	
Para 3.1.1.4	Ships with the distinguishing mark **ECO-S** in the class notation	The term "Hong Kong Convention" has been introduced as the convention shortened name	

Item	Applicability	Description	Remarks
Paras 3.4.2.3, 3.4.2.10, 3.4.2.12, 3.4.2.13 and 3.4.2.15 (deleted)	Technical documentation	Provisions for technical documentation (in respect of air pollution prevention) required for assignment of distinguishing marks **ECO** and **E**CO-S have been deleted (previously transferred to Part I "Classification"). Paras 3.4.2.4 — 3.4.2.9, 3.4.2.11, 3.4.2.14 and 3.4.2.16 have been renumbered 3.4.2.3 — 3.4.2.11 accordingly	
Para 3.4.2.12 (new)	Technical documentation	Reference to the list of technical documentation (in respect of air pollution prevention) specified in Part I "Classification" for assignment of distinguishing marks **ECO** and **ECO-S** has been introduced	
Para 3.4.3.6	Ships with the distinguishing mark **ECO-S** in the class notation	The requirement to have certificates is supplemented by international certificates issued in accordance with the Hong Kong Convention	
Paras 3.4.4.1 — 3.4.4.3, 3.4.4.8, 3.4.4.13, 3.4.4.15 and 3.4.4.16 (deleted)	Technical documentation	Provisions for technical documentation (in respect of marine environment pollution) required for assignment of distinguishing marks **ECO** and ECO-S have been deleted (previously transferred to Part I "Classification"). Paras 3.4.4.4 — 3.4.4.7, 3.4.4.9 — 3.4.4.12, 3.4.4.14 and 3.4.4.17 have been renumbered 3.4.4.1 — 3.4.4.10 accordingly	

Item	Applicability	Description	Remarks
Para 3.4.4.11 (new)	Technical documentation	Reference to the list of technical documentation (in respect of marine environment pollution) specified in Part I "Classification" for assignment of distinguishing marks **ECO** and **ECO-S** has been introduced	
Para 3.5.3.6.5	Ships with distinguishing marks **ECO** or **ECO-S** in class notation	Reference to applicable requirements has been changed	
Para 3.6.4	Ships with the distinguishing mark **ECO-S** in the class notation	The requirement to have certificates is supplemented by international certificates issued in accordance with the Hong Kong Convention	
Para 4.1.3.1	Technical documentation	List of technical documentation for assignment of distinguishing mark **ANTI-ICE** previously transferred to Part I "Classification" has been replaced by the reference to the relevant para of Part I "Classification"	
Para 5.1.3.1	Technical documentation	List of technical documentation for assignment of distinguishing marks **BLS-SPM, BLS** and **SPM** previously transferred to Part I "Classification" has been replaced by the reference to the relevant para of Part I "Classification"	
Para 5.1.3.2 (new)	Oil tankers equipped with bow loading system (BLS) Operating documentation	Requirement on availability of the BLS Operating Manual on board the ship has been introduced. Existing para 5.1.3.2 has been renumbered 5.1.3.3	

Item	Applicability	Description	Remarks
Para 6.1.1.4	Ships equipped with a helideck or a helicopter facility Distinguishing marks **HELIDECK, HELIDECK-F, HELIDECK-H**	The provisions have been specified concerning compliance with the requirements of ICAO and national aviation regulations. The requirement to provide a compliance document issued by the Civil Aviation Authority has been deleted.	**Entry-into-force date: 11.07.2024** (Urgent Rule Change Notice № 311-05-2023 от 11.07.2024)
Para 6.1.3.1	Technical documentation	List of technical documentation for assignment of distinguishing marks **HELIDECK**, **HELIDECK-F** and **HELIDECK-H** previously transferred to Part I "Classification" has been replaced by the reference to the relevant para of Part I "Classification"	
Para 6.2.1	Ships equipped with a helideck or a helicopter facility Helideck	The provisions have been specified regarding fulfillment of the requirements for the helideck arrangement ensuring flight sectors	**Entry-into-force date: 11.07.2024** (Urgent Rule Change Notice № 311-05-2023 от 11.07.2024)
Para 6.5.1.1	Ships equipped with a helideck or a helicopter facility Helicopter refuelling system	The provisions regarding fulfillment of the requirements for handling of aviation fuel have been specified	**Entry-into-force date: 11.07.2024** (Urgent Rule Change Notice № 311-05-2023 от 11.07.2024)

Item	Applicability	Description	Remarks
Chapter 6.6	Ships equipped with a helideck or a helicopter facility Electrical equipment	The requirements for the lighting and illumination means of helidecks have been introduced (the content of Chapter 6.9, Part XI "Electrical Equipment" has been transferred; the requirement for the lighting characteristics and arrangement has been specified)	**Entry-into-force date: 11.07.2024** (Urgent Rule Change Notice № 311-05-2023 от 11.07.2024)
Chapter 6.7	Ships equipped with a helideck or a helicopter facility Communications	The requirement to determine the list of the radio and meteorological equipment has been specified	**Entry-into-force date: 11.07.2024** (Urgent Rule Change Notice № 311-05-2023 от 11.07.2024)
Para 7.1.3.1	Technical documentation	List of technical documentation for assignment of distinguishing mark **WINTERIZATION (DAT)** previously transferred to Part I "Classification" has been replaced by the reference to the relevant para of Part I "Classification"	
Para 8.3.1	Technical documentation	List of technical documentation for assignment of distinguishing marks **RP-1, RP-1A, RP-1AS, RP-2** and **RP-2S** previously transferred to Part I "Classification" has been replaced by the reference to the relevant para of Part I "Classification"	
Para 9.1.1	Ships using gases or other low-flashpoint fuels	Heading of the para has been amended. The rest of the text has been fully revised and transferred to paras 9.1.1.1 — 9.1.1.5	

Item	Applicability	Description	Remarks
Para 9.1.1.1 (new)	Ships using gases or other low-flashpoint fuels	Scope of application of Section 9 has been changed — ships subject to other requirements have been excluded therefrom	
Para 9.1.1.2 (new)	Ships using gases or other low-flashpoint fuels (except for gas carriers) Alternative design and arrangements	Provision on application of alternative design and arrangements has been introduced	
Para 9.1.1.3 (new)	Liquefied gas carriers using gases or other low-flashpoint fuels Alternative design and arrangements	Provision on application of alternative design and arrangements has been introduced	
Para 9.1.1.4 (new)	Ships using gases or other low-flashpoint fuels (except for gas carriers)	Requirement on compliance of the ships with IGF Code has been introduced	Transferred from existing para 9.1.1
Para 9.1.1.5 (new)	Offshore facilities other than sea-going ships	Provision on application of the requirements of Section 9 to the offshore facilities other than sea-going ships has been introduced	Transferred from existing para 9.1.1
Para 9.1.2	Ships using natural gas as fuel or other low-flashpoint fuels Distinguishing mark **GFS** Classification Certificate	There has been introduced the name of gas (natural gas) used as fuel by the ships assigned the distinguishing mark GFS. Requirements have been supplemented by information on assignment of the distinguishing mark **GFS** to gas carriers. Requirement has been introduced for making an entry into the Classification Certificate indicating the alternative fuel approved for use	

Item	Applicability	Description	Remarks
Para 9.1.4	Technical documentation	List of technical documentation for assignment of distinguishing mark **GFS** previously transferred to Part I "Classification" has been replaced by the reference to the relevant para of Part I "Classification"	
Paras 9.1.5, 9.1.5.1 — 9.1.5.2 (new)	Ships using gases or other low-flashpoint fuels	Requirements have been introduced for the risk analysis with regard to international requirements	IGF Code, as amended IACS Rec. No. 146 (Aug 2016)
Paras 9.1.6, 9.1.6.1 — 9.1.6.6 (new)	Ships using gases or other low-flashpoint fuels Alternative design and arrangement	Requirements have been introduced for the development, evaluation and approval of alternative design and arrangements with regard to international requirements	Regulation II-1/55 SOLAS-74 as amended by IMO resolution MSC.392(55) IGF Code, as amended
Para 9.2.4.11	Ships using gases as fuel Fuel preparation rooms	Reference to the requirements for the fuel preparation rooms located below deck has been introduced	IMO circular MSC.1/Circ.1667
Para 9.2.4.12 (new)	Ships using gases as fuel Fuel preparation rooms	Requirements for the fuel preparation rooms located below deck have been introduced	IMO circular MSC.1/Circ.1667
Para 9.2.7.3	Ships equipped for using gas as fuel Air locks	Reference to the applicable requirements has been changed	
Para 11.2.1	Technical documentation	List of technical documentation for assignment of descriptive notation **LNG bunkering ship** previously transferred to Part I "Classification" has been replaced by the reference to the relevant para of Part I "Classification"	

Item	Applicability	Description	Remarks
Chapter 12.2	Technical documentation	List of technical documentation for assignment of distinguishing mark **IWS** previously transferred to Part I "Classification" has been replaced by the reference to the relevant para of Part I "Classification" Numeration of paras has been introduced	
Para 13.3.2,	Technical documentation	Reference to the list of technical documentation for assignment of descriptive notation **Anchor handling vessel** specified in Part I "Classification" has been introduced	
Paras 13.3.2.1 — 13.3.2.11 (deleted)	Technical documentation	List of technical documentation for assignment of descriptive notation **Anchor handling vessel** previously transferred to Part I "Classification" has been deleted	
Para 13.3.4.1	Anchor handling vessels Anchor handling equipment Anchor chain stoppers Towing pins Stern rollers	Names of anchor handling equipment have been introduced instead of references to paras where they were specified	

Item	Applicability	Description	Remarks
Chapter 14.4	Technical documentation	List of technical documentation for assignment of distinguishing mark **GRS** previously transferred to Part I "Classification" has been replaced by the reference to the relevant para of Part I "Classification" Numeration of paras has been introduced to Chapter	
Para 17.5.1	Technical documentation	Reference to the list of technical documentation for assignment of distinguishing mark **HMS** specified in Part I "Classification"	
Para 17.5.2 (deleted)	Technical documentation	List of technical documentation for assignment of distinguishing mark **HMS** previously transferred to Part I "Classification" has been deleted. Existing paras 17.5.3 — 17.5.7 have been renumbered 17.5.2 — 17.5.6 accordingly	
Para 17.8.6.3	Ships equipped with hull strength and stability monitoring systems Measuring channels for the ship's hull deformations	Reference to document containing maximum permissible the ship's hull deformation has been amended	
Para 18.1.3	Technical documentation	List of technical documentation for assignment of distinguishing mark **COMF(C)** previously transferred to Part I "Classification" has been replaced by the reference to the relevant para of Part I "Classification"	

Item	Applicability	Description	Remarks
Para 18.2.3.1	Technical documentation	List of technical documentation for assignment of distinguishing mark **COMF(N-1,2,3), (N-S)** previously transferred to Part I "Classification" has been replaced by the reference to the relevant para of Part I "Classification"	
Para 18.3.3	Technical documentation	List of technical documentation for assignment of distinguishing mark **COMF(V-1,2,3)** previously transferred to Part I "Classification" has been replaced by the reference to the relevant para of Part I "Classification"	
Para 20.2.1	Technical documentation	List of technical documentation for assignment of distinguishing marks **UWILD** and **UWILD-S** previously transferred to Part I "Classification" has been replaced by the reference to the relevant para of Part I "Classification"	
Para 20.3.1.4.1	Ships with distinguishing marks **UWILD** or **UWILD-S** in the class notation	Requirements have been amended following the amendments introduced to para 20.2.1	
Para 21.2.1	Technical documentation	Requirements to the scope of technical documentation submitted for assignment of distinguishing marks **POSIMOOR-FIX, POSIMOOR** and **POSIMOOR-TA** previously transferred to Part I "Classification" have been replaced by the reference to the relevant para of Part I "Classification"	

Item	Applicability	Description	Remarks
Para 22.3.1	Technical documentation	Reference to the list of technical documentation for assignment of distinguishing mark **CON-M** specified in Part I "Classification" has been amended	
Para 23.1.3	Technical documentation	List of technical documentation for assignment of distinguishing marks **LFLFS (Me)** and **LFLFS (Et)** previously transferred to Part I "Classification" has been replaced by the reference to the relevant para of Part I "Classification"	
Para 24.3.1	Technical documentation	List of technical documentation for assignment of distinguishing mark **Open cargo hatch** previously transferred to Part I "Classification" has been replaced by the reference to the relevant para of Part I "Classification"	
Para 25.3.1	Technical documentation	List of technical documentation for assignment of descriptive notation **Heavy cargo carrier** and **Heavy cargo carrier Semi-submersible ship** previously transferred to Part I "Classification" has been replaced by the reference to the relevant para of Part I "Classification"	

Item	Applicability	Description	Remarks
Para 27.4	Technical documentation	List of technical documentation for assignment of distinguishing mark **ETW** previously transferred to Part I "Classification" has been replaced by the reference to the relevant para of Part I "Classification"	
Para 29.1.2	Technical documentation	Reference to the list of technical documentation for assignment of distinguishing marks **ACFP(P), ACFP(S)** and **ACFP(S,F)** specified in Part I "Classification" has been introduced	
Paras 29.1.2.1 and 29.1.2.2 (deleted)	Technical documentation	List of technical documentation for assignment of distinguishing marks **ACFP(P)**, **ACFP(S)** and **ACFP(S,F)** previously transferred to Part I "Classification" has been deleted	
Para 30.1.2.1	Technical documentation	List of technical documentation for assignment of distinguishing marks **RC-C, RC-A, RC-IA** and **RC-E** previously transferred to Part I "Classification" has been replaced by the reference to the relevant para of Part I "Classification"	
Chapter 31.2	Technical documentation	List of technical documentation for assignment of distinguishing mark **HNLS** previously transferred to Part I "Classification" has been replaced by the reference to the relevant para of Part I "Classification"	

Item	Applicability	Description	Remarks
Chapter 32.2	Technical documentation	List of technical documentation for assignment of distinguishing marks **WSV1** and **WSV2** previously transferred to Part I "Classification" has been replaced by the reference to the relevant para of Part I "Classification"	

PART XXI. CYBER RESILIENCE

Item	Applicability	Description	Remarks
Para 1.1.8 and para 1.1.9 (new)	Ships and offshore installations Computer based systems and networks	Requirements have been introduced for assignment of distinguishing mark **CYBER-A**	
Section 4 (new)	Ships and offshore installations Computer based systems and networks	Requirements have been introduced for assignment of distinguishing mark **CYBER-A**	

PART I. CLASSIFICATION

2 CLASS OF A SHIP

2.2 CLASS NOTATION OF A SHIP. MANDATORY AND OPTIONAL DISTINGUISHING MARKS AND DESCRIPTIVE NOTATIONS IN THE CLASS NOTATION ASSIGNED BY RUSSIAN MARITIME REGISTER OF SHIPPING

Para 2.2.3.2. The **description of ice class mark Icebreaker6** is amended as follows:

"**Icebreaker6** — intended for ice breaking operations in harbour and roadstead water areas as well as in freezing seas where the ice is up to 1,5 m thick. Continuous motion capability in unbroken ice up to 1 m thick. The total shaft power not less than 5,5 MW;".

Para 2.2.29 is amended as follows:

"**2.2.29 Distinguishing mark for a ship equipped to use natural gas as fuel.**

Ships equipped for using natural gas as fuel in compliance with the requirements of Section 9 of Part XVII "Distinguishing Marks and Descriptive Notations in the Class Notation Specifying Structural and Operational Particulars of Ships" of these Rules, as well as gas carriers carrying liquefied ~~methane~~ natural gas (methane), using cargo as fuel and complying with the requirements of the International Code for the Construction and Equipment of Ships Carrying Liquefied Gases in Bulk (IGC Code) and the Rules for the Classification and Construction of Ships Carrying Liquefied Gases in Bulk, are assigned the distinguishing mark **GFS** (Gas Fuelled Ship) added to the character of classification.".

Para 2.2.64 is amended as follows:

"**2.2.64 Distinguishing ~~mark for a ship complying~~ marks confirming compliance with cyber resilience requirements.**

~~If a ship complies with the requirements of Part XXI "Cyber Resilience", the distinguishing mark **CYBER** is added to the character of classification.~~

CYBER is a distinguishing mark that may be added to the character of classification of ships and offshore installations complying with the requirements of Part XXI "Cyber Resilience", except for Section 4.

CYBER-A is a distinguishing mark that may be added to the character of classification of ships and offshore installations complying with the requirements for the distinguishing mark **CYBER** where, in accordance with Section 4 of Part XXI "Cyber Resilience", onboard computer based systems and information networks have been additionally verified for cyber security by the RS-recognized firm.".

2.4 ADDITIONAL ENTRIES IN THE CLASSIFICATION CERTIFICATE

Para 2.4.1 is amended as follows:

"**2.4.1** When complying with definite requirements of the RS rules stipulated by the structural features or operational characteristics of the ship the fulfilment of which is not reflected by distinguishing marks and descriptive notation in the class notation, the confirmation of compliance of the ship with such requirements is certified by the entry in Section "Other characteristics" of the Classification Certificate stating, for example, that

the ship is equipped for occasional loading/unloading of cargoes in a horizontal direction — by a roll-on/roll-off; the ship is suitable for escort operations, towing and serving oil tankers and/or oil recovery ships; the ship may operate in oil harbour water areas; the ship may occasionally carry bulk cargoes; the ship may carry heavy bulk cargoes (with indication of bulk cargo density), and other entries stipulated by the RS rules (refer also to 1.1.4.8, 1.1.5.1, 1.1.5.2, 3.3.1.5, 3.10.4.1 and 3.12.1.4.3 of Part II "Hull", 1.1.1.2, 1.1.1.3, 1.1.1.6, 1.1.3.1, 2.4.3, 9.1.2, 10.3.2.1, 10.5.3.2, 13.2.4.1.5 and 13.3.10.3 of Part XVII "Distinguishing Marks and Descriptive Notations in the Class Notation Specifying Structural and Operational Particulars of Ships" of these Rules; 2.2.3.1, 3.2.4.1 and 4.2.3.2 of Part II "Life-Saving Appliances" of the Rules for the Equipment of Sea-Going Ships).".

2.5 SUMMARY INFORMATION ON DISTINGUISHING MARKS AND DESCRIPTIVE NOTATIONS IN THE CLASS NOTATION OF A SHIP

Table 2.5. Item 1.5 is amended as follows:

"**1.5 GFS — distinguishing mark for a ship equipped to use natural gas as fuel**

Distinguishing mark	Brief description	References to additional RS requirements for the distinguishing mark
GFS (Gas Fuelled Ship)	The mark is assigned if a ship is equipped for using natural gas as fuel, as well as to gas carriers carrying liquefied ~~methane~~ natural gas (methane), using cargo as fuel and complying with the requirements of the International Code for the Construction and Equipment of Ships Carrying Liquefied Gases in Bulk (IGC Code) and the Rules for the Classification and Construction of Ships Carrying Liquefied Gases in Bulk	**Rules for the Classification and Construction of Sea-Going Ships** Part I "Classification", 2.2.29 Part IX "Machinery", 8.10.2 Part XVII "Distinguishing Marks and Descriptive Notations in the Class Notation Specifying Structural and Operational Particulars of Ships", Section 9

."

Table 2.5. **Item 1.32** is deleted.

Table 2.5. **New item 2.40** is introduced reading as follows:

"**2.40 CYBER, CYBER-A — distinguishing marks confirming compliance with cyber resilience requirements**

Distinguishing mark	Brief description	Reference to additional RS requirements for the distinguishing mark
CYBER	Assigned to ships complying with cyber resilience requirements	**Rules for the Classification and Construction of Sea-Going Ships** Part I "Classification", 2.2.64 Part XXI "Cyber Resilience", except for Section 4

Distinguishing mark	Brief description	Reference to additional RS requirements for the distinguishing mark
CYBER-A	Assigned to ships complying with cyber resilience requirements where onboard computer based systems and information networks have been additionally verified for cyber security by the RS-recognized firm	**Rules for the Classification and Construction of Sea-Going Ships** Part I "Classification", 2.2.64 Part XXI "Cyber Resilience"

."

3 TECHNICAL DOCUMENTATION

3.2 DESIGN DOCUMENTATION

New paras 3.2.9.1.35 and **3.2.9.1.36** are introduced reading as follows:

"

No.	Description of documentation	Stamp	TD	DD	PAD	Remarks
.35	Non-destructive testing (NDT) plan for welds of ship piping systems, containing the information according to 3.1.3.1 of Part XIV "Welding"	A		●	●	If the specified information including the scope of non-destructive testing is given in the drawings of ship piping systems, then the NDT plan for welds is not required
.36	Table of welding of ship piping systems, containing the following information: shape or symbol of edge preparation (types of weld joints); diameter and wall thickness, brands and grades of base metal; welding processes; grades of welding consumables)	A		●	●	If the information listed herein is stated to the full in the drawings of ship piping systems, then submission of the table of welding is not required

".

PART II. HULL

1 DESIGN PRINCIPLES

1.2 MATERIALS

Para 1.2.3.3. The Footnote is deleted.

2 GENERAL REQUIREMENTS FOR HULL STRUCTURES

2.4 DOUBLE BOTTOM

Paragraph 2.4.4.6 is amended as follows:

"**2.4.4.6** The stiffeners on the watertight sections of centre girder (duct keel), side girders and floors shall satisfy the following requirements:

.1 the section modulus of vertical stiffeners on the watertight sections of centre girder (duct keel), side girders and floors shall not be less than stipulated under 1.6.4.1 taking:

p = as determined by ~~Formula~~ Formulae (1.3.4.2.1-4) and (1.3.4.2.1-5) for mid-height of vertical stiffener, whichever is greater (in the absence of a safety valve, $p_v = 0$);

l — span, in m, of stiffener, defined as the spacing of longitudinals to which the stiffener is welded or as double bottom depth if the stiffener is not in line with bottom or inner bottom longitudinals;

$m = 8$ and 10 for stiffeners sniped at ends and welded to the bottom and inner bottom longitudinals respectively;

$k_\sigma = 0{,}75$;

.2 the section modulus of horizontal stiffeners on the centre girder (duct keel) and side girders shall not be less than stipulated under 1.6.4.1 taking:

p = as determined by ~~Formula~~ Formulae (1.3.4.2.1-4) and (1.3.4.2.1-5) for the level of the horizontal stiffener considered, whichever is greater (in the absence of a safety valve, $p_v = 0$);

l = distance, in m, between floors or between floors and brackets (refer to 2.4.2.2);

$m = 12$;

$k_\sigma = 0{,}5k_B \leq 0{,}75$ in the midship region;

$k_\sigma = 0{,}75$ at the ends of the ship within $0{,}1L$ from the fore or after perpendicular.

For regions between the midship region and the above portions of ship ends, k_σ shall be determined by linear interpolation.

k_B shall be determined by Formula (2.2.4.1);

.3 in the midship region of ships of unrestricted service and of restricted areas of navigation **R1** and **R2**, 65 m and greater in length, as well as of ships of restricted areas of navigation **R2-RSN, R2-RSN(4,5), R3-RSN** and **R3**, 60 m and greater in length, the buckling strength of horizontal stiffeners on the centre girder (duct keel) and side girders shall be ensured in accordance with 1.6.5.".

3 DESIGN PRINCIPLES

3.12 FLOATING DOCKS

Para 3.12.2.2 is amended as follows:

"**3.12.2.2** Structural layout of pontoons.

Plate and beam structures of the pontoon shall maintain local strength of the appropriate pontoon structures (pontoon deck, bottom, longitudinal and transverse bulkheads, etc.), as well as transverse strength of the pontoon.

Spacing of primary longitudinal and transverse framing members of the pontoon shall be determined according to 1.1.3 with $L = L_{p.d}$.

~~Primary transverse structures of the pontoon (pontoons), i.e. non-tight bulkheads, shall be fitted in 3 to 7 spacings, but they shall not be spaced more than ($B - bp.d$)/6 apart.~~

A centreline bulkhead shall be fitted under the keel blocks. A box structure formed by two longitudinal bulkheads arranged symmetrically on each side of the centre line maybe used in lieu of the centre line bulkhead.

Bulkheads or girders shall be aligned with inner wall sides.

~~Where transverse framing is adopted for a pontoon (pontoons), additional primary longitudinal supporting members may be fitted to limit a span of transverse members of the bottom and pontoon deck. They shall be spaced not more than 3 to 5 spacings apart.~~".

PART III. EQUIPMENT, ARRANGEMENTS AND OUTFIT

7 OPENINGS IN HULL, SUPERSTRUCTURES AND DECKHOUSES AND THEIR CLOSING APPLIANCES

7.10 HATCHWAYS OF DRY CARGO HOLDS

Chapter 7.10 is replaced by the following text:

"**7.10.1 General.**

The deck openings through which cargoes or ship's stores are loaded and unloaded shall be protected by strong hatchways. If these hatchways are situated in positions 1 and 2, the hatchway covers shall be weathertight. The tightness shall be provided by one of the following two methods:

.1 by portable covers and tarpaulins as well as battening devices;

.2 by weathertight covers made of steel or other equivalent material fitted with rubber or other suitable gaskets and clamping devices.

The requirements of this Chapter are applicable to all cargo hatch covers and coamings on exposed decks depending on the specific ship types as categorized below:

Type-1 ships, including all ships except bulk carriers, self-unloading bulk carriers, ore carriers and combination carriers;

Type-2 ships, including all bulk carriers, self-unloading bulk carriers, ore carriers and combination carriers.

The requirements of this Chapter do not apply to bulk carriers of 90 m in length and above, contracted for construction on or after 1 July 2015. The requirements for design of cargo hatch covers are regulated by the Common Structural Rules.

The requirements of this Chapter do not apply to portable covers secured weathertight by tarpaulins and battening devices, as defined in 3.2.4 of the Guidelines on Application of Provisions of the International Convention on Load Lines (LL-66/88).

The requirements of this Chapter do not apply to sea coastal ships in restricted areas **RN(SCI)** and **RN(SCII)**. The requirements for design of cargo hatch covers are regulated in 26.2.2.6 of Part XVII "Distinguishing Marks and Descriptive Notations in the Class Notation Specifying Structural and Operational Particulars of Ships".

7.10.2.1 The height of hatchway coamings in positions 1 and 2 shall be at least 600 mm and 450 mm, respectively.

If the length of the ship is less than 24 m, the height of the coamings may be reduced down to 380 mm for ships of restricted area of navigation **R2**, **R2-RSN**, **R2-RSN(4,5)** and **R3-RSN** and down to 300 mm for ships of restricted area of navigation **R3**.

In ships of restricted area of navigation **R3** having the length of 24 m and over (except passenger ships) the specified height of cargo hatchway coamings may be reduced from 600 mm down to 450 mm and from 450 mm down to 380 mm, respectively.

In fishing vessels, the height of cargo hatchway coamings in position 2 may be reduced down to 300 mm.

7.10.2.2 The height of hatchway coamings specified in 7.10.1.2 may be reduced as compared to that required by 7.10.2.1or the coamings may be omitted entirely provided that the cover tightness and securing means are found efficient and the following is submitted:

for hatches that are closed at sea — technical background containing operational limitations considering designation and nature of hatch application;

for hatches that may be open at sea — technical background containing assessment of seaworthiness and deck flooding as well as confirmation that the safety of the ship is provided at any sea condition in accordance with the designated area of navigation.

7.10.3 Materials.

7.10.3.1 For steel of top plate, bottom plate and primary supporting members (PSM), refer to 1.6.

7.10.3.2 The wood of hatchway covers shall be of good quality and of the type and grade which proved to be satisfactory for this purpose. Wedges shall be of hard wood.

7.10.3.3 Canvas used for making tarpaulins shall be impregnated to make them moisture-resistant and shall not contain jute thread. Mass of 1 m^2 of canvas before impregnation shall be not less than 0,55 kg. Breaking stress of impregnated canvas band 200×50 mm in size shall be at least 3 kN and 2 kN in longitudinal and transverse directions, respectively. When tested for watertightness, the impregnated canvas shall not get wet under water head of 0,15 m acting for 24 h.

7.10.3.4 The rubber for packing gaskets of hatchway covers shall be elastic, strong, and resistant to atmospheric changes. The rubber shall be of sufficient hardness.

7.10.3.5 All internal and external surfaces of steel hatch covers in bulk carriers (except inaccessible spaces in box type covers) shall have effective epoxy or other equivalent protective coating applied in accordance with the recommendations of the manufacturer (refer to 1.1.4.7 and 3.3.5.1 of Part II "Hull").

7.10.4 Design loads.

Hatchway covers shall be designed to sustain deck cargoes which are intended to be carried on these covers. Where operation of the cargo handling cars on hatchways covers is anticipated in the course of the ship's service, during cargo handling operations, the loads induced by such cars shall be taken into consideration. For hatchway covers in positions 1 and 2 the design load shall be calculated in accordance with 3.2.5.2 of the Guidelines on Application of Provisions of the International Convention on Load Lines (LL-66/88) or 3.2.5.2 of the Load Line Rules for Sea-Going Ships; design of hatch covers shall comply with the requirements of 3.2.5.3 — 3.2.5.5 of the above-stated documents, as applicable.

For ships of less than 24 m in length of restricted area of navigation engaged on international voyages and for all ships of restricted area of navigation not engaged on international voyages the load intensity reduced by the following values may be used instead of load intensity specified in 3.2.5.2 of the Load Line Rules for Sea-Going Ships:

15 % for ships of restricted areas of navigation **R2**, **R2-RSN**, **R2-RSN(4,5)** and **R3-RSN**;

30 % for ships of restricted areas of navigation **R3**.

7.10.5 Design of hatch covers specified in 7.10.1.1.

7.10.5.1 Design of these hatch covers shall meet the requirements of 3.2.4 of the Guidelines on Application of Provisions of the International Convention on Load Lines (LL-66/88) or 3.2.4 of the Load Line Rules for Sea-Going Ships.

7.10.6 Structure of hatch covers indicated in 7.10.1.2.

7.10.6.1 Structure of these covers shall meet the requirements of 3.2.5 of the Guidelines on Application of Provisions of the International Convention on Load Lines (LL-66/88) or 3.2.5 of the Load Line Rules for Sea-Going Ships.

7.10.6.2 Primary supporting members and stiffeners of hatch covers shall be continuous over the breadth and length of hatch covers, as far as practical. When this is impractical, sniped end connections shall not be used and appropriate arrangements shall be adopted to provide sufficient load carrying capacity.

7.10.6.3 The spacing of primary supporting members parallel to the direction of stiffeners shall not exceed 1/3 of the span of primary supporting members. If sufficient strength based on finite element (FE) analysis can be verified, this requirement may be waived.

Stiffeners of hatch coamings shall be continuous over the breadth and length of hatch coamings.

7.10.6.4 Unless otherwise quoted, the thickness t of the following sections is the net thickness.

Net thickness is the member thickness necessary to obtain the minimum net scantlings. The required gross thicknesses are obtained by adding corrosion additions t_s given in Table 7.10.6.44. Strength calculations using FEM shall be performed with net scantlings.

7.10.6.5 Structural assessment of hatch covers and hatch coamings shall be carried out using the design loads, defined in this Chapter and the following definitions shall be used:

L — length of ship, in m, as defined in 1.1.3 of Part II "Hull";

L_{LL} — length of ship, in m, as defined in this Part;

x — longitudinal coordinate of midpoint of assessed structural member measured from aft end of length L or L_{LL}, as applicable;

$D_{\min}$ — the least moulded depth, in m, as defined in 1.2.1 of the Load Line Rules for Sea-Going Ships;

h_N — standard superstructure height, in m,

$h_N = 1{,}05 + 0{,}01L_{LL}$, and $1{,}8 \leq h_N \leq 2{,}3$.

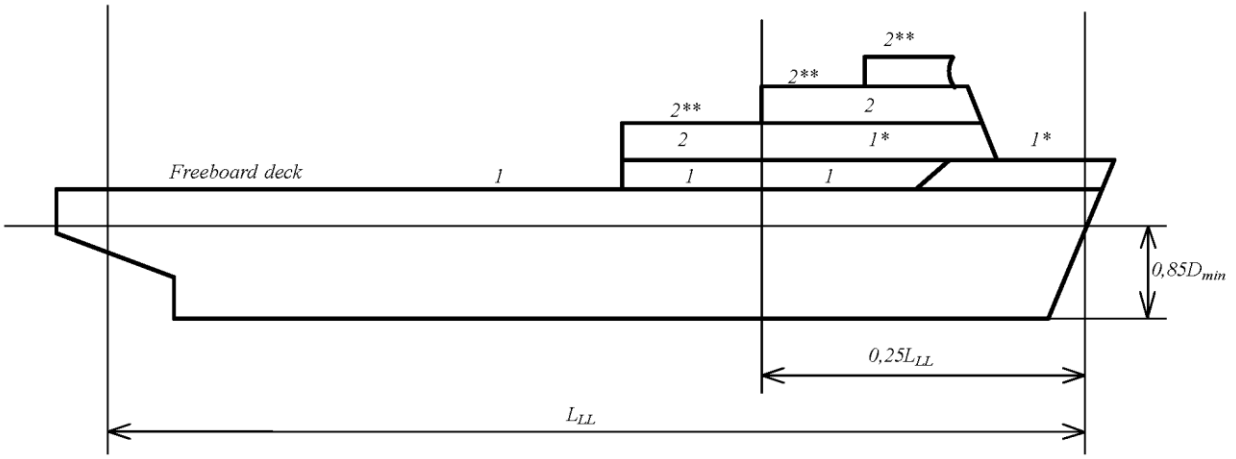
7.10.6.6 The pressure P_{HC}, in kN/m^2, on the hatch cover panels is given in Table 7.10.6.6. The vertical weather design load needs not to be combined with cargo loads. In Fig. 7.10.6.6 positions 1 and 2 are illustrated for an example ship.

Table 7.10.6.6

Design load P_{HC} of weather deck hatches

Position	Design load P_{HC}, in kN/m²	
	$x/L_{LL} \leq 0{,}75$	$0{,}75 < x/L_{LL} \leq 1{,}0$
1	for 24 m $\leq L_{LL} \leq$100 m	
	$\frac{9{,}81}{76}(1{,}5L_{LL} + 116)$	on freeboard deck: $\frac{9{,}81}{76}\left[(4{,}28L_{LL} + 28)\frac{x}{L_{LL}} - 1{,}71L_{LL} + 95\right]$ upon exposed superstructure decks located at least one superstructure standard height above the freeboard deck: $\frac{9{,}81}{76}(1{,}5L_{LL} + 116)$
	for $L_{LL} >$ 100 m	
	9,81 × 3,5	on freeboard deck for type B ships according to LL-66/88: $9{,}81\left[(0{,}0296L_1 + 3{,}04)\frac{x}{L_{LL}} - 0{,}0222L_1 + 1{,}22\right]$ on freeboard deck for ships with less freeboard than type B according to LL-66/88: $9{,}81\left[(0{,}1452L_1 + 8{,}52)\frac{x}{L_{LL}} - 0{,}1089L_1 + 9{,}89\right]$ $L_1 = L_{LL}$ but not more than 340 m upon exposed superstructure decks located at least on superstructure standard height above the freeboard deck: 9,81 × 3,5
2	for 24 m $\leq L_{LL} \leq$ 100 m	
	$\frac{9{,}81}{76}(1{,}1L_{LL} + 87{,}6)$	
	for $L_{LL} >$ 100 m	
	9,81 × 2,6 upon exposed superstructure decks located at least one superstructure standard height above the lowest position 2 deck: 9,81 × 2,1	

Positions 1 and 2



Positions 1 and 2 for an increased freeboard

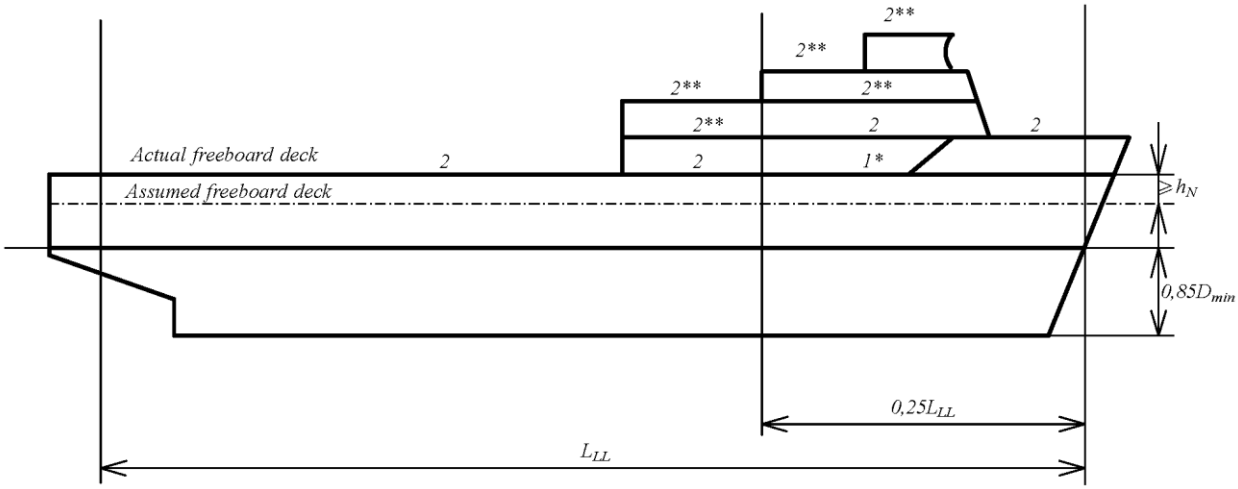


Fig. 7.10.6.6
*Reduced load upon exposed superstructure decks located at least one superstructure standard height above the freeboard deck.
**Reduced load upon exposed superstructure decks of ships with $L_{LL} > 100$ m located at least one superstructure standard height above the lowest position 2 deck.

7.10.6.7 Where an increased freeboard is assigned, the design load for hatch covers according to Table 7.10.6.6 on the actual freeboard deck may be as required for a superstructure deck, provided the summer freeboard is such that the resulting draught will not be greater than that corresponding to the minimum freeboard calculated from an assumed freeboard deck situated at a distance at least equal to the standard superstructure height h_N below the actual freeboard deck (refer to Fig. 7.10.6.6).

7.10.6.8 The horizontal weather design load P_A, in kN/m^2, for determining the scantlings of outer edge girders (skirt plates) of weather deck hatch covers and of hatch coamings shall be determined by the formula

$$P_A = f_n f_c (f_b c_L C_w - z) \qquad (7.10.6.8)$$

where $C_w = L/25 + 4{,}1$ for $L < 90$ m;

$C_w = 10{,}75 - \left(\frac{300-L}{100}\right)^{1,5}$ for 90 m $\leq L <$ 300 m;

$C_w = 10{,}75$ for 300 m $\leq L <$ 350 m;

$C_w = 10{,}75 - \left(\frac{L-350}{150}\right)^{1,5}$ for 350 m $\leq L \leq$ 500 m;

$c_L = \sqrt{L/90}$ for $L < 90$ m;

$c_L = 1$ for $L \geq 90$ m;

$f_n = 20 + L_1/12$ for unprotected front coamings and hatch cover skirt plates;

$f_n = 10 + L_1/12$ for unprotected front coamings and hatch cover skirt plates, where the distance from the actual freeboard deck to the summer load line exceeds the minimum non-corrected tabular freeboard according to LL-66/88 by at least one standard superstructure height h_N;

$f_n = 5 + L_1/15$ for side and protected front coamings and hatch cover skirt plates;

$f_n = 7 + L_1/100 - 8x'/L$ for aft ends of coamings and aft hatch cover skirt plates abaft amidships;

$f_n = 5 + L_1/100 - 4x'/L$ for aft ends of coamings and aft hatch cover skirt plates forward of amidships;

$L_1 = L$, need not be taken greater than 300 m;

$f_b = 1{,}0 + \left(\frac{x'/L - 0.45}{C_B + 0{,}2}\right)^2$ for $x'/L < 0{,}45$;

$f_b = 1{,}0 + 1{,}5\left(\frac{x'/L - 0.45}{C_B + 0{,}2}\right)^2$ for $x'/L \geq 0{,}45$

where $0{,}6 \leq C_B \leq 0{,}8$ when determining scantlings of aft ends of coamings and aft hatch cover skirt plates forward of amidships; C_B need not be taken less than 0,8;

x' = distance, in m, between the transverse coaming or hatch cover skirt plate considered and aft end of the length L. When determining side coamings or side hatch cover skirt plates, the side shall be subdivided into parts of approximately equal length, not exceeding $0{,}15L$ each, and x' shall be taken as the distance between aft end of the length L and the centre of each part considered;

z = vertical distance, in m, from the summer load line to the midpoint of stiffener span, or to the middle of the plate field;

$$f_c = 0{,}3 + 0{,}7\frac{b'}{B'}$$

where b' = breadth of coaming, in m, at the position considered;

B' = actual maximum breadth of ship, in m, on the exposed weather deck at the position considered;

b'/B' shall not be taken less than 0,25.

The design load P_A shall not be taken less than the minimum values given in Table 7.10.6.8.

Table 7.10.6.8

Minimum design load $P_{A\,\min}$

L	$P_{A\,\min}$, in kN/m^2, for	
	unprotected fronts	elsewhere
≤ 50	30	15
> 50	$25 + \frac{L}{10}$	$12{,}5 + \frac{L}{20}$
< 250		
≥ 250	50	25

7.10.6.9 Horizontal weather design load applicable to coamings of Type-2 ships is taken as stated below.

The pressure P_{Coam}, in kN/m^2, on the No. 1 forward transverse hatch coaming is given by:

$P_{Coam} = 220$, when a forecastle is fitted in accordance with 3.3.5.4 of Part II "Hull" and the current version[1] of IACS UR S28;

$P_{Coam} = 290$ in the other cases.

The pressure P_{Coam}, in kN/m^2, on the other coamings is given by:

$P_{Coam} = 220$.

Note. The horizontal weather design loads P_A and P_{Coam}need not be included in the direct strength calculation of the hatch cover, unless it is utilized for the design of substructures of horizontal

[1] That is effective on the date of this version of the Rules.

support according to 7.10.6.51.

7.10.6.10 The load on hatch covers due to distributed cargo loads P_L, in kN/m^2, resulting from heave and pitch (i.e. ship in upright condition) shall be determined according to the following formula:

$$P_L = P_{Cargo}(1 + a_V) \qquad (7.10.6.10)$$

where P_{Cargo} = uniform cargo hold, in kN/m^2;
a_V = vertical acceleration addition as follows:

$$a_V = F \cdot m$$

where $F = 0{,}11\frac{v_0}{\sqrt{L}}$;

$m = m_0 - 5(m_0 - 1)\frac{x}{L}$ for $0 \le x/L \le 0{,}2$;

$m = 1$ for $0{,}2 < x/L \le 0{,}7$;

$m = 1 + \frac{m_0+1}{0{,}3}\left(\frac{x}{L} - 0{,}7\right)$ for $0{,}7 < x/L \le 1{,}0$

where $m_0 = 1{,}5 + F$;
v_0 = maximum speed at summer load line draught;
v_0 shall not be taken less than $\sqrt{L}$, in knots.

7.10.6.11 The load P, in kN, due to a concentrated force P_S, in kN, except for container load, resulting from heave and pitch (i.e. ship in upright condition) shall be determined as follows:

$$P = P_S(1 + a_V). \qquad (7.10.6.11)$$

7.10.6.12 The loads defined in 7.10.6.12.1 shall be applied where containers are stowed on the hatch cover.

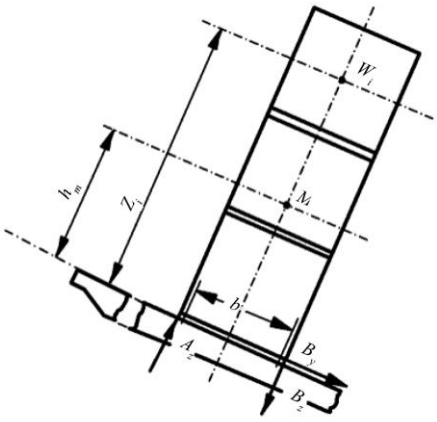


Fig. 7.10.6.12
Forces due to container loads

7.10.6.12.1 The load P, in kN, applied at each corner of a container stack, and resulting from heave and pitch (i.e. ship in upright condition) shall be determined as follows:

$$P = 9{,}81\frac{M}{4}(1 + a_V) \qquad (7.10.6.12.1)$$

where a_V = vertical acceleration addition according to 7.10.6.10;
M = maximum designed mass of container stack, in t.

7.10.6.12.2 The loads, in kN, applied at each corner of a container stack, and resulting from heave, pitch, and the ship's rolling motion (i.e. ship in heel condition) shall be determined as follows (refer also to Fig. 7.10.6.12):

$$A_z = 9{,}81\frac{M}{2}(1 + a_V)\left(0{,}45 - 0{,}42\frac{h_m}{b}\right); \quad (7.10.6.12.2\text{-}1)$$

$$B_z = 9{,}81\frac{M}{2}(1 + a_V)\left(0{,}45 + 0{,}42\frac{h_m}{b}\right); \quad (7.10.6.12.2\text{-}2)$$

$$B_y = 2{,}4M \quad (7.10.6.12.2\text{-}3)$$

where a_V = vertical acceleration addition according to 7.10.6.10;
M = maximum designed mass of container stack, in t;
h_m = designed height of centre of gravity of stack above hatch cover top, in m, may be calculated as weighted mean value of the stack, where the centre of gravity of each tier is assumed to be located at the centre of each container,
$h_m = \Sigma(z_i \cdot W_i)/M$;
z_i = distance from hatch cover top to the centre of i-th container, in m;
W_i = weight of i-th container, in t;
b = distance between midpoints of foot points, in m, refer to Fig. 7.10.6.12;
A_z, B_z = support forces in z-direction at the forward and aft stack corners;
B_y = support force in y-direction at the forward and aft stack corners.

Values of A_z and B_z applied for the assessment of hatch cover strength shall be shown in the drawings of the hatch covers.

N o t e . It is recommended that container loads as calculated above are considered as limit for foot point loads of container stacks in the calculations of cargo securing (container lashing).

7.10.6.13 The load cases defined in 7.10.6.12.1 and 7.10.6.12.2 shall also be considered for partial non homogeneous loading which may occur in practice, e.g. where specified container stack places are empty. For each hatch cover, the heel directions, as shown in Table 7.10.6.13.

The load case partial loading of container hatch covers can be evaluated using a simplified approach, where the hatch cover is loaded without the outermost stacks that are located completely on the hatch cover. If there are additional stacks that are supported partially by the hatch cover and partially by container stanchions then the loads from these stacks shall also be neglected, refer to Table 7.10.6.13.

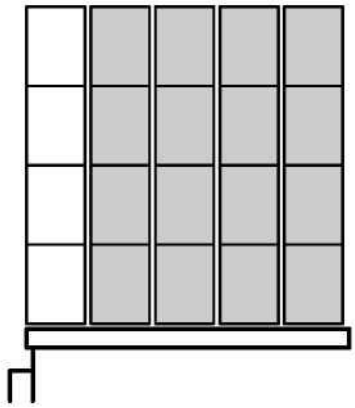
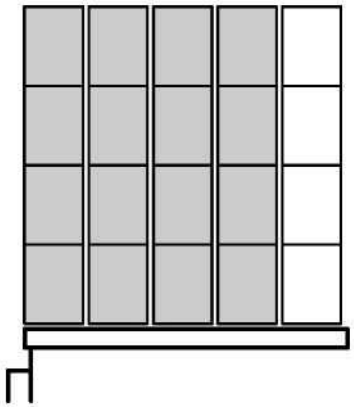
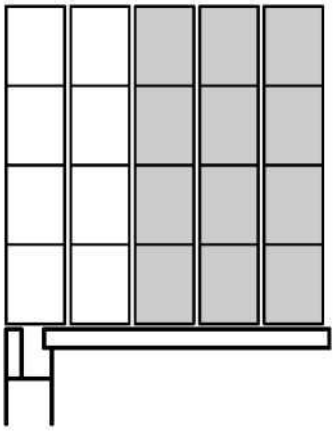
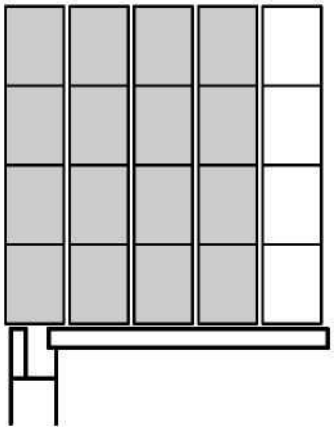
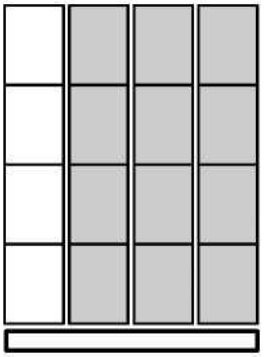
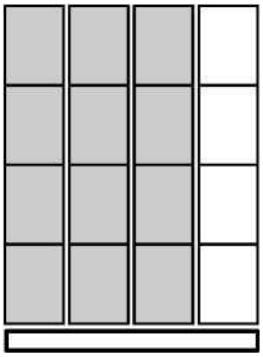
In addition, the case where only the stack places supported partially by the hatch cover and partially by container stanchions are left empty shall be assessed in order to consider the maximum loads in the vertical hatch cover supports.

It may be necessary also to consider partial load cases where more or different container stack places are left empty.

In the case of mixed stowage (20' + 40' container combined stack), the foot point forces at the fore and aft end of the hatch cover shall not be higher than resulting from the design stack weight for 40' containers, and the foot point forces at the middle of the cover shall not be higher than resulting from the design stack weight for 20' containers.

Table 7.10.6.13

Partial loading of container hatch covers

Heel direction	←	→
Hatch covers supported by the longitudinal hatch coaming with all container stacks located completely on the hatch cover		
Hatch covers supported by the longitudinal hatch coaming with the outermost container stack supported partially by the hatch cover and partially by container stanchions		
Hatch covers not supported by the longitudinal hatch coaming (center hatch covers)		

7.10.6.14 Hatch covers, which in addition to the loads according to 7.10.6.6, 7.10.6.7 and 7.10.6.12 are loaded in the ship's transverse direction by forces due to elastic deformations of the ship's hull, shall be designed such that the sum of stresses does not exceed the permissible values given in 7.10.6.15.

7.10.6.15 Yield strength of all hatch cover structural members shall comply with the following formulae:

$\sigma_{vm} \leq \sigma_a$ for shell elements in general;

$\sigma_{axial} \leq \sigma_a$ for rod or beam elements in general

where σ_a = allowable stress as defined in Table 7.10.6.15;

R_{eH} = specified minimum yield stress, in N/mm^2, of the material;

σ_{vm} = Von Mises stress, in N/mm², to be taken as follows:

$$\sigma_{vm} = \sqrt{\sigma_x^2 - \sigma_x \cdot \sigma_y + \sigma_y^2 + 3\tau_{xy}^2}, \text{ in N/mm}^2 \qquad (7.10.6.15)$$

where σ_x = normal stress, in N/mm^2, in x-direction;
σ_y = normal stress, in N/mm^2, in y plane;
τ_{xy} = shear stress, in N/mm^2, in the x-y plane;
σ_{axial} = axial stress in rod or beam elements, in N/mm^2;

Indices x and y are coordinates of a two-dimensional Cartesian system in the plane of the considered structural element.

In case of FEM calculations using shell (or plate) strain elements, the stresses shall be read from the centre of the individual element. It shall be observed that, in particular, at flanges of unsymmetrical girders, the evaluation of stress from element centre may lead to non-conservative results. Thus, a sufficiently fine mesh shall be applied in these cases or, the stress at the element edges shall not exceed the allowable stress. Where shell elements are used, the stresses shall be evaluated at the mid plane of the element.

For steels with a minimum yield stress of more than 355 N/mm^2, the value of R_{eH} shall be taken in accordance with 3.13.7 of Part III "Materials".

Table 7.10.6.15

Allowable stresses

Members of	Subject to	σ_a, in N/mm^2
Hatch cover structure	External pressure, as defined in 7.10.6.6	$0{,}80\ R_{eH}$
	Other loads, as defined in 7.10.6.8 —7.10.6.14	$0{,}90\ R_{eH}$ for static + dynamic load case $0{,}72\ R_{eH}$ for static load case

7.10.6.16 The vertical deflection of primary supporting members due to the vertical weather design load according to 7.10.6.6 and 7.10.6.7 shall not be more than $0{,}0056 l_g$ where l_g — is the greatest span of primary supporting members.

Note. Where hatch covers are arranged for carrying containers and mixed stowage is allowed, i.e. a 40' container stowed on top of two 20' containers, particular attention shall be paid to the deflections of hatch covers. Further the possible contact of deflected hatch covers within hold cargo shall be observed.

7.10.6.17 The local net plate thickness t, in mm, of the hatch cover top plating shall not be less than:

$$t = 0{,}0158\, F_p s \sqrt{\frac{P}{0{,}95 \mathrm{R}_{eH}}} \qquad (7.10.6.17)$$

and shall not be less than 1 % of the spacing of the stiffener or 6 mm if that be greater

where F_p = 1,5 in general;
F_p = 1,9 σ/σ_a, for $\sigma/\sigma_a \geq 0{,}8$ for the attached plate flange of primary supporting members;
s = stiffener spacing, in mm;
P = pressure P_{HC} and P_L, in kN/m^2, as defined in 7.10.6.6 and 7.10.6.10;
σ = maximum normal stress, in N/mm^2, of hatch cover top plating, determined according to Fig. 7.10.6.17;
σ_a = as defined in Table 7.10.6.15.

For flange plates under compression sufficient buckling strength according to 7.10.6.25 shall be demonstrated.

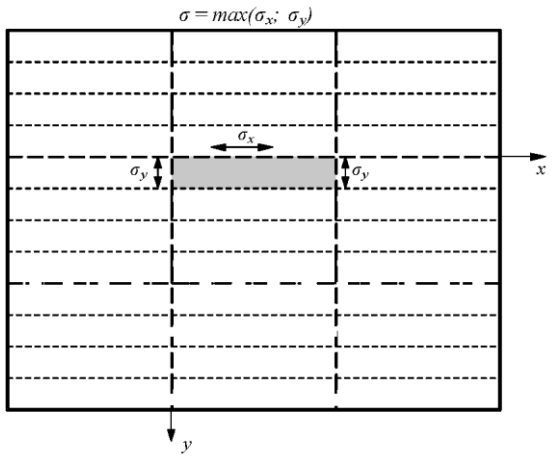


Fig. 7.10.6.17

7.10.6.18 The thickness of lower plating of double skin hatch covers and box girders shall fulfill the strength requirements and shall be obtained from the calculation according to 7.10.6.22 under consideration of permissible stresses according to 7.10.6.15. When the lower plating is taken into account as a strength member of the hatch cover, the net thickness, in mm, of lower plating shall be taken not less than 5 mm. When project cargo is intended to be carried on a hatch cover, the net thickness shall not be less than:

$$t = 6{,}5s \times 10^{-3}, \text{ in mm} \qquad (7.10.6.18)$$

where s = stiffener spacing, in mm.

N o t e . Project cargo means especially large or bulky cargo lashed to the hatch cover. Examples are parts of cranes or wind power stations, turbines, etc. Cargoes that can be considered as uniformly distributed over the hatch cover, e.g. timber, pipes or steel coils need not to be considered as project cargo.

7.10.6.19 The net section modulus Z and net shear area A_{shr} of uniformly loaded hatch cover stiffeners constraints at both ends shall not be less than:

$$Z = \frac{Psl^2}{f_{bc}\sigma_a}, \text{ in cm}^3, \qquad (7.10.6.19\text{-}1)$$

$$A_{shr} = \frac{8{,}7Psl}{\sigma_a}, \text{ in cm}^2 \qquad (7.10.6.19\text{-}2)$$

where l = stiffener span, in m, to be taken as the spacing, in m, of primary supporting members or the distance between a primary supporting member and the edge support, as applicable. When brackets are fitted at both ends of all stiffener spans, the secondary stiffener span may be reduced by an amount equal to 2/3 of the minimum brackets arm length, but not greater than 10 % of the unsupported span, for each bracket;

s = stiffener spacing, in mm;

P = pressure P_{HC} and P_L, in kN/m^2, as defined in 7.10.6.6 and 7.10.6.10;

f_{bc} = boundary coefficient of stiffener, taken equal to:

$f_{bc} = 8$, in the case of stiffener simply supported at both ends or simply supported at one end and clamped at the other end;

$f_{bc} = 12$, in the case of stiffener clamped at both ends;

σ_a = allowable stress as defined in Table 7.10.6.15.

For stiffeners of lower plating of double skin hatch covers, requirements mentioned above are not applied due to the absence of lateral loads.

The net thickness, in mm, of the stiffener (except U-type/trapeze stiffeners) web shall be taken not less than 4 mm.

The net section modulus of the stiffeners shall be determined based on and attached plate width assumed equal to the stiffener spacing.

Stiffeners parallel to primary supporting members shall be continuous at crossing primary supporting member and may be regarded for calculating the cross-sectional properties of primary supporting members. It shall be verified that the combined stress of those stiffeners induced by the bending of primary supporting members and lateral pressures does not exceed the permissible stresses according to 7.10.6.15. These requirements are not applied to stiffeners of lower plating of double skin hatch covers if the lower plating is not considered as strength member.

For hatch cover stiffeners under compression sufficient safety against lateral and torsional buckling according to 7.10.6.24.3 shall be verified.

For hatch covers subject to wheel loading or point loads stiffener scantlings shall be determined under consideration of the permissible stresses according to 7.10.6.15.

7.10.6.20 Scantlings of primary supporting members are obtained from calculations according to 7.10.6.23 and 7.10.6.24 under consideration of permissible stresses according to 7.10.6.15.

For all components of primary supporting members sufficient safety against buckling shall be verified according to 7.10.6.24.3.

The net thickness, in mm, of webs of primary supporting members shall not be less than:

$$t = 6{,}5\, s \times 10^{-3}, \text{ in mm;} \qquad (7.10.6.20)$$

$$t_{\min} = 5 \text{ mm}$$

where s = stiffener spacing, in mm.

7.10.6.21 Scantlings of edge girders are obtained from the calculations according to 7.10.6.23 and 7.10.6.24 under consideration of permissible stresses according to 7.10.6.15.

The net thickness, in mm, of the outer edge girders exposed to wash of sea shall not be less than the largest of the following values:

$$t = 0{,}0158 s \sqrt{\frac{P_A}{0{,}95 R_{eH}}}; \qquad (7.10.6.21\text{-}1)$$

$$t = 8{,}5\, s \times 10^{-3}, \text{ in mm;}$$

$$t_{\min} = 5 \text{ mm}$$

where P_A = horizontal pressure as defined in 7.10.6.8;
s = stiffener spacing, in mm.

The moment of inertia I, in cm^4, of edge girders shall not be less than:

$$I = 6 q S_{SD}^4, \text{ in cm}^4 \qquad (7.10.6.21\text{-}2)$$

where q = packing line pressure, in N/mm, minimum 5 N/mm;
S_{SD} = spacing of securing devices, in m, not to be taken less than 2 m.

7.10.6.22 The stresses in hatch covers are to be determined by FE analysis.

The stress calculation model in 7.10.6.23 shall be used for both yielding and buckling strength assessments in accordance with 7.10.6.15 and 7.10.6.24, respectively.

The net scantlings as defined in 7.10.6.4 shall be used.

7.10.6.23 General requirements for calculations by means of finite element method (FEM calculations).

For the strength assessments of hatch covers by means of FE analysis, the hatch cover geometry shall be idealized as realistically as possible. In no case shall element width be larger

than stiffener spacing. In way of force transfer points and cutouts the mesh shall be refined where applicable. The ratio of element length to width shall not exceed 3.

The element size along the height of webs of primary supporting member shall not exceed one-third of the web height. Stiffeners, which support plates subjected to lateral pressure loads, shall be included in the FE model idealization. Stiffeners may be modelled by using beam elements, or shell/plate elements. Buckling stiffeners may be disregarded for the stress calculation.

Hatch covers fitted with U-type stiffeners as shown in Fig. 7.10.6.23 shall be assessed by means of FE analysis. The geometry of the U-type stiffeners shall be accurately modelled using shell/plate elements. Nodal points shall be properly placed on the intersections between the webs of a U-type stiffener and the hatch cover plate, and between the webs and flange of the U-type stiffener.

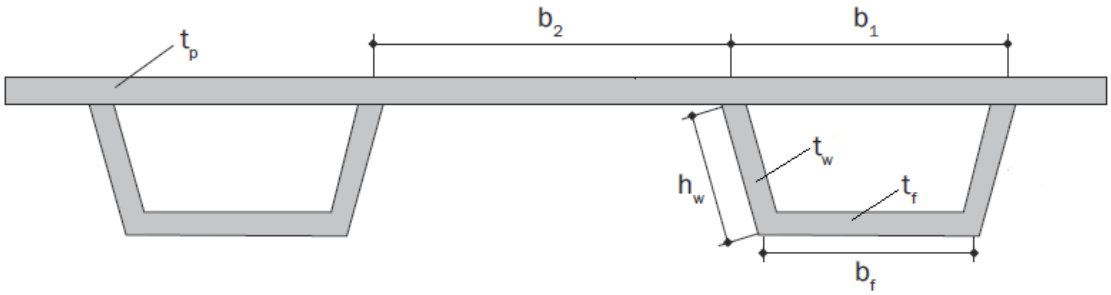


Fig. 7.10.6.23
Example of hatch cover fitted with U-type stiffeners

Wherever applicable the following boundary conditions shall be applied to the FE model:

boundary nodes in way of a bearing pad on the hatch coamings shall be fixed against displacement in the direction perpendicular to the pad;

lifting stoppers shall be fixed against displacements in the direction determined by the stoppers;

for a folding type hatch cover, the FE nodes connected through a hinge shall have the same translational displacement in the direction perpendicular to the hatch cover top plating.

7.10.6.24 Buckling strength of hatch cover structures.

7.10.6.24.1 General.

Buckling strength of all hatch cover structures shall be checked. Buckling assessments shall be performed in compliance with the requirements in IACS UR S35 for the conditions specified in 7.10.6.24.2 and 7.10.6.24.3.

The net scantlings as defined in 7.10.6.4 shall be used for buckling check.

7.10.6.24.2 Slenderness requirements.

The slenderness requirements shall be in accordance with those specified in Section 2 of IACS UR S35.

The slenderness requirements need not be applied to the lower boundary of double skin hatch covers unless the cargo hold is designed for carriage of ballast or liquid cargo.

The breadth of the primary supporting member flange shall be not less than 40 % of its depth for laterally unsupported spans greater than 3,0 m. Tripping brackets attached to the flange may be considered as a lateral support for primary supporting members.

7.10.6.24.3 Buckling requirements.

7.10.6.24.3.1 These requirements apply to the buckling assessment of hatch cover structures subjected to compressive and shear stresses and lateral pressures. The buckling assessment shall be performed for the following structural elements:

stiffened and unstiffened panels, including curved panels and panels stiffened with U-type stiffeners;

web panels of primary supporting members in way of openings.

The panel types and assessment methods, the applied lateral pressure and stresses, safety factors and buckling check criteria are defined in 7.10.6.24.3.2 — 7.10.6.24.3.5,

respectively. The procedure and detailed requirements for buckling assessment are given in Section 4 of IACS UR S35.

7.10.6.24.3.2 Panel types and assessment methods.

The plate panel of a hatch cover structure shall be modelled as stiffened panel (SP) or unstiffened panel (UP) as defined in Section 4 of IACS UR S35. Assessment Method A (-A) and Method B (-B) as defined in Section 1 of IACS UR S35, shall be used in accordance with Table 7.10.6.24.3.2, Figs. 7.10.6.24.3.2-1 and 7.10.6.24.3.2-2. For a web panel with opening, the procedure for opening should be used for its buckling assessment.

For a hatch cover fitted with U-type stiffeners, the additional buckling assessment requirements specific for panels with U-type stiffeners in Section 5 of IACS UR S35 shall also be followed.

Table 7.10.6.24.3.2

Structural members and assessment methods

Structural elements	Assessment method[1, 2]	Normal panel definition
Hatch cover top/bottom plating structures, refer to Fig. 7.10.6.24.3.2-1		
Hatch cover top/bottom plating	SP-A	Length: between transverse girders Width: between longitudinal girders
Irregularly stiffened panels	UP-B	Plate between local stiffeners/PSM
Hatch cover web panels of primary supporting members, refer to Fig. 7.10.6.24.3.2-2		
Web of transverse/longitudinal girder (single skin type)	UP-B	Plate between local stiffeners/face plate/PSM
Web of transverse/longitudinal girder (double skin type)	SP-B[3]	Length: between PSM Width: full web depth
Web panel with opening	Procedure for opening	Plate between local stiffeners/face plate /PSM
Irregularly stiffened panels	UP-B	Plate between local stiffeners/face plate /PSM

[1]SP and UP stand for stiffened and unstiffened panel respectively.
[2]A and B stand for Method A and Method B respectively.
[3] In case that the buckling carlings/brackets are irregularly arranged in the web of transverse/longitudinal girder, UP-B method may be used.

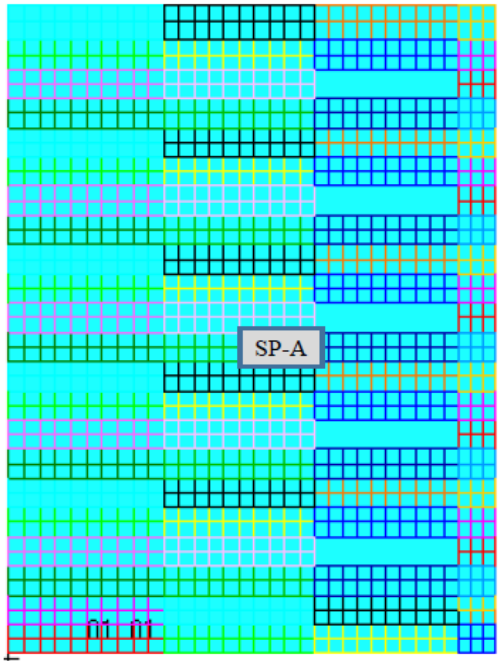


Fig. 7.10.6.24.3.2-1
Hatch cover top/bottom plating structures

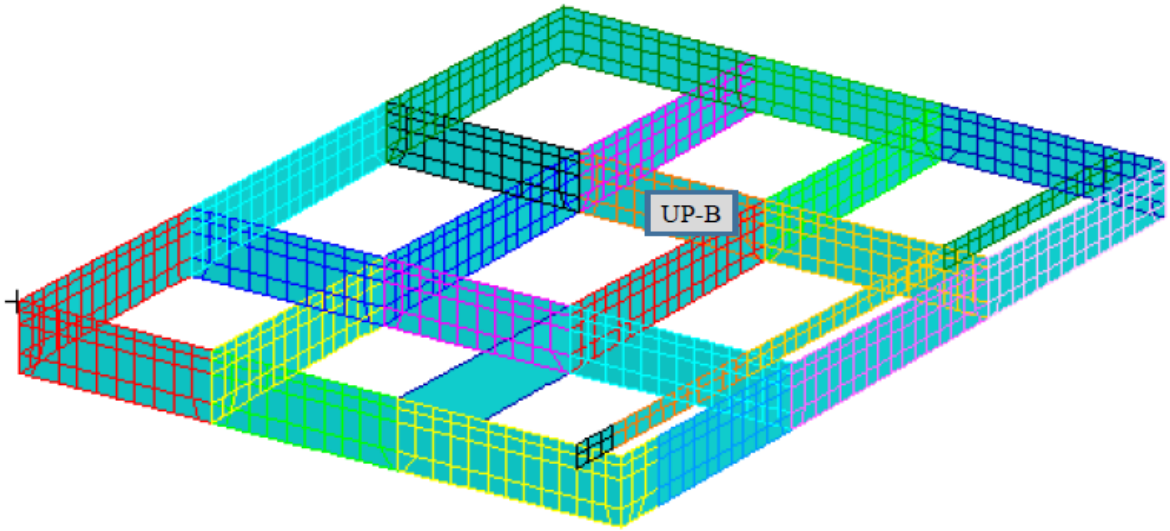


Fig. 7.10.6.24.3.2-2
Hatch cover webs of primary supporting members

7.10.6.24.3.3 Applied lateral pressure and stresses.

The buckling assessment of hatch covers is based on the lateral pressure as defined in 7.10.6.6, 7.10.6.8 and 7.10.6.9, and stresses obtained from FE analysis.

7.10.6.24.3.4 Safety factors.

For all hatch cover structural members, safety factor S=1,0 shall be applied to both of the plating and stiffener buckling capacity formulas as defined in 2.2 of Section 5 of IACS UR S35and 2.3 of Section 5 of IACS UR S35, respectively.

7.10.6.24.3.5 Buckling acceptance criteria.

A structural member is considered to have an acceptable buckling strength if it satisfies the following criterion:

$$\eta_{act} \leq \eta_{all}$$

where η_{act} = buckling utilisation factor based on the applied stress, as defined in 3.2.2 of Section 1 of IACS UR S35 and in Section 4 of UR S35, and calculated per Section 5 of UR S35;
η_{all} = allowable buckling utilisation factor, taken as given in Table 7.10.6.24.3.5.

Table 7.10.6.24.3.5

Allowable buckling utilisation factors

Structural component	Subject to	Allowable buckling utilisation factor η_{all}
Plates and stiffeners Web of PSM	External pressure, as defined in 7.10.6.6	0,80
	Other loads, as defined in 7.10.6.8 — 7.10.6.14	0,90 for static + dynamic load case 0,72 for static load case

7.10.6.25 Securing and arrangement of containers on the hatch covers shall comply with the Technical Requirements for the Arrangement and Securing of the International Standard Containers on Board the Ships Intended for Container Transportation. Structures under container load shall be calculated according to 7.10.6.5 — 7.10.6.14 using the permissible stresses as per 7.10.6.15.

7.10.6.26 To ensure weather tightness, the requirements of 7.10.6.37 — 7.10.6.43 applicable to hatch covers shall be met.

The packing material of hatch covers gaskets shall be suitable for all expected service conditions of the ship and shall be compatible with the cargoes to be transported. The packing

material shall be selected with regard to dimensions and elasticity in such a way that expected deformations can be carried. Forces shall be carried by the steel structure only.

The packings shall be compressed so as to give the necessary tightness effect for all expected operating conditions. Special consideration shall be given to the packing arrangement in ships with large relative movements between hatch covers and coamings or between hatch cover sections. The specification or grade of the packing material shall be indicated on the drawings.

7.10.6.27 For hatch covers of cargo holds solely for the transport of containers, upon request of the shipowner and subject to compliance with the following conditions the fitting of weather tight gaskets according to 7.10.6.26 may be dispensed with:

the hatchway coamings shall be not less than 600 mm in height;

the exposed deck on which the hatch covers are located is situated above a depth $H(x)$.

$H(x)$ shall be shown to comply with the following criteria:

$$H(x) \geq T_{fb} + f_b + h, \text{ in m} \qquad (7.10.6.27)$$

where T_{fb} = draught, in m, corresponding to the assigned summer load line;
f_b = minimum required freeboard, in m, determined in accordance with regulation 28 of LL-66/88, as amended, where applicable;
$h =$ 4,6 m for $x/L_{LL} \leq 0{,}75$;
$h =$ 6,9 m for $x/L_{LL} > 0{,}75$.

Labyrinths, gutter bars or equivalents shall be fitted proximate to the edges of each panel in way of the coamings. The clear profile of these openings shall be kept as small as possible.

Where a hatch is covered by several hatch cover panels, the clear opening of the gap in between the panels shall be not wider than 50 mm.

The labyrinths and gaps between hatch cover panels shall be considered as unprotected openings with respect to the requirements of intact and damage stability calculations.

Bilge alarms shall be provided in each hold fitted with non-weathertight covers.

Furthermore, Chapter 3 of IMO circular MSC/Circ. 1087 shall be referred to concerning the stowage and segregation of containers containing dangerous goods.

7.10.6.28 Cross-joints of multi-panel covers shall be provided with efficient drainage arrangements.

7.10.6.29 The net thickness of weather deck hatch coamings shall not be less than that determined by the following formulae:

for Type-1 ships:

$$t = 0{,}0142s\sqrt{\frac{P_A}{0{,}95R_{eH}}}, \text{ in mm;} \qquad (7.10.6.29\text{-}1)$$

$$t_{\min} = 6 + L_1/100, \text{ in mm;} \qquad (7.10.6.29\text{-}2)$$

for Type-2 ships:

$$t = 0{,}016s\sqrt{\frac{P_{coam}}{0{,}95R_{eH}}}, \text{ in mm;} \qquad (7.10.6.29\text{-}3)$$

$$t_{\min} = 9{,}5, \text{ in mm} \qquad (7.10.6.29\text{-}4)$$

where P_A = pressure, in kN/m^2, as defined in 7.10.6.8;
P_{coam} = pressure, in kN/m^2, as defined in 7.10.6.9;
s = stiffener spacing, in mm;
$L_1 = L$, need not be taken greater than 300 m.

In addition, for both Type-1 and Type-2 ships, longitudinal strength aspects shall be observed.

Strength aspects of longitudinal hatch coamings for Type-1 and Type-2 ships shall meet the requirements of 1.6.5 of Part II "Hull".

7.10.6.30 The stiffeners shall be continuous at the coaming stays. For stiffeners with both ends constraint, the elastic net section modulus Z, in cm^3, and net shear area A_{shr}, in cm^2, calculated on the basis of net thickness, shall not be less than:

for Type-1 ships:

$$Z = \frac{P_A s l^2}{f_{bc} R_{eH}}; \qquad (7.10.6.30\text{-}1)$$

$$A_{shr} = \frac{P_A s l}{R_{eH}} 10^{-2} \qquad (7.10.6.30\text{-}2)$$

where f_{bc} = 12 in general;
f_{bc} = 8 for the end spans of stiffeners sniped at the coaming corners;
l = stiffener span, in m, to be taken as the spacing of coaming stays;
s = stiffener spacing, in mm.

For sniped stiffeners of coaming at hatch corners shear area at the fixed support shall be increased by 35 %. The gross thickness of the coaming plate at the sniped stiffener end shall not be less than those defined as per the formula

$$t_{gr} = 19{,}6\sqrt{\frac{P_A s(l - 0{,}0005s)}{1000 R_{eH}}}, \text{ in mm;} \qquad (7.10.6.30\text{-}3)$$

for Type-2 ships:

$$Z = 1{,}21 \frac{P_{Coam} s l^2}{f_{bc} c_p R_{eH}} \qquad (7.10.6.30\text{-}4)$$

where f_{bc} = 16 in general;
f_{bc} = 12 for the end spans of stiffeners sniped at the coaming corners;
l = span of stiffeners, in m;
s = spacing of stiffeners, in mm;
P_A = pressure, in kN/m^2, as defined in 7.10.6.8;
P_{coam} = pressure, in kN/m^2, as defined in 7.10.6.9;
c_p = ratio of the plastic section modulus to the elastic section modulus of the stiffeners with an attached plate breadth, in mm, equal to $40t$, where t is the plate net thickness;
c_p = 1,16 in the absence of more precise evaluation.

For both Type-1 and Type-2 ships, horizontal stiffeners on hatch coamings, which are part of the longitudinal hull structure, shall be designed according to the requirements in 1.6.5 of Part II "Hull".

7.10.6.31 Coaming stays shall be designed for the loads transmitted through them and permissible stresses according to 7.10.6.15.

At the connection of the coaming stays with deck (refer to Figs. 7.10.6.31-1 and 7.10.6.31-2), the net section modulus Z, in cm^3, shall be taken not less than:

$$Z = \frac{P s_c H_c^2}{1{,}9 R_{eH}}, \text{ in cm}^3, \qquad (7.10.6.31)$$

where H_c = stay height, in m;
s_c = stay spacing, in mm;
P = pressure on coaming, in kN/m^2, taken as P_A defined in 7.10.6.8 in general and as P_{Coam} defined in 7.10.6.9 for Type-2 ships.

For other designs of coaming stays, such as those shown in Figs. 7.10.6.31-3 and 7.10.6.31-4, the stresses shall be determined through FEM. The calculated stresses shall comply with the permissible stresses according to 7.10.6.15.

Coaming stays shall be supported by appropriate substructures. For calculating the section modulus of coaming stays, their face plate area shall be taken into account only when it is welded with full penetration welds to the deck plating and adequate underdeck structure is fitted to support the stresses transmitted by it.

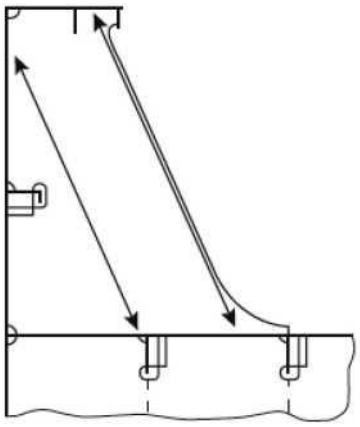


Fig. 7.10.6.31-1

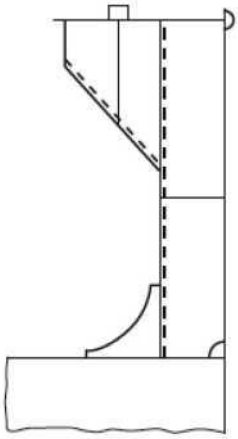


Fig. 7.10.6.31-2

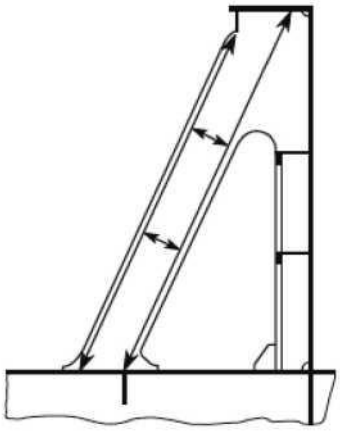


Fig. 7.10.6.31-3

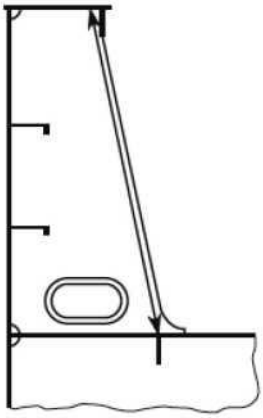


Fig. 7.10.6.31-4

7.10.6.32 At the connection with deck, the net thickness t_w, in mm, of the coaming stays shall be taken not less than:

$$t_w = \frac{2Ps_c H_c}{hR_{eH}} \qquad (7.10.6.32)$$

where H_c = stay height, in m;
h = stay depth, in mm, at the connection with the deck.

Webs shall be connected to the deck by fillet welds on both sides with a throat thickness of $a = 0{,}44t_w$.

For Type-2 ships, toes of stay webs shall be connected to the deck plating with full or partial penetration double bevel welds extending over a distance not less than 15 % of the stay width.

7.10.6.33 Hatch coamings which are part of the longitudinal hull structure shall be designed according to the requirements of 1.6.5 of Part II "Hull".

Longitudinal hatch coamings with a length exceeding $0{,}1L$ shall be provided with tapered brackets or equivalent transitions and a corresponding substructure at both ends. At the end of the brackets they shall be connected to the deck by full penetration welds of minimum 300 mm in length.

7.10.6.34 Hatch coamings and supporting structures shall be adequately stiffened to accommodate the loading from hatch covers, in longitudinal, transverse and vertical directions.

Structures under deck shall be checked against the load transmitted by the stays.

Unless otherwise stated, weld connections shall be dimensioned according to 1.7 of Part II "Hull" and materials shall be selected according to 2.2 of Part XIV "Welding".

7.10.6.35 On ships carrying cargo on deck, such as timber, coal or coke, the stays shall be spaced not more than 1,5 m apart.

Coaming plates shall extend to the lower edge of the deck beams or hatch side girders shall be fitted that extend to the lower edge of the deck beams. Extended coaming plates and hatch side girders shall be flanged or fitted with face bars or half round bars. Fig. 7.10.6.35 gives an example.

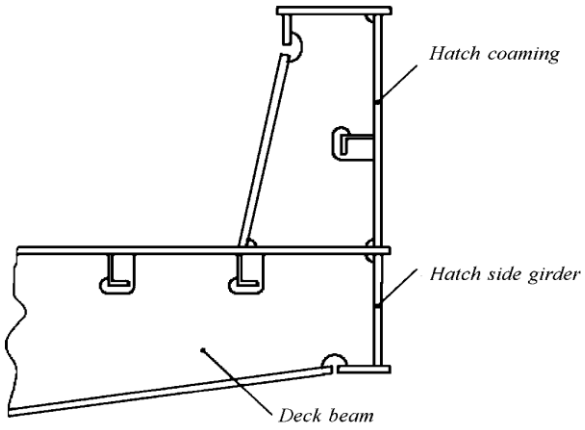


Fig. 7.10.6.35

7.10.6.36 If drain channels are provided inside the line of gasket by means of a gutter bar or vertical extension of the hatch side and end coaming, drain openings shall be provided at appropriate positions of the drain channels.

Drain openings in hatch coamings shall be arranged with sufficient distance to areas of stress concentration (e.g. hatch corners, transitions to crane posts).

Drain openings shall be arranged at the ends of drain channels and shall be provided with non-return valves to prevent ingress of water from outside. It is unacceptable to connect fire hoses to the drain openings for this purpose.

If a continuous outer steel contact between cover and ship structure is arranged, drainage from the space between the steel contact and the gasket shall also be provided for.

7.10.6.37 Securing devices between cover and coaming and at cross-joints shall be installed to provide weathertightness. Sufficient packing line pressure shall be maintained.

Securing devices shall be appropriate to bridge displacements between cover and coaming due to hull deformations.

Securing devices shall be of reliable construction and effectively attached to the hatchway coamings, decks or covers. Individual securing devices on each cover shall have approximately the same stiffness characteristics.

Sufficient number of securing devices shall be provided at each side of the hatch cover considering the requirements of 7.10.6.21. This applies also to hatch covers consisting of several parts.

7.10.6.38 Where rod cleats are fitted, resilient washers or cushions shall be incorporated.

Where hydraulic cleating is adopted, positive means shall be provided so that it remains mechanically locked in the closed position in the event of failure of the hydraulic system.

7.10.6.39 The gross sectional area, in cm^2, of the securing devices shall not be less than that defined by the formula

$$A = 0{,}28 q S_{SD} k_l \qquad (7.10.6.39)$$

where q = packing line pressure, in N/mm, minimum 5 N/mm;
S_{SD} = spacing between securing devices, in m, but shall not be taken less than 2 m;
$k_l = \left(\frac{235}{R_{eH}}\right)^e$;
R_{eH} = minimum yield strength of the material, in N/mm^2, but shall not be taken greater than $0{,}7R_m$ where R_m is the tensile strength of the material, in N/mm^2;
e = 0,75 for $R_{eH} > 235$ N/mm^2;
e = 1,00 for $R_{eH} \leq 235$ N/mm^2.

Rods or bolts shall have a gross diameter no less than 19 mm for hatchways exceeding 5 m² in area.

Securing devices of special design in which significant bending or shear stresses occur may be designed as anti-lifting devices according to 7.10.6.40. As load, the packing line pressure q multiplied by the spacing between securing devices S_{SD} shall be applied.

7.10.6.40 The securing devices of hatch covers, on which cargo is lashed, shall be designed for the lifting forces resulting from loads according to 7.10.6.12 — 7.10.6.14, refer to Fig. 7.10.6.40. Unsymmetrical loadings, which may occur in practice, shall be considered. Under these loadings the equivalent stress in the securing devices shall not exceed:

$$\sigma_{vm} = 150/k_l, \text{ N/mm}^2. \qquad (7.10.6.40)$$

N o t e . The partial load cases given in Table 7.10.6.13 may not cover all unsymmetrical loadings, critical for hatch cover lifting.

Chapter 5.6 of the current version[2] of IACS recommendation No. 14 (the document is available at the IACS website: www.iacs.org.uk) shall be referred to for the omission of anti-lifting devices.

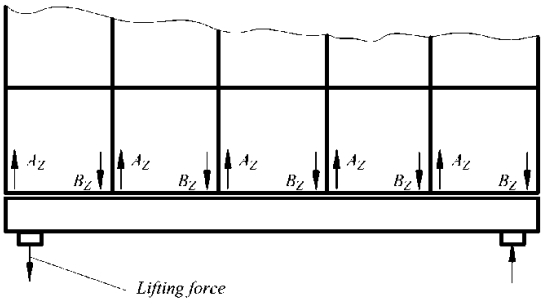


Fig. 7.10.6.40
Lifting forces at a hatch cover

7.10.6.41 For the design of the hatch cover supports, the horizontal mass forces $F_h = ma$ shall be calculated with the following accelerations:

$a_x = 0{,}2g$ in longitudinal direction;

$a_y = 0{,}5g$ in transverse direction;

$m =$ sum of mass of cargo lashed on the hatch cover and mass of hatch cover.

The accelerations in longitudinal direction and in transverse direction do not need to be considered as acting simultaneously.

7.10.6.42 For the transmission of the support forces resulting from the load cases specified in 7.10.6.5 — 7.10.6.14 and of the horizontal mass forces specified in 7.10.6.41, supports shall be provided which shall be designed such that the nominal surface pressures in general do not exceed the following values:

$$P_{n\max} = dP_n, \text{ in N/mm}^2 \qquad (7.10.6.42\text{-}1)$$

where $d = 3{,}75 - 0{,}015L$;
$d_{\max} = 3{,}0$;
$d_{\min} = 1{,}0$ in general;
$d_{\min} = 2{,}0$ for partial loading conditions, refer to 7.10.6.13;
P_n = permissible nominal surface pressure, refer to Table 7.10.6.42.

For metallic supporting surfaces not subjected to relative displacements, the nominal surface pressure shall be calculated by the formula

$$P_{n\max} = 3P_n, \text{ in N/mm}^2. \qquad (7.10.6.42\text{-}2)$$

[2] That is effective on the date of this version of the Rules.

Drawings of the supports shall be submitted to the Register. In the drawings of supports the permitted maximum pressure given by the material manufacturer shall be specified.

Where large relative displacements of the supporting surfaces are expected, the use of material having low wear and frictional properties is recommended.

The substructures of the supports shall be of such a design, that a uniform pressure distribution is achieved.

Irrespective of the arrangement of stoppers, the supports shall be able to transmit the following force P_h in the longitudinal and transverse directions:

$$P_h = \mu \frac{P_V}{\sqrt{d}} \qquad (7.10.6.42\text{-}3)$$

where P_V = vertical supporting force;
μ = frictional coefficient, in general equal to 0,5.

For non-metallic, low-friction support materials on steel, the friction coefficient may be reduced but not to be less than 0,35.

Supports as well as the adjacent structures and substructures shall be designed such that the permissible stresses according to 7.10.6.15 are not exceeded.

Table 7.10.6.42

Permissible nominal surface pressure P_n

Support material	P_n, in N/mm^2, when loaded by	
	vertical force	horizontal force (on stoppers)
Hull structural steel	25	40
Hardened steel	35	50
Lower friction materials	50	—

7.10.6.43 Hatch covers shall be sufficiently secured against horizontal shifting. Stoppers shall be provided for hatch covers, on which cargo is carried.

The greater of the loads resulting from 7.10.6.8 and 7.10.6.41 shall be applied for the dimensioning of the stoppers and their substructures.

The permissible stress in stoppers, their substructures, in the cover, and of the coamings shall be determined according to 7.10.6.14. In addition, the requirements in 7.10.6.42 shall be observed.

Specifically for Type-2 ships, the following additional requirements shall be complied with.

Hatch covers shall be effectively secured, by means of stoppers, against the transverse forces arising from a pressure of 175 kN/m^2.

With the exclusion of No.1 hatch cover, hatch covers shall be effectively secured, by means of stoppers, against the longitudinal forces acting on the forward end arising from a pressure of 175 kN/m^2.

No. 1 hatch cover shall be effectively secured, by means of stoppers, against the longitudinal forces acting on the forward end arising from a pressure of 230 kN/m^2.

This pressure may be reduced to 175 kN/m^2 when a forecastle is fitted in accordance with IACS UR S28.

The equivalent stress in stoppers and their supporting structures and calculated in the throat of the stopper welds shall not exceed the allowable value of $0{,}8R_{eH}$.

7.10.6.44 Corrosion additions (corrosion allowance) t_s, in mm, for hatch covers and hatch coamings are given in Table 7.10.6.44.

Table 7.10.6.44

Corrosion additions t_s for hatch covers and hatch coamings

Application	Structure	t_s, in mm
Weather deck cargo hatches of container ships, car carriers, paper carriers, passenger ships	Hatch covers	1,0
	Hatch coamings	1,5
Weather deck cargo hatches of Type-2 ships	Hatch covers in general	2,0
	Top and bottom plating of double skin hatch covers	2,0
	Internal structure of double skin hatch covers	1,5
	Hatch coamings and coaming stays	1,5
Weather deck cargo hatches of all other ship type	Hatch covers in general	2,0
	Weather exposed plating and bottom plating of double skin hatch covers	1,5
	Internal structure of double skin hatch covers and closed box girders (hollow beams)	1,0
	Hatch coamings not part of the longitudinal hull structures	1,5
	Hatch coamings part of the longitudinal hull structures	2
	Coaming stays and stiffeners	1,5

".

Chapter 7.13 and reference thereto in para 7.5.1.1 are deleted. Existing **Chapters 7.14** and **7.15** are renumbered **Chapters 7.13** and **7.14** accordingly.

8 ARRANGEMENT AND EQUIPMENT OF SHIP'S SPACES. OTHER ARRANGEMENTS AND EQUIPMENT

8.8 PILOT TRANSFER ARRANGEMENTS, MEANS OF EMBARKATION AND DISEMBARKATION

Para 8.8.1 is amended as follows:

"**8.8.1** The requirements of this Chapter apply to all self-propelled ships except for cargo ships of less than 500 gross tonnage and fishing vessels, unless otherwise stated in the Chapter.".

New para 8.8.3 is introduced reading as follows:

"**8.8.3** Ships shall be provided with means of embarkation on and disembarkation from ships for use in port, such as gangways and accommodation ladders.

Means of embarkation and disembarkation may be omitted if a ship is engaged in voyages between designated ports where appropriate shore accommodation/embarkation ladders (platforms) are provided.".

Existing para 8.8.3 is renumbered **8.8.4**.

Existing para 8.8.3 is replaced by the following text:

"**8.8.4** The means of embarkation and disembarkation shall be constructed and installed in compliance with the requirements of IMO circular MSC.1/Circ.1331. For fishing vessels and cargo ships of less than 500 gross tonnage, the construction and installation of means of embarkation and disembarkation shall meet the requirements of manufacturer's standards.".

PART VI. FIRE PROTECTION

3 FIRE-FIGHTING EQUIPMENT AND SYSTEMS

3.1 GENERAL

Table 3.1.2.1. In **Footnote 10** the references to IMO circular MSC.1/Circ.1395/Rev.6 have been updated.

3.8 CARBON DIOXIDE SMOTHERING SYSTEM

Para 3.8.2.5 is amended as follows:

"**3.8.2.5** ~~A~~ In the carbon dioxide extinction station, a device shall ~~have arrangements~~ be provided for weighing ~~the~~ cylinders or measuring ~~the~~ level of ~~liquid~~ carbon dioxide (fire extinguishing medium) therein by the approved method, or on each cylinder an automatic device shall be installed for control of carbon dioxide (fire extinguishing medium) mass and pressure.".

3.11 AEROSOL FIRE EXTINGUISHING SYSTEM

Formula 3.11.1.3. In **explication**, the explanation of the efficiency coefficient f is amended as follows:

"f = efficiency coefficient~~, in %,~~ is the ~~percentage~~ dimensionless coefficient characterizing the part of fire extinguishing aerosol that is produced from the aerosol generating agent and actually discharged ~~from a specific~~ by an aerosol generator; ~~(~~the coefficient is determined ~~by comparing~~ as the ratio of the mass loss of ~~a~~ the generator after ~~discharge~~ its coming into operation to ~~its beginning~~ the minimum mass~~)~~ of the aerosol generating agent documented by the manufacturer; $f \leq 1$.".

4 FIRE DETECTION AND ALARM SYSTEMS

4.3 FIRE WARNING ALARMS

Para 4.3.2. The **first paragraph** is amended as follows:

"**4.3.2** The audible and visual signal warning of putting a total flooding system into action shall be given ~~only~~ within the space into which the extinguishing medium shall be discharged, as well as within the adjacent spaces not protected by the fire extinguishing system the only exit from which is provided through the protected space.".

5 FIRE-FIGHTING OUTFIT, SPARE PARTS AND TOOLS

5.1 FIRE-FIGHTING OUTFIT

Para 5.1.4.5.1 is amended as follows:

"**.5.1** of 1000 and more gross tonnage, the number of fire hoses is determined one fire hose per each 30 m of length and one spare fire hose, but not less than five hoses per ship. This number doesn't include any hoses required for machinery or boiler spaces. The Register may require to increase number of hoses in order to ensure sufficient number of hoses and their accessibility at any time, considering the type of ship and character of voyages made by the ship~~. A ship carrying dangerous goods shall be equipped with three additional hoses and~~

~~nozzles in excess of those required above~~;".

7 SPECIAL REQUIREMENTS FOR SHIPS CARRYING PACKAGED DANGEROUS GOODS AND DANGEROUS GOODS IN BULK

7.1 GENERAL

Para 7.1.1 is amended as follows:

"**7.1.1** The requirements of ~~the present~~ this Section are aimed at providing additional fire safety measures in respect of ships carrying packaged dangerous goods and dangerous goods in bulk.".

Para 7.1.2. **Definition "IMSBC Code"** is amended as follows:

"IMSBC Code is the International Maritime Solid Bulk Cargoes Code adopted by IMO resolution MSC.268(85), as amended by IMO resolutions MSC.318(89), MSC.354(92), MSC.393(95), MSC.426(98), ~~and~~ MSC.462(101), MSC.500(105) and MSC.539(107).".

7.2 SHIPS CARRYING PACKAGED DANGEROUS GOODS OR DANGEROUS GOODS IN BULK

Para 7.2.3.1 is amended as follows:

"**7.2.3.1** A ship engaged in the carriage of dangerous goods in any cargo spaces shall be provided with a fixed carbon dioxide or inert gas fire extinguishing system complying with the provisions of the FSS Code or with a fire extinguishing system which gives equivalent protection for the cargoes carried with regard to the following:

.1 the requirement specified in 7.2.3.1 may be waived if the ship is constructed, and solely intended, for the carriage of ore, coal, grain, unseasoned timber, non-combustible cargoes or cargoes, which constitute a low fire risk, listed in Table 1 of IMO circular MSC.1/Circ.1395/Rev.6, and is fitted with steel hatch covers and effective means of closing ventilators and other openings leading to the cargo spaces;

.2 for dangerous bulk cargoes of classes 5.1, 9 and MHB listed in Table 2 of IMO circular MSC.1/Circ.1395/Rev.6, for which a fixed gas fire extinguishing system is ineffective, equivalent protection shall be provided by implementing requirements of 7.2.5.1 and 7.2.5.2;

.3 each open ro-ro space having a deck above it and each space deemed to be a closed ro-ro space not capable of being sealed shall be fitted with an approved fixed pressure water-spraying system for manual operation which shall protect all parts of any deck and vehicle platform in such space. However, the drainage and pumping arrangements shall be such as to prevent the build-up of free surfaces as specified in 7.2.13.".

Table 7.2.4-1. **Footnote 2** is amended as follows:

"[2] In special cases where the barges are capable of containing flammable vapours or alternatively if they are capable of discharging flammable vapours to a safe space outside the barge carrier compartment by means of ventilation ducts connected to the barges, these requirements may be reduced or waived upon agreement with the Register, provided the alternative structures, measures and appliances are available for ensuring fire safety ~~which is subject to special consideration by the Register~~.".

Para 7.2.5.2 is supplemented by the following text:

"A ship carrying dangerous goods shall be equipped with three additional fire hoses and nozzles;".

Para 7.2.5.5 is amended as follows:

"**.5** the total required ~~quantity~~ capacity of the water supply shall satisfy the requirements of 7.2.5.2 and 7.2.5.3, if applicable, simultaneously calculated for the largest designated cargo space. The capacity requirements of 7.2.5.2 shall be met by the total capacity of the main fire pumps, not including the capacity of the emergency fire pump, if fitted. If a ~~drencher~~ pressure water-spraying system is used to satisfy the requirements of 7.2.5.3, the pressure water-spraying system pump shall also be taken into account in this total capacity calculation;".

Para 7.2.6 is amended as follows:

"**7.2.6** Electrical equipment, including wiring, shall not be fitted in enclosed cargo spaces or vehicle spaces unless it is essential for operational purposes. However, if electrical equipment is fitted in such spaces, it shall meet the following requirements:

.1 according to 2.9.2, Part XI "Electrical Equipment" it shall be of a certified safe type for use in the dangerous environments to which it may be exposed unless it is possible to completely isolate the electrical system by removal of links in the system other than fuses in compliance with 2.9.9, Part XI "Electrical Equipment";

.2 cables within the cargo spaces, including through runs of cables, shall meet the requirements of 2.9.10, Part XI "Electrical Equipment"; herewith, cables shall be protected against damage from impact, and cable penetrations of the decks and bulkheads shall be sealed against the passage of gas or vapour in accordance with 16.8.1.6 and 16.8.6.1, Part XI "Electrical Equipment" respectively;

.3 electrical equipment shall also comply with the requirements of ~~2.9.2, 2.9.3, 2.9.9, 2.9.10, 2.9.12, 16.8.1.6, 16.8.4.5, 16.8.6.1 and 19.11~~ 20.11, Part XI "Electrical Equipment".

Any other equipment which may constitute a source of ignition of explosive mixtures of vapours, gases or dust with air shall not be permitted in cargo spaces.

Cargo spaces shall not have sources of heat as required by IMDG or IMSBC Codes during carriage of particular packaged dangerous goods or dangerous goods in bulk, respectively. Packaged dangerous goods are considered protected from sources of heat if positioned at least 2,4 m therefrom.".

Para 7.2.8 is amended as follows:

"**7.2.8** Ventilation of cargo spaces shall comply with the following requirements ~~of Part VIII "Systems and Piping"~~:

.1 power ventilation shall be provided in enclosed cargo spaces. The arrangement shall be such as to provide for at least six air changes per hour in the cargo space based on an empty cargo space and for removal of vapours from the upper or lower parts of the cargo space, as appropriate (cargo vapour density relative to air density). ~~a~~Arrangement of the ventilation system ~~with~~ shall meet the requirements of 12.1.7, 12.1.8, 12.7.1, 12.7.3 и 12.7.5, Part VIII "Systems and Piping". For bulk cargoes of class 4.2 (refer to Footnote 2 to Table 7.2.4-2), class 4.3, as well as MHB of Groups A and B emitting flammable gas when wet and self-heating, additionally with the requirements of 12.7.7, Part VIII "Systems and Piping"; when cargoes emitting flammable gases are carried in sufficient quantities to constitute a fire or explosion hazard that shall be indicated in Annex 1 to the IMSBC Code or by the cargo information provided by the shipper, the cargo spaces shall be effectively ventilated and atmosphere in the cargo spaces shall be monitored by means of the appropriate gas detectors; due consideration shall be given to the ventilation and monitoring of the atmosphere in the enclosed spaces adjacent to the cargo spaces;

.2 **f**ans shall be such as to avoid the possibility of ignition of flammable gas air mixtures, and construction ~~of ventilation fans, with~~ thereof shall meet the requirements of 12.7.4, Part VIII "Systems and Piping" and 5.3, Part IX "Machinery". Suitable wire mesh guards shall be fitting over inlet and outlet

ventilation openings with mesh size of 13 x 13 mm;

.3 natural ventilation ~~system~~ shall be provided in enclosed cargo spaces intended for the carriage of dangerous goods in bulk, ~~unless not fitted with~~ where there is no provision for mechanical ventilation (refer to 12.7.2, Part VIII "Systems and Piping"); cargo spaces with natural ventilation shall not be used for the carriage of bulk cargoes of Group B which are self-heating (SH), emitting flammable gas when wet (WF), emitting toxic gas when wet (WT).".

Para 7.2.10 is amended as follows:

"**7.2.10** Ships shall be provided with the following outfit:

.1 four ~~full~~ sets of full protective clothing, resistant to chemical ~~exposure~~ attack, which shall be selected taking into account the hazards associated with the chemicals being transported and shall meet the recommendations of the IMDG Code, IMSBC Code/BC Rules on protective clothing usage during carriage of particular dangerous goods ~~intended for use in emergency situations~~. The protective clothing shall cover all skin, so that no part of the body is unprotected ~~and, subject to cargo characteristics, shall meet the recommendations of the IMDG Code, the IMSBC Code/BC Rules~~;

.2 at least two self-contained breathing apparatuses ~~in~~ additional to those required by item 10 of Table 5.1.2 ~~shall be provided~~. Two spare charges ~~or two spare breathing apparatus~~ suitable for use with the breathing apparatuses shall be provided ~~in addition to those required for the fireman's outfit~~ for each required apparatus. Passenger ships carrying not more than 36 passengers and cargo ships that are equipped with suitably located means for fully charging the air cylinders free from contamination need carry only one spare charge for each required apparatus (refer to 5.1.15.2).".

7.3 SHIPS CARRYING PACKAGED IRRADIATED NUCLEAR FUEL, PLUTONIUM AND HIGH-LEVEL RADIOACTIVE WASTES (INF CARGO)

Para 7.3.13 is amended as follows:

"**7.3.13** Every ship shall carry on board ~~an~~ the ~~approved~~ shipboard emergency plan approved by the Administration and based on the Guidelines for Developing Shipboard Emergency Plans for Ships Carrying Materials Subject to the INF Code adopted by IMO resolution A.854(20).".

PART VII. MACHIERY INSTLLATIONS

2 GENERAL REQUIREMENTS

2.3 ENVIRONMENTAL CONDITIONS

Chapter 2.3 is supplemented by **new paras 2.3.2 — 2.3.7** reading as follows:

"**2.3.2** Main propulsion and steering machinery and auxiliary machinery that are essential to the propulsion and steering, and the safety of the ship shall be capable of operation under the effects of acceleration and motions.

2.3.3 The requirements in 2.3.5 — 2.3.8 apply where documented evidence of equipment suitability is specifically required by the Register rules.

2.3.4 For ships subject to the requirements of SOLAS-74, ship builders shall identify and document the ship accelerations and motions periods to which machinery and equipment might be subjected to. The expected accelerations and ship motions periods shall comply within machinery and equipment manufacturers requirements. The estimations shall take into account the ship type, machinery or equipment location and expected service conditions.

2.3.5 Machinery and equipment manufacturers shall submit evidence to the Register that their machinery or equipment can operate under the required static and dynamic conditions stated in 2.3.1 and at least at the levels of shipboard accelerations as stated in 2.3.4 and/or specified in the relevant RS requirements. Documentation of satisfactory performance shall take the form of:

.1 Report of testing under representative conditions; or

.2 Report of theoretical verification using recognised computational techniques accompanied by detailed and relevant validation data; or

.3 Historical data which provides relevant demonstration of satisfactory experience in service.

2.3.6 Machinery and equipment manufacturers shall submit details of the requirements/recommendations for installation of the machinery and equipment onboard to ensure satisfactory operation in service under the required static and dynamic conditions as described in 2.3.1 and at least at the levels of shipboard accelerations as stated in 2.3.4 and/or specified in the relevant RS requirements.

N o t e : Consideration shall be given for positioning machinery in order to minimize the dynamic load on bearings due to ship motion.

2.3.7 Shipbuilders shall submit details demonstrating that the installation of the machinery and equipment onboard is in accordance with manufacturer's requirements/ recommendations.".

4 MACHINERY SPACES, ARRANGEMENT OF MACHINERY AND EQUIPMENT

4.5 MEANS OF ESCAPE FROM MACHINERY SPACES

Para 4.5.4 amended as follows:

"**4.5.4** The width of inclining ladders serving as escape routes and the width of doors providing access to embarkation decks shall be at least 600 mm. The width of inclining ladders in ships of less than 1000 gross tonnage may be reduced to 500 mm.".

Appendix 1 is amended as follows:

"*APPENDIX 1*

LIST OF MINIMUM. RECOMENDED SPARE PARTS

Recognizing the complexity and diversity of machinery, equipment and systems providing essential services, a recommended list of spare parts may not always be relevant. In such circumstances, a risk-based approach shall be taken in order to determine the spare parts to be carried onboard. Such a risk-based approach is described in IACS Rec.26 for internal combustion engines, however, the approach described is equally relevant to other machinery, equipment and systems.

In cases where a risk assessment approach is not followed, Tables 1 — ~~4~~5 contain the list of recommended spare parts to the equipment and essential to the propulsion and safety of the ship. The tables are not intended to replace any guidance provided by manufacturers or suppliers regarding recommended spare parts.

The spare parts shall be properly secured in easily accessible places, marked and efficiently protected against corrosion.

Table 1

List of minimum recommended spare parts for main internal combustion engines of ships for unrestricted service

Nos.	Item	Spare part	Number recommended
1	Main bearings	Main bearings or shells for one bearing of each size and type fitted, complete with shims, bolts and nuts	1
2	Main thrust block	Pads for one face of Michell type thrust block, or	1 set
		Complete white metal thrust shoe of solid ring type, or	1
		Inner and outer race with rollers, where roller thrust bearings are fitted	1
3	Cylinder liner	Cylinder liner, complete with joint rings and gaskets	1
4	Cylinder cover	Cylinder cover, complete with valves, joint rings and gaskets	1
		Cylinder cover bolts and nuts, for one cylinder	½ set
5	Cylinder valves	Exhaust valves, complete with casings, seats, springs and other fittings for one cylinder	2 sets
		Air inlet valves, complete with casings, seats, springs and other fittings for one cylinder	1 set
		Starting air valve, complete with casting, seat springs and other fittings	1
		Cylinder overpressure sentinel valve, complete	1
		Fuel valves of each size and type fitted, complete with all fittings, for one engine	1 set[1]
6	Connecting rod bearings	Bottom end bearings or shells of each size and type fitted, complete with shims, bolts and nuts, for one cylinder	1 set
		Top end bearings or shells of each size and type fitted, complete with shims, bolts and nuts, for one cylinder	1 set
7	Pistons	Crosshead type internal combustion engine; piston of each type fitted, complete with piston rod, stuffing box, skirt, rings, studs and nuts	1
		Trunk piston type internal combustion engine: piston of each type fitted, complete with skirt, rings, studs, nuts, gudgeon pin and connecting rod	1
8	Piston rings	Piston rings, for one cylinder	1 set
9	Piston cooling	Telescopic cooling pipes and fittings or their equivalent, for one cylinder unit	1 set
10	Cylinder lubricators	Lubricator, complete, of the largest size, with its chain drive or gear wheels, or equivalent spare part kit	1
11	Fuel injection pumps	Fuel pump complete or, when replacement at sea is practicable, a complete set of working parts for one pump (plunger, sleeve, valves, springs, etc.), or equivalent high pressure fuel pump	1
12	Fuel injection piping	High pressure double wall fuel pipe of each size and shape fitted, complete with couplings	1
13	Scavenge blower (including turbo chargers)	Rotors, rotor shafts, bearings, nozzle rings and gear wheels or equivalent working parts if other types	1 set[2]
14	Scavenging system	Suction and delivery valves for one pump of each type fitted	1 set
15	Reduction and/or reverse gear	Complete bearing bush, of each size fitted in the gear case assembly	1 set
		Roller or ball race, of each size fitted in the gear case assembly	1 set
16	Control, alarm and safety system	Parts essential for safe engine operation	1 set

[1] (a) Engines with one or two fuel valves per cylinder: one set of fuel valves, complete.

(b) Engines with three or more fuel valves per cylinder: two fuel valves complete per cylinder, and a sufficient number of valve parts, excluding the body, to form, with those fitted in the complete valves, a full engine set.

[2] The spare parts may be omitted where it has been demonstrated, at the Builder's test bench for one engine of the type concerned, that the engine can be manoeuvred satisfactorily with one blower out of action. The requisite blanking and blocking arrangements for running with one blower out of action are to be available on board (refer to 2.1.7, Part VII "Machinery Installations").

N o t e s : 1. The availability of other spare parts, such as gears and chains for camshaft drive, should be specially considered and decided upon by the ~~owner~~ ship operator.

2. It is assumed that the new crew has on board the necessary tools and equipment.

3. When the recommended spares are utilized, it is recommended that new spares are supplied as soon as possible.

4. In case of multi-engine installations, the minimum recommended spares are only necessary for one engine.

~~5. For electronically controlled engines spare and dual-fuel internal combustion engines parts as recommended by the engine designer/manufacturer.~~

Table 2

List of minimum recommended spare parts for each part of auxiliary internal combustion engine driving electric generators for essential services on board ships for unrestricted service

Nos.	Item	Spare part	Number recommended
1	Main bearings	Main bearings or shells for one bearing of each size and type fitted, complete with shims, bolts and nuts	1
2	Cylinder valves	Exhaust valves, complete with casings, seats, springs and other fittings for one cylinder	2 sets
		Air inlet valves, complete with casings, seats, springs and other fittings for one cylinder	1 set
		Starting air valve, complete with casing, seat springs and other fittings	1
		Cylinder overpressure sentinel valve, complete	1
		Fuel valves of each size and type fitted, complete with all fittings, for one engine	½ set
3	Connecting rod set bearings	Bottom end bearings or shells of each size and type fitted, complete with shims, bolts and nuts, for one cylinder	1 set
		Trunk piston internal combustion engine type: gudgeon pin with bush for one cylinder	1 set
4	Piston rings	Piston rings, for one cylinder	1 set
5	Piston cooling	Telescopic cooling pipes and fittings or their equivalent, for one cylinder	1 set
6	Fuel injection pumps	High pressure double wall fuel pipe of each size and shape fitted, complete with couplings	1
7	Fuel injection piping	High pressure double wall fuel pipe of each size and shape fitted, complete with couplings	1
8	Gaskets and Packings	Special gaskets and packings of each size and type fitted, for cylinder covers and cylinder liners for one cylinder	1 set
9	Control, alarm and safety system	Parts essential for safe engine operation	1 set

N o t e s : 1. The availability of other spare parts should be specially considered and decided upon by the ship ~~owner~~ operator.
2. It is assumed that the crew has on board the necessary tools and equipment.
3. When the recommended spares are utilized, it is recommended that new spares are supplied as soon as possible.
4. Where the number of generators of adequate capacity fitted for essential services exceeds the required number, spare parts may be omitted.
~~5. For electronically controlled engines and dual-fuel internal combustion engines spare parts as recommended by the engine designer/manufacturer.~~

Table 3

List of minimum recommended spare parts for each steam turbines driving electric generators for essential services of ships for unrestricted service

Nos.	Item	Spare part	Number recommended
1	Turbine shaft	Carbon sealing rings, where fitted, with springs, for each size and sealing rings type of gland, for one turbine	1 set
2	Oil filters	Strainer baskets or inserts, for filters of special design, of each type and size	1 set
3	Control, alarm and safety system	Parts essential for safe turbine operation	1 set

N o t e s : 1. The availability of other spare parts shall be specially considered and decided upon by the Ship ~~owner~~ operator.
2. It is assumed that the crew has on board the necessary tools and equipment.
3. When the recommended spares are utilized, it is recommended that new spares are supplied as soon as possible.
4. Where the number of generators of adequate capacity fitted for essential services exceeds the required number, spare parts

Table 4

List of minimum recommended spare parts for main steam turbines of ships for unrestricted service

Nos.	Item	Spare part	Number recommended
1	Turbine shaft	Carbon sealing rings, where fitted, with springs for each size sealing rings and type of gland	1 set
2	Oil filters	Strainer baskets or inserts for filters of special design, of each type and size	1 set

Nos.	Item	Spare part	Number recommended
3	Control, alarm and safety system	Parts essential for safe turbine operation	1 set
N o t e s : 1. The availability of other spare parts should be specially considered and decided upon by the Ship ~~owner~~ operator. 2. It is assumed that the crew has on board the necessary tools and equipment. 3. When the recommended spares are utilized, it is recommended that new spares are supplied as soon as possible.			

T a b l e 5

List of minimum recommended spare parts for essential auxiliary machinery of ships for unrestricted service

Nos.	Item	Spare part	Number recommended
		Pumps	
1	Piston pumps	Valve with seats and springs, each size fitted	1 set
		Piston rings, each type and size for one piston	1 set
2	Centrifugal pumps	Bearing of each type and size	1
		Rotor sealings of each type and size	1
3	Gear type pumps	Bearing of each type and size	1
		Rotor sealings of each type and size	1
Notes: 1. When a sufficiently rated standby pump is available, the spare parts may be dispensed with. 2. It is recommended that where, for maintenance or repair work of the pumps, special tools or equipment shall be used, these are available on board. 3. When the recommended spares are utilized, it is recommended that new spares are supplied as soon as possible.			
		Compressors	
1	Valves	Suction and delivery valves complete of each size fitted in one unit	½ set
2	Pistons	Piston rings of each type and size fitted for one piston	1 set
Notes: 1. It is recommended that where, for maintenance or repair work of the compressors, special tools or equipment shall be used, these are available on board. 2. When the recommended spares are utilized, it is recommended that new spares are supplied as soon as possible.			

".

PART VIII. SYSTEMS AND PIPING

1 GENERAL

1.3 SCOPE OF SURVEYS

Table 1.3.2 is amended as follows:

"T a b l e 1.3.2

Piping system for	Class I ($p > p_2$ or $t > t_2$)	Class II	Class III ($p < p_1$ or $t < t_1$)
Toxic and corrosive media	Without special safeguards[1]	With special safeguards[1]	—
Inflammable media heated above flash point or having flash point below 60 °C[2]~~, liquefied gases~~	Without special safeguards[1]	With special safeguards	—
Steam[3]	$p > 1{,}6$ or $t > 300$	Any pressure and temperature combination except the values indicated for Classes I and III	$p \leq 0{,}7$ and $t \leq 170$
Thermal oil[3]	$p > 1{,}6$ or $t > 300$	Any pressure and temperature combination except the values indicated for Classes I and III	$p \leq 0{,}7$ and $t \leq 150$
Fuel oil, lubricating oil and hydraulic oil[3]	$p > 1{,}6$ or $t > 150$	Any pressure and temperature combination except the values indicated for Classes I and III	$p \leq 0{,}7$ and $t \leq 60$

Piping system for	Class I ($p > p_2$ or $t > t_2$)	Class II	Class III ($p < p_1$ or $t < t_1$)
Other media[3, 4, 5]	$p > 4$ or $t > 300$	Any pressure and temperature combination except the values indicated for Classes I and III	$p \leq 1{,}6$ and $t \leq 200$

[1] Class II pipes are not to be used for toxic media.
[2] Cargo oil pipes belong to Class III.
[3] p = design pressure, MPa (refer to 2.3.2.); t = design temperature, °C (refer to 2.3.5).
[4] Including water, air, gases, non-flammable hydraulic fluids, urea for selective catalytic reduction (SCR) systems to reduce the NO_x emissions*.
[5] For open-ended pipes (drains, overflows, vents, exhaust gas lines, boiler escape pipes) irrespective of the temperature, Class III pipes may be used.
* When piping material selected according to ISO 18611-3:2014 for urea in SCR systems.

".

2 METAL PIPING

2.4 PIPE JOINTS

Para 2.4.4.1 is amended as follows:

"**2.4.4.1** Threaded connections shall be accomplished in compliance with the requirements of the approved national and/or international standards. Such connections shall not be applied in systems conveying toxic and flammable media or media causing severe corrosive or erosive wear, as well as in conditions with heavy fatigue loads.

Threaded connections with diameter of not more than 25 mm may be used for connecting small bore instrumentation equipment (e.g., pressure/temperature sensors) to piping systems conveying flammable media if such connections comply with a recognized national and/or international standard.

The threaded slip-on joints with taper thread may be applied in Class I pipelines with the diameter up to 33,7 mm and Class II and III pipelines with the diameter up to 60,3 mm.

Joints with parallel thread may be applied in Class III pipelines with the diameter up to 60,3 mm.

~~In particular cases,~~ Threaded connection sizes in excess of those mentioned above may be accepted ~~by the Register after special consideration~~ if in compliance with the national or international standards.".

Table 2.4.5.11-2 is amended as follows:

"Table 2.4.5.11-2

Application of mechanical joints depending upon the class of piping

Types of joints	Classes of piping systems		
	I	II	III
Pipe unions			
Welded and brazed type	+ (outside diameter/ OD ≤-60,3 mm)	+ (outside diameter/ OD ≤-60,3 mm)	+
Compression couplings			
Swage type	+	+	+
Typical compression type	+ ~~(outside diameter/ OD ≤ 60,3 mm)~~	+ ~~(outside diameter/ OD ≤ 60,3 mm)~~	+
Bite type, flared type	+ ~~(outside diameter/ OD ≤ 60,3 mm)~~	+ ~~(outside diameter/ OD ≤ 60,3 mm)~~	+
Press type	–	–	+
Slip-on joints			
Machine grooved type	+	+	+
Grip Type	–	+	+
Slip type	–	+	+
Symbols: + application is allowed; – application is not allowed.			

".

Para 2.4.5.12.6 is amended as follows:

"**.6** pressure pulsation test (for Classes I and II mandatory, for Class III, where necessary).".

9 SYSTEMS SPECIAL FOR CARRIAGE OF CARGOES IN BULK

9.10 SHIP SERVICE SYSTEMS IN CARGO AREA

Para 9.10.1 is amended as follows:

"**9.10.1** Ballast, sounding and air pipes of segregated ballast tanks shall not pass through cargo tanks. Cargo and similar pipes intended to serve cargo and slop tanks shall not be laid through segregated ballast tanks. This requirement may be dispensed with, in the case of shorter pipes, provided they are completely welded or equivalent, with thickened flanged connections (welded flange joint rated of not less than 1 MPa or design pressure, whichever is greater), the number of which shall be kept to a minimum. Thermal expansion of the pipes shall be compensated by ~~the pipe bends~~ expansion loops of omega bend "Ω" to counteract excessive stresses or displacement caused by thermal expansion or hull deformation which could be fabricated from straight lengths of pipe. The bend radii shall be in accordance with the requirements of 2.2.1. In Fig. 9.10.1, the recommended design of an air pipe is shown by way of an example. Piping shall be seamless and its material shall be steel. The pipe wall thickness shall not be less than indicated in Table 9.10.1.".

12 VENTILATION SYSTEM

12.4 VENTILATION SYSTEMS OF OIL TANKERS AND COMBINATION CARRIERS CARRYING CRUDE OIL AND PETROLEUM PRODUCTS WITH FLASH POINT 60 °c AND BELOW

Para 12.4.2 is amended as follows:

"**12.4.2** The ventilation inlets of accommodation spaces, service spaces and control stations shall be located on the aft transverse bulkhead not facing cargo tanks, or on the side of the superstructure or deckhouse at a distance equal, at least, to 4 % of the ship's length, but not less than 3 m from the end of the superstructure or deckhouse facing cargo tanks. This distance, however, need not exceed 5 m.

The inlets and outlets of ventilation ducts for machinery spaces shall be situated as far aft as practicable. Special consideration shall be given to location of these vents in oil tankers equipped to load and discharge at the stern.

If, owing to the design of a ship, it is impossible in practice, or unreasonable, to fulfil the requirements relating to the location of ventilation inlets, alternative provisions may be adopted[1], provided that no ignition source is located in the dangerous zones defined in 20.2.3, Part XI "Electrical Equipment", except for electrical installations that have the required protection complying with 2.9, Part XI "Electrical Equipment".

[1]Refer to IMO circular MSC.1/Circ.1459.".

21 TESTS

21.2 HYDRAULIC TESTS OF PIPING

Para 21.2.3 is amended as follows:

"**21.2.3** All the piping systems assembled on board the ship shall be checked for tightness in operating conditions in the presence of a surveyor to the Register, except that particular testing is required for the following piping:

.1 heating coils in tanks and liquid ~~or gas~~ fuel lines shall be tested by 1,5p, but not less than 0,4 MPa;

.2 liquefied gas pipelines shall be leak tested in compliance with 13.14.17.

Pneumatic leak testing may be carried out on water sensitive systems, in lieu of hydrostatic testing. In certain circumstances, a combined hydrostatic – pneumatic strength test may also be applied, where the system is partially filled with water and the free space above is pressurized with a test gas (typically air or nitrogen).".

PART IX. MACHINERY

1 GENERAL

1.2 SCOPE OF SURVEYS

Table 1.2.3.1-3 is amended as follows:

"Table 1.2.3.1-3

The following documents shall be submitted for the approval of Dual Fuel (DF) and Gas Fuel (GF) engines[1]

1	Schematic layout or other equivalent documents of gas system on the engine
2	Gas piping system (including double-walled arrangement where applicable)
3	Parts for gas admission system (the documentation to contain specification of pressures, pipe dimensions and materials)
4	Arrangement of explosion relief valves (crankcase, charge air manifold, exhaust gas manifold and exhaust gas system on the engine) as applicable
5	List of certified safe equipment and evidence of relevant certification
6	Safety concept[2]
7	Report of the risk analysis[2]
8	Gas used as fuel specification[2]
9	Schematic layout or other equivalent documents of ~~fuel oil system (main and~~ pilot fuel system~~s) on the engine~~[3]
10	Shielding of high pressure fuel pipes for pilot fuel system, assembly[3]
11	High pressure parts for pilot fuel oil injection system (the documentation to contain specification of pressures, pipe dimensions and materials)[3]
12	Schematic layout or other equivalent documents of the Ignition system[4]
13	Relief devices for combustion air inlet and exhaust gas manifolds[5]

[1] taking into account the design features of the engine, the Register may request the provision of additional documentation;
[2] for information;
[3] required for DF engine;
[4] required for GF engine.
[5] refer to Section 3 of Appendix 12 to Section 5, Part IV "Technical Supervision during Manufacture of Products" of the Rules for Technical Supervision During Construction of Ships and Manufacture of Materials and Products for Ships.

".

3 STEAM TURBINES

3.6 CONTROL, PROTECTION AND REGULATION

Para 3.6.11 is amended as follows:

«**3.6.11** For main turbine installations a slow-turning device, which operates automatically, shall be provided. Discontinuation of this automatic turning from the bridge shall be possible. For attended machinery spaces, the slow turning device may be arranged to be operated manually.».

9 GAS INTERNAL COMBUSTION ENGINES

Chapter 9.1 is amended as follows:

"9.1 GENERAL

9.1.1 The requirements of the present Section are applicable to dual-fuel internal combustion engines (DF engines) with ignition from compression, operated on liquid fuel and natural gas (methane) as well as to gas-fuel internal combustion engines (GF engines), or any variations thereof including fuel sharing capability, operated on natural gas ~~only~~ or similar fuels with main component methane such as bio-methane or synthetic methane.

It shall be ensured by the gas supply system that the gas supplied to the engine is always in gaseous state. This Section does not cover requirements for liquid or cryogenic gas.

DF engines and GF engines may not be permitted for emergency applications.

The requirements of 9.2 — 9.11 are applicable to all crosshead-type engines as well as to trunk piston internal combustion engines operating on gas with a maximum working gas pressure of more than 1,0 MPa.

The requirements of 9.2, 9.3, 9.12 and 9.13 are applicable to trunk piston internal combustion engines operating on gas with a maximum working gas pressure of 1,0 MPa and less. ~~The gas can be ignited by the combustion of a certain amount of fuel (pilot injection) or by extraneous ignition (sparking plug).~~

~~Gas can be introduced as follows:~~

~~into the air inlet manifold, scavenge space, or cylinder air inlet channel port; or~~

~~mixed with air before the turbocharger ("pre-mixed engines").~~

Engines intended for installation on ships with the distinguishing mark **GFS** in the class symbol shall additionally meet the applicable requirements of Chapter 9.6 of Part XVII "Distinguishing Marks and Descriptive Notations in the Class Notation Specifying Structural and Operational Particulars of Ships".".

Chapter 9.2 is amended as follows:

"9.2 DEFINITIONS AND EXPLANATIONS

9.2.1 In this Section the following definitions are accepted:

~~Certified safe type means electrical equipment that is certified in accordance with the recommendation published by the International Electrotechnical Commission (IEC), in particular publication IEC 60092-502:1999, or with recognized standards at least equivalent. The certification of electrical equipment is to correspond to the category and group for methane gas.~~

Certified safe equipment is equipment certified by an independent national test institution or competent body to be in accordance with a recognised standard for electrical apparatus in hazardous areas.

Note: Refer to IEC 60079 series, Explosive atmospheres and IEC 60092-502:1999 Electrical Installations in Ships – Tankers – Special Features.

Double block and bleed valves mean the set of valves referred to in:

IGC Code means the International Code for the Construction and Equipment of Ships Carrying Liquefied Gases in Bulk (as amended by IMO resolutions MSC.370(93), MSC.411(97) and MSC.441(99));

IGF Code means the International Code of Safety for Ships Using Gases or other Low Flashpoint Fuels (IMO resolution MSC.391(95) as amended by IMO resolution MSC.422(98);

Dual fuel engine (DF engine) means an engine that can burn natural gas as fuel simultaneously with liquid fuel, either as pilot oil or bigger amount of liquid fuel (Gas mode), and also has the capability of running on liquid diesel fuel oil only (Diesel mode).

Explosion relief device means a device to protect personnel and component against a determined overpressure in the event of a gas explosion. The device may be a valve, a rupture disc or other, as applicable.

~~Engine room is a machinery space or enclosure containing gas fuelled engine(s).~~

Gas (Gas fuel) means ~~a fluid having a vapour pressure exceeding 0,28 MPa absolute at a temperature of 37.8 °C~~ natural gas used as fuel consisting primarily of methane.

Note: Gas may also be bio-methane or synthetic methane etc. with methane as main component.

Gas admission valve is a valve or injector on the engine, which controls gas supply to the cylinder(s) according to the ~~cylinder(s) actual~~ engine's gas demand.

Gas engine means either a DF engine or a GF engine.

Gas fuel only engine ("GF engine") means an engine capable of operating on gas fuel only and not able to switch over to oil fuel operation.

Gas piping means piping containing gas or air/gas mixtures, ~~including venting pipes~~.

~~Gas Valve Unit (GVU) is a set of manual shutoff valves, actuated shut-off and venting valves, gas pressure sensors and transmitters, gas temperature sensors and transmitters, gas pressure control valve and gas filter used to control the gas supply to each gas consumer. It also includes a connection for inert gas purging.~~

High pressure gas means gas with a maximum working pressure greater than 10 bar gauge.

IGC Code means the International Code for the Construction and Equipment of Ships Carrying Liquefied Gases in Bulk (as amended ~~by IMO resolution MSC.370(93)~~).

IGF Code means the International Code of Safety for Ships Using Gases or other Low Flashpoint Fuels (IMO resolution MSC.391(95) as amended).

Low pressure gas means gas with a maximum working pressure ~~up~~ lower or equal to 1,0 MPa gauge.

Lower Heating Value ("LHV") means the amount of heat produced from the complete combustion of a specific amount of fuel, excluding latent heat of vaporization of water.

Methane Number is a measure of resistance of a gas fuel to knock, which is assigned to a test fuel based upon operation in knock testing unit at the same standard knock intensity (pure methane is used as the knock resistant reference fuel, that is, methane number of pure methane is 100, and pure hydrogen is used as the knock sensitive reference fuel, methane number of pure hydrogen is 0).

Pilot fuel means the fuel oil that is injected into the cylinder to ignite the main gas-air mixture on DF engines.

Pre-mixed engine means an engine where gas is supplied in a mixture with air through a common manifold for all cylinders, e.g. mixed before or after the turbocharger.

Recognized standards mean applicable international or national standards acceptable by the Register or standards laid down and maintained by an organization which complies with the standards adopted by IMO and which are recognized by the Register.

Safety Concept is a document describing the safety philosophy with regard to gas as fuel, risks associated with this type of fuel, risk control under reasonably foreseeable abnormal conditions, possible failure scenarios and their control measures including a detailed

evaluation regarding the hazard potential of injury from a possible explosion. The results of the risk analysis, refer to 9.3, shall be reflected in the safety concept.".

Chapter 9.3 is amended as follows:

"**9.3 RISK ANALYSIS**

9.3.1 Scope of the risk analysis.

The risk analysis is to address:

a failure or malfunction of any system or component involved in the gas operation of the engine;

a gas leakage downstream of ~~the gas valve unit~~ double block and bleed valves;

the safety of the engine in case of emergency shutdown or blackout, when running on gas;

the inter-actions between the gas fuel system and the engine.

With regard to the scope of the risk analysis it shall be noted that failures in systems external to the engine, such as fuel storage or fuel gas supply systems, may require action from the engine control and monitoring system in the event of an alarm or fault condition. Conversely failures in these external systems may, from the ship perspective, require additional safety actions from those required by the engine limited risk analysis.

9.3.2 Form of the risk analysis.

The risk analysis shall be carried out in accordance with international standard ~~ISO~~ IEC 31010:20~~0~~19: Risk management – Risk assessment techniques, or other recognized standards.

The required analysis shall be based on the single failure concept, which means that only one failure needs to be considered at the same time. Both detectable and non-detectable failures shall be considered. Consequences failures, i.e. failures of any component directly caused by a single failure of another component, are also to be considered.

9.3.3 Procedure for the risk analysis.

The risk analysis shall:

.1 identify all the possible failures in the concerned equipment and systems which could lead:

to the presence of gas in components or locations not designed for such purpose, and/or

to ignition, fire or explosion;

.2 evaluate the consequences (also refer to 9.12.1.2);

.3 where necessary, identify the failure detection method;

.4 where the risk cannot be eliminated, identify the corrective measures in the system design (such as, redundancies safety devices, monitoring or alarm provisions which permit restricted operation of the system), in the system operation (such as initiation of the redundancy, activation of an alternative mode of operation).

The results of the risk analysis shall be documented.

9.3.4 Equipment and systems to be analysed.

The risk analysis required for engines shall cover at least the following aspects:

.1 failure of the gas-related systems or components, in particular:

gas piping and its enclosure, where provided;

~~cylinder gas supply~~ gas admission valves.

Thus, failures of the gas supply components not located directly on the engine, such as block-and-bleed valves and other components of ~~GVU~~ gas supply system, shall not be considered in the analysis;

.2 failure of the ignition system (oil fuel pilot injection, glow plugs or sparking plugs);

.3 failure of the air to fuel ratio control system (charge air by-pass, gas pressure control valve, etc.);

.4 for engines where gas is ~~injected~~ supplied upstream of the turbocharger compressor, failure of a component likely to result in a source of ignition (hot spots);

.5 failure of the gas combustion or abnormal combustion (misfiring, knocking)

.6 failure of the engine monitoring, control and safety systems. Where engines incorporate electronic control systems, a failure mode and effects analysis shall be carried out in accordance with requirements of 9.3.4.1— 9.3.4.3;

.7 ~~abnormal~~ presence of gas in engine components (e.g. air inlet manifold and exhaust manifold or ~~of DF or GF engines~~ scavenge space) and in the external systems connected to the engines (e.g. exhaust duct, cooling water system, hydraulic oil system, etc.);

.8 changes of operating modes for DF engines;

.9 hazard potential for crankcase fuel gas accumulation, for ~~engines where the space below the piston is in direct communication with the crankcase~~ trunk piston engines, refer to 10.3.1.2 of the IGF Code and 2.3.3.

.10 Risk of crankcase explosion in connection with active crankcase ventilation which produces a flow of external air into the crankcase, (refer to 2.3.3).".

Chapter 9.12 is amended as follows:

"**9.12 DESIGN OF DF ENGINE AND GF ENGINE**

9.12.1.2 Components containing or likely to contain gas shall be designed to:

minimize the risk of fire and explosion so as to demonstrate an appropriate level of safety commensurate with that of an oil-fueled engine;

mitigate the consequences of a possible explosion to a level providing a tolerable degree of residual risk, due to the strength of the component(s) or the fitting of suitable pressure relief devices of an approved type. The strength of the component(s) of arrangement of explosion relief devices shall be documented (e.g., as part of risk analysis) or otherwise demonstrated to be sufficient for a worst-case explosion. Discharge from ~~pressure~~ explosion relief devices shall prevent the passage of flame to the machinery space and be arranged such that the discharge does not endanger personnel or damage other engine components or systems. Explosion relief devices shall be fitted with a flame arrester.

Also refer to the IGF Code 10.2 and 10.3.

9.12.2 Requirements for design and gas piping as an engine component.

9.12.2.1 General.

9.12.2.1.1 The piping shall be designed in accordance with the criteria for gas piping (design pressure, wall thickness, materials, piping fabrication and joining details etc.) as given in the IGF Code chapter 7. ~~For engines of gas carriers,~~ or IGC Code chapter 5.1 — 5.9 and 16 ~~applies~~, as applicable.

9.12.2.1.2 Other connections as mentioned in IGF Code 7.3.6.4.4 may be accepted subject to type approval in accordance with the requirements of para 2.4, Part VIII of RS Rules/C and para 8.5.4, Part IV of Rules TSDCS.

9.12.2.1.3 All single walled or high-pressure gas pipes should be considered as Class I. Low pressure double walled gas pipes should be considered as Class II. All secondary enclosures for gas pipes should be considered as Class II. Single walled gas vent pipes, if permitted, should be considered as Class I, except it is justified that the maximum built up pressure is less than 5 bar gauge, in which case it should be considered as Class II. Gas vent pipes protected by a secondary enclosure should be considered as Class II. Secondary enclosure for vent pipes should be considered as Class III.

Table 9.12.2.1.3

Design pressure for gas pipes

	Design pressure	
Gas pipe, low pressure	refer to IGF 7.3.3.1	refer to IGC Code 5.4.1
Gas pipe, high pressure	refer to IGF 7.3.3.1	refer to IGC Code 5.4.1
outer pipe, low pressure	refer to IGF Code 9.8.1	refer to IGC Code 5.4.4
outer pipe, high pressure	refer to IGF Code 9.8.2	refer to IGC Code 5.4.4
Open ended pipes	refer to IGF Code 7.3.3.2	refer to IGC Code 5.4.1

9.12.2.1.4 Flexible bellows used in the fuel gas system on the engine shall be approved based on the requirements of IGF Code 16.7.2, and IGC Code 5.13.1.2, as applicable.

9.12.2.1.5 The number of cycles, pressure, temperature, axial movement, rotational movement and transverse movement which the bellow will encounter in actual service on the engine should be specified by the engine designer.

9.12.2.1.6 Endurance against high cycle fatigue due to vibration loads shall be verified by testing or alternatively be documented by the Expansion Joint Manufacturers Association, Inc. (EJMA) calculation or equivalent (i.e., more than 107 cycles). The fatigue test due to ship deformations in IGF 16.7.2.4 is considered not relevant for bellows which are an integral part of the engine.

9.12.2.2 Pipes and equipment containing fuel gas are defined as hazardous area Zone 0 (refer to IGF Code 12.5.1).

The space between the gas fuel piping and the wall of the outer pipe or duct is defined as hazardous area Zone 1 (refer to IGF Code 12.5.2.6).

9.12.2.3 The "double wall" gas piping system on the engine shall be arranged according to the principles and requirements of the IGF Code 9.6. For engines of gas carriers, IGC Code 16.4.3 applies.

9.12.2.4 The design criteria for the double pipe or duct are given in the IGF Code 7.4.1.4 and 9.8.

In case of a ventilated double wall, the ventilation inlet shall be located in accordance with the provisions of IGF Code, regulation 13.8.3. For gas carriers, IGC Code 16.4.3.2 applies.

The pipe or duct shall be tested ~~in accordance with 21.2.1, Part VIII "Systems and Piping"~~ at 1.5 x design pressure to ensure gas tight integrity and to show that it can withstand the expected maximum pressure at gas pipe rupture.

9.12.2.5 Alternative arrangement.

Single walled gas piping is only acceptable:

for engines supplied with low pressure gas and installed in ESD protected machinery spaces, as defined in IGF Code 5.4.1.2 and in compliance with other relevant parts of the IGF Code (e.g. 5.6);

in the case gas is supplied into the air inlet directly on each individual cylinder during air intake to the cylinder on a Low - pressure engine, such that a single failure will not lead to release of fuel gas into the machinery space.

For engines of gas carriers, the IGC Code applies.

In case of gas leakage in an ESD-protected machinery space, which result in the shutdown of the engine(s) in that space, a sufficient propulsion and manoeuvring capability including essential and safety systems shall be maintained (refer to 2.1.13, Part VII "Machinery installations").

9.12.2.6 The safety concept of the engine is to indicate application of the "double wall" or "alternative" arrangement.

9.12.2.7 Charge air system and exhaust gas system on the engine.

The charge air system and exhaust gas system on the engine shall be designed in accordance with 9.12.1.2.

In case of a single engine installation, the engine shall be capable of operating at sufficient load to maintain power to essential consumers after opening of the ~~pressure~~ explosion relief devices caused by an explosion event. Sufficient power for propulsion capability shall be maintained.

Load reduction shall be considered on a case by case basis, depending on engine configuration (single or multiple) and relief mechanism (self-closing valve or ~~bursting~~ rupture disk).

9.12.2.8 ~~Exhaust system on the engine.~~

~~The exhaust gas system on the engine shall be designed in accordance with 9.12.1.2.~~

~~In case of a single engine installation, the engine shall be capable of operating at sufficient load to maintain power to essential consumers after opening of the pressure relief devices caused by an explosion event. Sufficient power for propulsion capability shall be maintained.~~

Continuous relief of exhaust gas (through open rupture disc) into the engine room or other enclosed spaces is not acceptable.

Suitable explosion relief system for air inlet manifolds, scavenge spaces and exhaust system should be provided unless designed to accommodate the worst-case overpressure due to ignited gas leaks or justified by the safety concept of the engine. A detailed evaluation regarding the hazard potential of overpressure in air inlet manifolds, scavenge spaces and exhaust system should be carried out and reflected in the safety concept of the engine. Explosion relief devices for air inlet and exhaust manifold shall be type approved according to Appendix 12 to Section 5, Part IV "Technical Supervision during Manufacture of Products" of the Rules for Technical Supervision During Construction of Ships and Manufacture of Materials and Products for Ships.

The necessary total relief area and the arrangement of the explosion relief devices shall be determined taking into account:

the worst-case explosion pressure depending on initial pressure and gas concentration,

the volume and geometry of the component, and - the strength of the component.

The arrangement shall be determined in the risk analysis) and reflected in the safety concept.

9.12.2.9 Engine crankcase.

9.12.2.9.1 Crankcase explosion relief valves shall be installed in accordance with 2.3.4 (refer also to IGF Code 10.3.1.2).

For engines not covered by 2.3.4, the detailed evaluation as required in 9.3.4.9 shall determine if crankcase explosion relief valves are necessary.

9.12.2.9.2 Inerting.

For maintenance purposes, a connection, or other means, shall be provided for crankcase inerting and ventilating and gas concentration measuring.

9.12.2.9.3 Crankcase ventilation

Ventilation of crankcase (either supply or extraction), if arranged, is to comply with 2.3.3. Relevant evidence is to be documented in Safety Concept. The ventilation systems for crankcase, sump and other similar engine spaces are to be independent from the systems on the other engines.

9.12.2.10 Gas ignition in the cylinder.

Requirements of IGF Code 10.3 apply. For engines of gas carriers, IGC Code 16.7 applies.

9.12.2.11 Control, monitoring, alarm and safety systems.

The engine control system shall be independent and separate from the safety system.

The gas ~~supply~~ admission valves shall be controlled by the engine control system or by the engine gas demand.

Combustion shall be monitored on an individual cylinder basis.

In the event that poor combustion is detected on an individual cylinder, gas operation may be allowed in the conditions specified in IGF Code 10.3.1.6.

If monitoring of combustion for each individual cylinder is not practicable due to engine size and design, common combustion monitoring may be accepted.

Unless the risk analysis required by 9.3 proves otherwise, the monitoring and safety system functions for DF or GF engines shall be provided in accordance with Table 9.12.2.11.

Table 9.12.2.11

Monitoring and Safety System Functions for DF (applies only to the gas mode) and GF Engines

Parameter	Alarm	Automatic activation of the double block and bleed valves	Automatic switching over to oil fuel mode[1)]	Engine shutdown
Abnormal pressures in the gas fuel supply line	X	X	X	X~~5)~~2)
Gas fuel supply systems – malfunction	X	X	X	X~~5)~~2)
Pilot fuel injection or spark ignition systems – malfunction	X	X~~2)~~3)	X	X~~2)~~3)~~5)~~2)
Exhaust gas temperature after each cylinder – high	X	X~~2)~~3)	X	X~~2)~~3)~~5)~~2)
Exhaust gas temperature after each cylinder, deviation from average – low~~3)~~4)	X	X~~2)~~3)	X	X~~2)~~3)~~5)~~2)
Cylinder pressure or ignition – failure, including misfiring, knocking and unstable combustion	X	~~X~~2)3)~~4)~~5)	X~~4)~~5)	X~~2)~~3)~~4)~~5)~~5)~~2)
Oil mist concentration in crankcase or bearing temperature[6)] – high	X	X		X~~7)~~
Pressure in the crankcase – high~~4~~8)	X	X	X	
Engine stops – any cause	X	X		
Failure of the control-actuating medium of the block and bleed valves	X	X	X	
Failure of crankcase ventilation system, if applicable	X	X[9)]	X[9)]	

Footnotes:

1) DF engine only, when running in gas mode.

~~5)~~2) GF engine only.

~~2)~~3) For GF engines, the double block and bleed valves and the engine shutdown may not be activated in case of specific failures affecting only one cylinder, provided that the concerned cylinder can be individually shutoff and the safe operation of the engine in such conditions is demonstrated by the risk analysis.

~~3)~~4) Required only if necessary for the detection of misfiring.

~~4)~~5) In the case where the failure can be corrected by an automatic mitigation action, only the alarm may be activated. If the failure persists after a given time, the safety actions shall be activated.

6) Where required in compliance with 2.3.

7) Only for trunk piston engines. For crosshead engines slow down shall apply (refer to Part XV, Table 4.2.10-1).

8) Only for trunk piston engines. This pressure sensor cannot replace or substitute a gas detector.

9) Automatic safety actions to be activated as specified by the engine manufacturer, refer to 2.3.

9.12.2.12 Gas admission valves.

~~G~~Electrically operated gas admission valves shall be certified safe by a competent body as follows:

the inside of the valve contains gas and shall therefore be certified for Zone 0;

when the valve is located within a pipe or duct in accordance with 9.12.2.3 and 9.12.2.4, the outside of the valve shall be certified for Zone 1;

when the valve is arranged without enclosure in accordance with the ESD-protected machinery space (taking in account 9.12.2.5 and 9.12.2.6) concept, no certification is required for the outside of the valve, provided that the valve is de-energized upon gas detection in the space.

However, if they are not rated for the zone they are intended for, it shall be documented that they are suitable for that zone. Documentation and analysis shall be based on IEC 60079-10-1:2015 or IEC 60092-502:1999.

Gas admission valves operated by hydraulic oil system are to be provided with sealing arrangement to prevent gas from entering the hydraulic oil system.".

Chapter 9.13 is amended as follows:

"**9.13 SPECIFIC DESIGN REQUIREMENTS**

9.13.1 DF engines.

9.13.1.1 General.

The maximum continuous power that a DF engine can develop in gas mode may be lower than MCR of the engine (i.e. in oil fuel mode), depending in particular on the gas composition and its quality or the engine design.

This maximum continuous power available in gas mode and the corresponding conditions shall be stated in the technical documentation and demonstrated during the type test taking into account the requirements of Section 5, Part IV "Technical Supervision during manufacture of products" of the Rules for Technical Supervision during Construction of Ships and Manufacture of Materials and Products for Ships.

9.13.1.2 Starting, changeover DF engines and stopping.

DF engines shall be arranged to ~~use~~ be started using either oil fuel or gas ~~fuel for the main fuel charge and~~ with pilot oil fuel for ignition. The engines shall be arranged for rapid changeover from gas use to fuel oil use. In the case of changeover to either fuel supply, the engines shall be capable of continuous operation using the alternative fuel supply without interruption to the power supply.

Changeover to gas fuel operation shall be only possible at a power level and under conditions where it can be done with acceptable reliability and safety as demonstrated through testing.

Changeover from gas fuel operation mode to oil fuel operation mode shall be possible at all situations and power levels.

The changeover process itself from and to gas operation shall be automatic but manual interruption shall be possible in all cases.

If the power level or other conditions do not allow safe and reliable gas operation, changeover to oil fuel mode shall be automatically performed.

In case of shut-off of the gas supply, the engines shall be capable of continuous operation by oil fuel only.

9.13.1.3 Pilot injection.

Gas supply to the combustion chamber shall not be possible without operation of the pilot oil injection.

Pilot injection shall be monitored by fuel oil pressure and combustion parameters or otherwise.

9.13.2 GF engines.

9.13.2.1 Spark ignition system.

In case of failure of the spark ignition, the engine is to be shut down except if this failure is limited to one cylinder, subject to immediate shut off of the cylinder gas supply and provided that the safe operation of the engine is substantiated by the risk analysis and by tests.

9.13.3 Pre-mixed engines.

9.13.3.1 Charge air system.

Inlet manifold, turbo-charger, charge air cooler, etc. are to be regarded as parts of the fuel gas supply system. Failures of those components likely to result in a gas leakage shall be considered in the risk analysis (refer to 9.3).

Flame arresters shall be installed before each cylinder head, unless otherwise justified in the risk analysis, considering design parameters of the engine such as the gas concentration in the charge air system, the path length of the gas-air mixture in the charge air system, etc.

9.13.4 Two-stroke engines.

9.13.4.1 Scavenge air system.

The risk analysis required in 9.3 is to cover the possible gas accumulation in a scavenge space.

9.13.4.2 Crankcase.

The risk analysis required in 9.3 shall cover the possible failure of a piston rod stuffing box.".

PART XI. ELECTRICAL EQUIPMENT

2 GENERAL REQUIREMENTS

2.6 LIGHTNING PROTECTION

Para 2.6.1.1 is amended as follows:

"**2.6.1.1** In ships provision shall be made for lightning protection devices covering the zone to be protected.

Boundaries of the zones subject to lightning protection shall be defined in two views (top view and side view) drawn to scale in the relevant ship's drawings.".

6 LIGHTING

6.9 LIGHTING AND ILLUMINATION MEANS OF HELIDECKS

Chapter 6.9 is deleted.

16 CABLES AND WIRES

16.8 CABLING

В **пункт 16.8.1.2** вносятся следующие изменения:

"**16.8.1.2** ~~C~~For power, control and signalling circuits, as well as instrumentation and internal communication circuits with the number of cores in the cable not less than four, cables and wires having stranded conductors shall be used, the cross-sectional area of the conductors being not less than~~:~~ 0,5 mm^2.

~~**.1** 1,0 mm^2 for power, control and signalling circuits of essential services and for power circuits of other services;~~

~~**.2** 0,75 mm^2 for control and signalling circuits;~~

~~**.3** 0,5 mm^2 with the number of cores in the cable not less than four for instrumentation and internal communication circuits.~~

For power circuits supplying non-essential services, the use is permitted of cables with single-wire conductors having a cross-sectional area of 1,5 mm^2 and less.

In data transfer circuits high-frequency cables may be used with the core diameter of 0,4 — 0,8 mm considering mechanical strength of such cables in compliance with IEC 60092-370.".

20 REQUIREMENTS FOR ELECTRICAL EQUIPMENT DEPENDING ON THE SHIP PURPOSE

20.4 SPECIAL PURPOSE SHIPS

New para 20.4.3 is introduced reading as follows:

"**20.4.3** On special purpose ships carrying more than 240 persons, requirements of 20.1.5 shall be met.".

Existing paras 20.4.3 — 20.4.4 are renumbered **20.4.4 — 20.4.5** accordingly.

PART XIII. MATERIALS

2 PROCEDURES OF TESTING

2.6 TESTING OF SHOP PRIMERS NOT REMOVED BEFORE WELDING

Para 2.6.3 is amended as follows:

"**2.6.3 Determination of porosity.**

Welds shall be subjected to breaking in such a manner that pore boundaries are clearly visible. Breaking shall be done alone the bisecting line of the angle made by the edges of the welded joint. If this requirement is not fulfilled, the specimen shall be discarded. Evaluation shall be done at least at x10 magnification. ~~The image shall be projected onto a polished glass disc of about 200 mm in diameter, where the area of pores shall be determined. The size of an individual pore shall be determined as the largest in the two mutually perpendicular directions.~~ The pore projection is determined as an ellipse with two sizes as main axes~~, on the basis of which the pore area is calculated~~.

Pores, the largest main axes of which are ≤0,5 mm, non-magnified, are not evaluated. The shear area of other pores shall be calculated. Simplified geometric formulas may be applied.

Evaluation shall be done on the basis of 100 mm: 60 mm from the beginning of the weld and 40 mm from the end of the specimen are not included in the estimation of the results. The following data shall be determined for each specimen:

the number of pores, *n*;

the value of area of an individual pore, mm^2;

~~the mean area of an individual pore, mm^2;~~

the total pore area, ~~*F*~~ mm^2~~.~~;

the fracture area of a welded joint, mm^2.".

Para 2.6.4 is amended as follows:

"**2.6.4 Test report.**

A test report shall be compiled for each test, containing the following:

primer mark/brand name;

characteristics of the coating pigments; characteristics of the bonding base of the coating;

chemical composition of the specimens of the base metal and welding wire; coating thickness (individual and mean values); calculation results based on tests, containing:

~~number of pores, n; mean area of individual pores, mm^2;~~ total pore area, mm^2;

percentage ratio of the total pore area to the fracture area of a welded joint;

conclusion on the compliance with the requirements of 6.5.4.4;

date, name and address of the testing centre. The signature of the executive in charge and the person responsible for conducting the tests.

The following documents shall be attached to the report:

a report on selection of the specimens from the batch of products indicating the batch number; Manufacturer's Certificates for the shop primer; Manufacturer's Certificates for the base metal and welding consumables; the Manufacturer's Certificate for the shielding gas used during welding tests for pore formation.".

3 STEEL AND CAST IRON

3.8 STEEL CASTINGS

Para 3.8.5.2 is amended as follows:

"**3.8.5.2** Sampling may be effected directly from the casting or the test samples may be cast to it, or be cast separately. All samples shall be identified.".

Para 3.8.5.3 is replaced by the following text:

"**3.8.5.3** The preferred test block arrangement, where practical, is for the manufacturer to provide at least one 30 mm test block by cast integrally on the castings or by attached to the casting.

N o t e . The test results represent the material from which the castings have been poured and the subsequent heat treatment process and may not necessarily represent the properties of the castings. These properties can be affected by solidification conditions and the rate of cooling during heat treatment, which are in turn influenced by casting thickness, size, complexity and shape. The purpose of the test block is to provide a qualitative check to demonstrate the effective control of existing heat treatment processes and procedures.

For castings where it is required that the mechanical properties need to be demonstrated for specific section thicknesses and when agreed upon between the manufacturer and the purchaser, then proposals for alternative test block arrangements (in terms of size and type) shall be submitted for the RS approval.

N o t e . The size of the test blocks for mechanical testing may be determined by the ruling section of the casting that they are representative of the casting's heat treatment and microstructure, as well as by the requirements of ISO 4885:2018, ISO 683-1:2016 and ISO 683-2:2016.

Alternatively, determination of test block size and type may be supported by statistical test data, production of a representative test block or a component, simulation software, or a combination of all these items.".

Para 3.8.5.6 is deleted.

Para 3.8.6.1 is amended as follows:

"**3.8.6.1** At least one sample shall be provided for each casting. Where one casting is made from several casts (without mixing) the number of samples shall be equal to the number of casts involved. The condition of 3.8.5.4 shall be met in this case.

Where the caee8sting is of complex design or where the finished mass exceeds 10 t, at least two cast on test blocks shall be ~~provided from the heaviest section,~~ located as far as practicable from each other.

Where large castings are made from two or more casts, which are not mixed in a ladle prior to pouring, two or more test blocks are to be provided corresponding to the number of casts involved. These are to be attached to the casting or cast integrally on the castings at locations as widely separated as possible.".

3.12 STEEL CASTINGS FOR PROPELLERS

Para 3.12.8.2.3 is amendment as follows:

"**3.12.8.2.3** Acceptance criteria for liquid penetrant testing and magnetic particle testing.

3.12.8.2.3.1 Definitions of liquid penetrant testing.

I n d i c a t i o n is the presence of detectable bleed-out of the penetrant liquid from the material discontinuities appearing at least 10 min after the developer has been applied.

R e l e v a n t i n d i c a t i o n is indication which has any dimension greater than 1,5 mm when categorization of indications is performed.

N o n - l i n e a r i n d i c a t i o n is an indication ~~with a largest dimension less than three times its smallest dimension (i.e. $l < 3w$)~~ having a length less than or equal to three times its width (i.e. $l \leq 3w$);

L i n e a r i n d i c a t i o n is an indication ~~with a largest dimension three or more times its smallest dimension (i.e. $l \geq 3w$)~~ having a length greater than three times its width (i.e. $l > 3w$).

Aligned indication is ~~considered to be~~ a unique indication and its length is equal to the overall length of the alignment. The aligned indication may have the following structure:

three or more non-linear indications aligned with the distance between indications less than 2 mm; or

linear indications aligned with the distance between two indications smaller than the length of the longest indication.

Illustration of liquid penetrant indications is given in Fig. 3.12.8.2.3.1.".

Figure 3.12.8.2.3.1. **Figure captions "*l*/*w* < 3" and "*l*/*w* ≥ 3"** are replaced by captions **"*l*/*w* ≤ 3"** and **"*l*/*w* > 3"** respectively.

Para 3.12.9.5.2.6 is amended as follows:

"**3.12.9.5.2.6** On completion of heat treatment of martensitic steels the weld repairs and adjacent material shall be ground smooth. All weld repairs shall be liquid penetrant tested.".

4 COPPER AND COPPER-BASE ALLOYS

4.2 PROPELLER CASTINGS

Figure 4.2.4. **Figure caption "Separately cast sample with dimensions in mm: *H* = 100, *B* =50, *L* > 150, *T* = 15, *D* = 25"** is replaced by the following caption "**Separately cast sample with dimensions in mm: *H* ≥ 100, *B* ≥50, *L* > 150, *T* ≥ 15, *D* ≥ 25**".

Para 4.2.7.3.1.2.1 is amended as follows:

"**4.2.7.3.1.2.1** Definitions.

Indication is the presence of detectable bleed-out of the penetrant from the material discontinuities appearing at least 10 min after the developer has been applied.

Relevant indication is an indication which has any dimension greater than 1,5 mm when categorization of indications is performed.

Non-linear indication is an indication ~~with a largest dimension less than three times its smallest dimension (i.e. l < 3w)~~ having a length less than or equal to three times its width (i.e. $l \leq 3w$).

Linear indication is an indication ~~with a largest dimension three or more times its smallest dimension (i.e. l ≥ 3w)~~ having a length greater than three times its width (i.e. $l > 3w$).

Aligned indication (refer to Fig. 4.2.7.3.1.2.1) is ~~considered to be~~ a unique indication and its length is equal to the overall length of the alignment. The aligned indication may have the following structure:

three or more non-linear indications aligned with the distance between indications less than 2 mm;

linear indications aligned with the distance between two indications smaller than the length of the longest indication.".

Figure 4.2.7.3.1.2.1. **Figure captions** "***l*/*w* < 3**" and "***l*/*w* ≥ 3**" are replaced by captions "***l*/*w* ≤ 3**" and "***l*/*w* > 3**", respectively.

Para 4.2.8.3 is amended as follows:

"**4.2.8.3** Repair of defects in zone C.

Defects that are not deeper than dB (depth in zone C) = $t/40$ mm ~~(*t* =minimum local thickness, in mm)~~ or 2 mm (whichever is greater) shall be removed by grinding. Those defects, which are deeper than allowable for removal by grinding, may be repaired by welding.

Note. *t* is minimum local thickness.".

Table 4.2.8.5.1-2 is amended as follows:

"Table 4.2.8.5.1-2

Time of conditioning for stress relief heat treatment of copper alloy propellers

Stress relief temperature, °C	CU1 and CU2		CU3 and CU4	
	hours per 25 mm thickness	max. recommended total time, hours	hours per 25 mm thickness	max. recommended total time, hours
350	5	15	–	–
400	1	5	–	–
450	0,5	2	5	15
500	0,25	1	1	5
550	0,25[1]	0,5[1]	0,5[1~~2~~]	2[1~~2~~]
600	–	–	0,25[1~~2~~]	1[1~~2~~]

[1] 550 °C only applicable for CU2 alloy.
[1~~2~~] 550 and 600°C only applicable for CU4 alloys.

".

6 PLASTICS AND MATERIALS OF ORGANIC ORIGIN

6.5 PROTECTIVE COATINGS

Para 6.5.4.4 is amended as follows:

"**6.5.4.4** A primer not removed before welding shall have the following results of qualification testing performed in compliance with the requirements of 2.6: ~~the total pore area *F*, m^2 in each specimen shall not exceed 150 mm^2~~ the ratio of the total pore area to the fraction area of a welded joint in each specimen shall not exceed 16 %.".

Para 6.5.4.5 is amended as follows:

"**6.5.4.5** The requirements for testing of shop primers at the manufacturers' of welded structures.

The acceptance of shop primers not removed before welding is performed on the basis of the satisfactory test results complying with the requirements of 6.5.4.4 and stated in the reports ~~signed by the RS surveyor~~. The test results are valid only for the particular mark of the shop primer subjected to testing and supplied by the particular manufacturer and for nominal thickness of coating not exceeding the value recorded during testing.".

PART XIV WELDING

2 TECHNOLOGICAL REQUIREMENTS FOR WELDING

2.8 WELDING OF CLAD STEELS

Para 2.8.1 is amended as follows:

"**2.8.1** Welding processes for clad steel shall be approved in accordance with Section 6, Part III "Technical Supervision during Manufacture of Materials" of Rules for Technical Supervision during Construction of Ships and Manufacture of Materials and Products for Ships, the welding consumables – in accordance with Section 4.

Edge preparation for parts to be welded shall be carried out in accordance with the agreed national standards or drawings approved by the Register.

Preparation of the edges shall be effected by machining or grinding. The edges of parts to be assembled shall fit each other closely ~~and shall not be out of alignment on the clad surface~~. Before welding it is permitted to misalign the edges relative to each other by up

to 10 % of the sheet thickness, but not more than half of the cladding layer thickness and no more than 3 mm if the cladding layer thickness exceeds 6 mm. At the same time, a protruding edge of a butt weld shall be overlapped by weld reinforcement with smooth transition to the base metal.".

New Chapter 2.15 is introduced reading as follows:

"**2.15 LASER AND LASER-ARC HYBRID WELDING**

2.15.1 Terms and definitions, general provisions.

2.15.1.1 The following terms and definitions have been adopted in this Chapter.

Laser welding (LW) is a welding technique by melting that uses a laser beam as the heat source for melting base metal and subsequent joining of welded parts. In laser welding it is allowed to use filler material which is loaded directly to a weld pool, in this case a weld is formed by melting of base and filler materials.

Laser-arc hybrid welding (LAHW) is a welding technique by melting that combines two energy sources: a laser beam and an electric arc in a common weld pool as shown in Fig. 2.15.1.1-1.

An electric arc in LAHW can be formed by means of:

consumable electrode in shield gas (processes 131, 133, 135, 138);

tungsten electrode in inert gas with solid filler material (process 141);

tungsten electrode in inert gas (process 142);

non-transferred plasma torch electrode (process 154).

Both solid and cored electrodes shall be used as a consumable electrode in LAHW. A solid electrode shall be used for tungsten inert gas welding in LAHW (process 141).

An electric arc may be positioned either in front or behind the laser beam.

Laser-arc hybrid welding may be performed by the following methods, schematically shown in Fig. 2.15.1.1-1 – 2.15.1.1-7:

"hybrid method" is a LAHW method in which a laser beam and an electric arc are used simultaneously to form a weld pool;

"double-sided hybrid method" is a LAHW method in which a laser beam and an electric arc are used simultaneously to form a weld pool from both sides of a joint to be welded;

"hybrid + arc method" (classical method) is a LAHW method in which a laser beam and an electric arc are used simultaneously to form a weld pool with an additional electric arc on the back side of the joint to be welded;

"hybrid + arc method" (combined method) is a LAHW method in which a laser beam and an electric arc are used simultaneously to form a weld pool, at that, the electric arc is at a certain distance in the direction of travel from the laser head;

"hybrid tandem method" (twin method) is a LAHW method which combines a laser beam and two electric arcs on both sides of the laser beam in one welding pool (applied to increase welding speed with obtaining required mechanical properties of the welded joint, for filling in the groove and to ensure deep penetration);

"double-sided hybrid tandem method" (double-sided twin method) is a LAHW method which combines a laser beam and two electric arcs on both sides of the laser beam in one welding pool.

Combined welding process is welding of a welded joint made in a series by two or more welding processes. In case of laser or laser-arc hybrid welding, the root run is performed by LW or LAHW and the subsequent run(s) are made by arc welding process(es). A combined process can be similarly performed, in which the first welding run is performed by the arc process (as a technological run to align assembly accuracy of a weld) followed by a run of laser or laser-arc hybrid welding and further filling by the arc process.

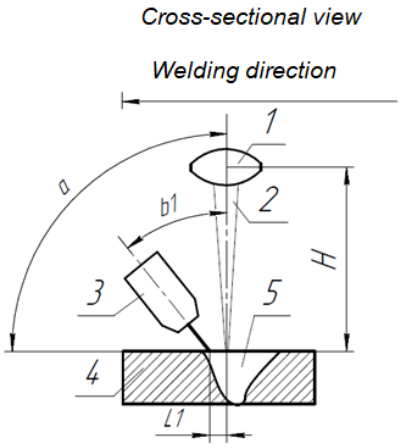


Fig. 2.15.1.1-1 LAHW scheme, "hybrid" method of butt welds in downhand position (PA):
1 — focusing lens; *2* — laser beam; *3* — arc torch; *4* — workpiece to be welded; *5* — weld pool;
α — angle between the horizontal surface and the laser beam;
b1 — angle between the laser beam and the arc torch; H — focal distance;
*L*1 – distance between the intersection of axes of welding wire and laser beam on the surface

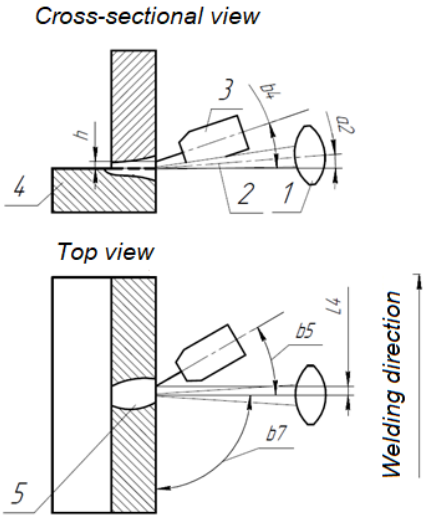


Fig. 2.15.1.1-2 LAHW scheme, "hybrid" method of butt welds in horizontal position (PA):
1 — focusing lens; *2* — laser beam; *3* — arc torch; *4* — workpiece to be welded; *5* — weld pool;
α*2* — angle between the horizontal surface and the laser beam; *b4* — angle between the arc torch and the horizontal surface; *L4* — distance between the intersection of axes of welding wire and laser beam in horizontal plane;
b7 — angle between the laser beam and the vertical surface;
h — height of focal spot from the angle (in horizon); *H* — focal distance;
L1 — distance between the intersection of axes of welding wire and laser beam on the surface

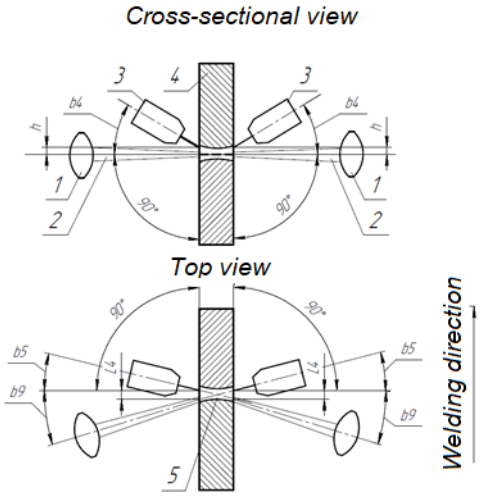


Fig. 2.15.1.1-3 LAHW scheme, "double-sided hybrid" method of butt welds in horizontal position (PC):
1 — focusing lens; *2* — laser beam; *3* — arc torch; *4* — workpiece to be welded; *5* — weld pool;
b4 — angle between the laser beam and the arc torch; *h* — height of welding wire position from the laser beam;
L4 — distance between the intersection of axes of welding wire and laser beam in horizontal plane;
H — focal distance;
b5 — inclination angle of arc torches in relation to the perpendicular to the vertical plane;
b9 — inclination angle of the laser beam in relation to the perpendicular to the vertical plane

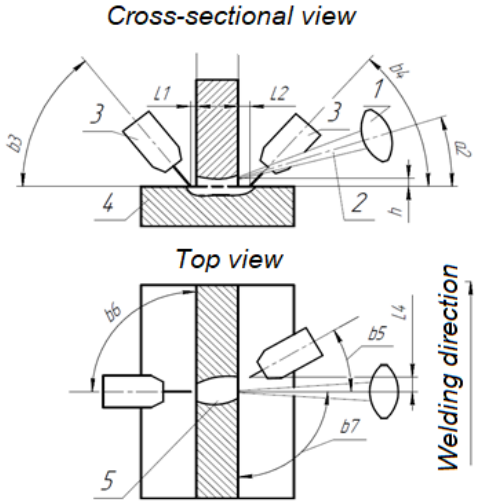


Fig. 2.15.1.1-4 LAHW scheme, "hybrid + arc" method of fillet welds in horizontal and vertical position (PB)
1 — focusing lens; *2* — laser beam; *3* — arc torch, *4* — workpiece to be welded; *5* — weld pool;
$\alpha 2$ — angle between the horizonal surface and the laser beam;
b3, b4 — inclination angles of arc torches in relation to horizontal surface;
b5 — angle between the arc torch and the laser beam; *b6* — inclination angle of the arc torch in relation to the vertical surface; *b7* — angle between the laser beam and the vertical surface;
L1, L2 — distance between electrode ends up to the vertical surface;
L4 — distance between the intersection of axes of welding wire and laser beam in horizontal plane; *h*- height of focal spot from the angle (in horizon)

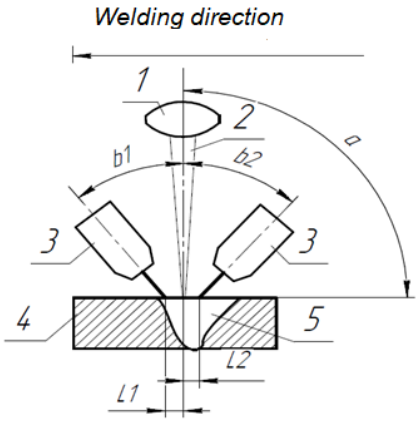
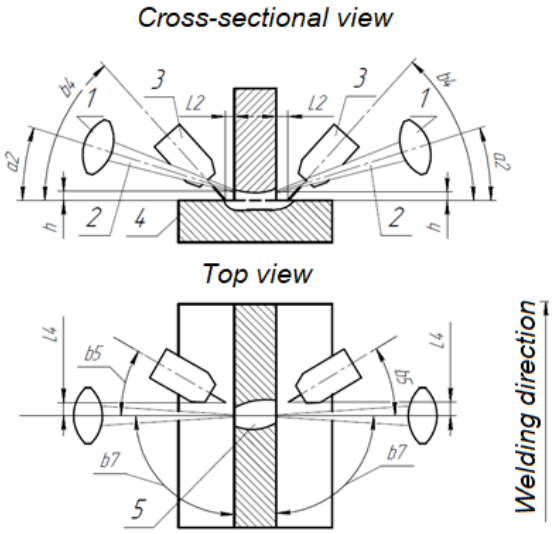
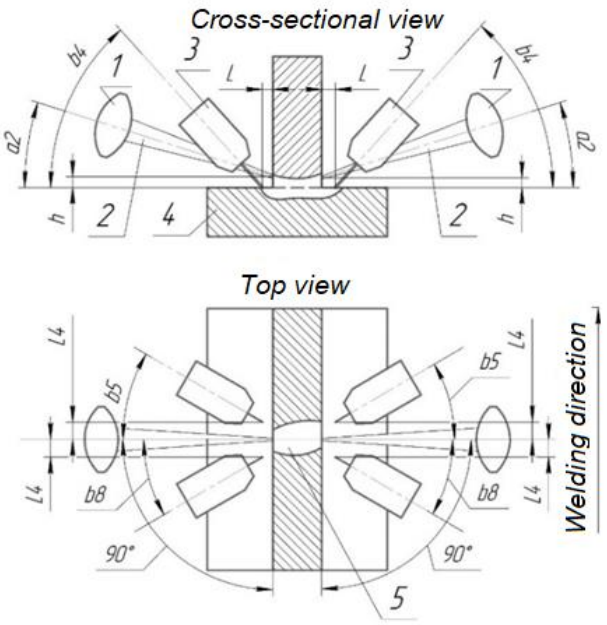


Fig. 2.15.1.1-5 LAHW scheme, "hybrid tandem" method of butt welds in downhand position (PA):
1 — focusing lens, *2* — laser beam, *3* — arc torch, *4* — workpiece to be welded, *5* — weld pool;
α — angle between a horizontal surface and a laser beam;
b1, *b2* — angles between the laser beam and arc torches;
L1, *L2* — distance between the intersection of axes of the laser beam and arc torches with the surface



2.15.1.1-6 LAHW scheme, "double sided hybrid" method of fillet welds in horizontal and vertical position (PB):
1 — focusing lens; *2* — laser beam; *3* — arc torch; *4* — workpiece to be welded, *5* – weld pool;
α*2* —angle between the horizontal surface and the laser beam; *b4* — angle between the horizontal surface and the arc torch; *b5* — inclination angle of the arc torch in relation to the laser beam;
b7 — angle between the laser beam and the vertical plane;
L4 — distance between the intersection of axes of the welding wire and the laser beam in horizontal plane;
h — height of focal spot from the angle (in horizon)



2.15.1.1-7 LAHW scheme, "double-sided hybrid tandem" method of fillet welds in horizontal and vertical position (PB):
1 — focusing lens; *2* — laser beam; *3* — arc torch; *4* — workpiece to be welded, *5* — weld pool;
$\alpha 2$ — angle between the horizontal surface and the laser beam; *b4* — angle between the horizontal surface and the arc torch; *b5*, *b8* — angles between arc torches and laser beams;
L4 — distance between the intersection of axes of the welding wire and the laser beam in horizontal plane;
h — height of focal spot from the angle (in horizon)

2.15.2 Scope of application.

2.15.2.1 Laser welding is permitted for use in the manufacture of shipboard equipment (plate and tubular heat exchangers, expansion bellows of pipelines, boiler wall tubular panels, pressure vessel bodies) made of corrosion-resistant (high-alloy austenitic) steels, aluminum, titanium and copper alloys.

2.15.2.2 Laser-arc hybrid welding with plasma arc welding with non-transferred arc (process 521 + 154) is permitted for welding shipboard equipment (plate and tubular heat exchangers, expansion bellows of pipelines, boiler wall tubular panels, pressure vessel bodies) made of corrosion-resistant (high-alloy austenitic) steels, aluminum, titanium and copper alloys.

2.15.2.3 Laser-arc hybrid welding by metal inert gas (MIG) welding and tungsten inert gas (TIG) welding is permitted for use for structures not involved in ensuring the overall strength of a ship (offshore installation) made of normal and higher strength shipbuilding steels.

2.15.3 Technological requirements for preparation of edges and assembly of welds.

2.15.3.1 Sheets cutting and edge preparation may be done by mechanical means (mechanical machining), hydroabrasive treatment, plasma or laser cutting providing edge beveling (cut taper angle) not exceeding 3° and required accuracy of structural elements of the joint.

2.15.3.2 When thermal cutting methods are used, the resulting mill scale shall be mechanically removed. The heat-affected zone shall also be mechanically removed if it is not overlapped with the heat-affected zone of the subsequent weld. The size of the heat-affected zone is determined by metallographic analysis of coupon samples during process preparation stage. It is necessary to ensure proper quality and prevent defects in welded joints.

2.15.3.3 Edges of sheets to be welded and the surfaces adjacent to them shall be cleaned from primer up to bare metal for at least 10 mm span (to side direction). They shall also be cleaned from rust, oxide films, mill scale, contaminants from oils, processing fluids and any other organic materials. Surfaces of edges shall have an appropriate roughness in

accordance with 2.13.11. It is permitted to weld components with primers approved by RS in compliance with 6.5.4 of Part XIII "Materials".

Edge cleaning prior to welding process is of particular importance for aluminium and its alloys, as it helps to prevent formation of unacceptable levels of porosity in weld metal. Oxide film on and near edges shall be removed under dry conditions and workpieces shall be kept dry and clean after cleaning prior to welding which shall be carried out within 24 h.

2.15.3.4 When assembling butt welds for laser and laser-arc hybrid welding, mutual displacement (warping) of sheet edges is allowed up to 0,1 of sheet thickness, but no more than 1,0 mm.

2.15.3.5 For laser and laser-arc hybrid welding with filler material, gaps between edges of steel components to be welded shall have the following recommended values, listed in Tables 2.15.3.5-1 and 2.15.3.5-2:

Table 2.15.3.5-1

Permissible root gaps between edges to be welded

Laser welding with filler material		
Type of welded joint	Metal thickness *t*, mm	Root gap, mm
Butt welds	$1 \le t \le 3$	0 — 0,2
	$3 < t \le 6$	0 — 0,3
	$6 < t \le 12$	0 — 0,4
Fillet welds, T- joint welds	$3 \le t \le 6$	0 — 0,3
	$6 < t \le 12$	0 — 0,4
	$12 < t \le 16$	0 — 0,5

Table 2.15.3.5-2

Permissible root gaps between edges to be welded

Laser-arc hybrid welding with filler material		
Type of welded joint	Metal thickness *t*, mm	Root gap, mm
Butt welds	$3 \le t \le 6$	0 – 0,4
	$6 < t \le 12$	0 – 0,8
	$12 < t \le 16$	0 – 1,0
	$16 < t \le 26$	0 – 1,0
	$26 < t \le 50$	0 – 1,2
Fillet welds, T- joint welds (PA)	$3 \le t \le 6$	0 — 0,7
	$6 < t \le 12$	0 — 1,0
	$12 < t \le 16$	0 — 1,0
	$16 < t \le 20$	0 — 1,0
Fillet welds, T- joint welds (PB, PC)	$3 \le t \le 6$	0 — 1,0
	$6 < t \le 12$	0 — 1,0
	$12 < t \le 16$	0 — 1,2
	$16 < t \le 20$	0 — 1,2

2.15.3.6 Root gaps between edges to be welded and their displacement in laser and laser-arc hybrid welding (especially without filler material) have lower values as opposed to arc welding processes, and the assembly of parts for welding itself is more precise. Exact values of gap tolerances may vary depending on material, thickness and specific welding conditions. Root gaps between edges to be welded that exceed the permissible values specified in Tables 2.15.3.5-1 and 2.15.3.5-2 may result in metal leaking from the weld pool or failure to fuse edges of joints, and assembled joints with no root gaps may result in pore defects due to the lack of venting space especially at the root area. Therefore, it is important to follow the recommended tolerances to ensure quality welded joint.

2.15.3.7 The assembly of joints for laser and laser-arc hybrid welding shall be inspected and accepted by the technical control service for compliance with the requirements of this Section.

2.15.4 Weld configurations.

2.15.4.1 The depth of penetration in a single run in laser or laser-arc hybrid welding process is significantly higher than in electric arc welding process. It depends on such factors as laser power, focusing parameters, welding speed, laser beam angle, etc. For this reason, different types of edge preparation, other than for arc welding, are used when preparing parts for welding. It allows to ensure complete penetration and quality weld formation.

2.15.4.2 Recommended types of butt, angle, tee and overlap welded joints of normal and higher strength steels for laser and laser-arc hybrid welding with instructions on edge preparation are listed in Tables 2.15.4.2-1 — 2.15.4.2-5 taking into consideration the root gap tolerances specified in Tables 2.15.3.5-1 — 2.15.3.5-2.

2.15.4.3 For laser welding of aluminium, copper and titanium alloys it is permitted to use the types of welded joints applicable for steels in accordance with Tables 2.15.4.2 -1 — 2.15.4.2-5 as well as non-standard types of joints if positive results of qualification tests of welding process have been obtained.

2.15.5 Laser and laser-arc hybrid welding processes.

2.15.5.1 Thin sheet steels and alloys up to 8 mm thick may be welded by laser welding without edges preparation in any spatial position.

2.15.5.2 Steels and alloys thicker than 8 mm may be laser welded in multi-run mode with filler wire in all spatial positions using a special tapered (narrow-slotted) groove (refer to Fig. 2.15.5.2). The mode of filling a special narrow groove is performed by a defocused laser beam with additional variation within the width of the filled groove with a frequency sufficient to obtain a continuous weld.

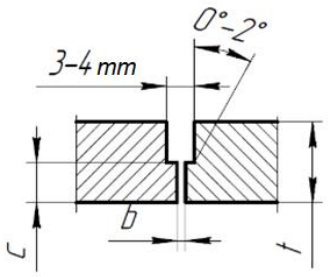


Fig. 2.15.5.2 Special tapered (narrow-slotted) groove in multi-run laser welding:
t — steel thickness; *C* — thickness of root face; *b* — gap of butt joint assembly

2.15.5.3 Steels of no weldability limitations with thicknesses of more than 3 mm and above may be welded by laser-arc hybrid welding in the lower and horizontal spatial positions. For parts with thicknesses of 12 mm and above, a Y-shaped preparation with a groove angle of 30 to 60° is used. Filling of the remaining groove after root face welding is performed by arc welding processes accepted in shipbuilding or by laser-arc hybrid welding with defocused beam.

2.15.5.4 Normal and high-strength steels with a thickness of more than 20 mm are welded by double-sided laser-arc hybrid welding in the downhand and horizontal spatial positions using a groove with an angle of 30 to 60°.

2.15.5.5 Welding of butt joints with metal thickness exceeding 10 mm may be performed using flux and copper-flux backing (refer to Fig. 2.15.5.5 *a*).

2.15.5.6 To ensure correct operation of a tracking sensor, welding of butt welds without edge preparation (for thicknesses from 3 to 12 mm) is recommended to perform with bevel on edges up to 1,5 mm (refer to Fig. 2.15.5.5 *b*).

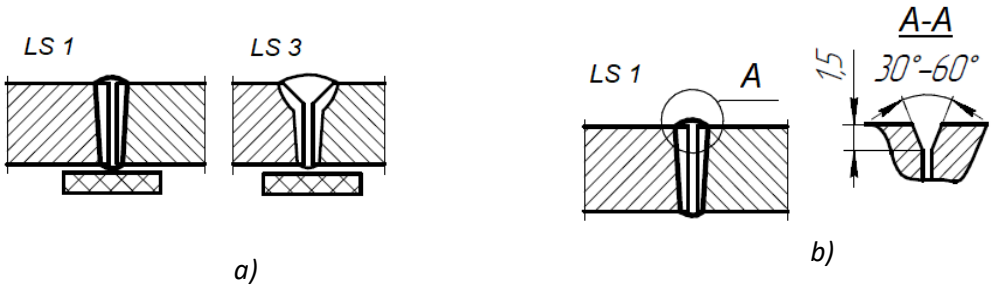


Fig. 2.15.5.5
a) — use of flux or copper and flux backing;
b) — special bevel for the tracking sensor on edge preparation without bevel

Table 2.15.4.2-1

Preparation of welded joints and applicability of welding methods for butt welds

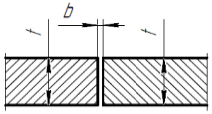
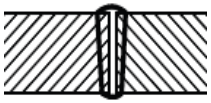
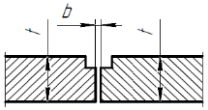
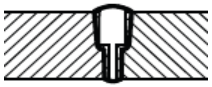
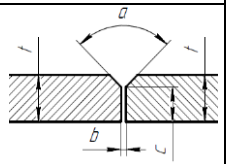
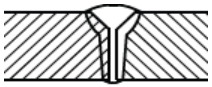
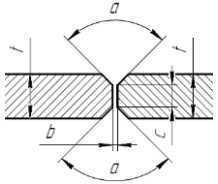
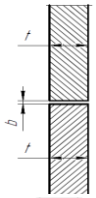
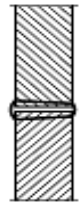
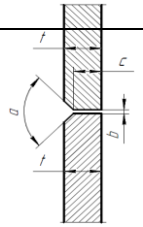
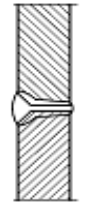
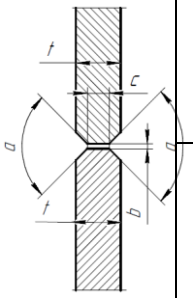
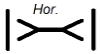
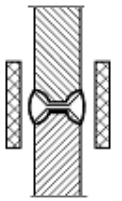
Designation of joint	Metal thickness t, mm	Structural elements of prepared edges	Groove type	Groove angle, degree	Thickness of root face (c), mm	Applicability of welding methods						
						Laser	Laser + electrode	Hybrid	Hybrid + arc	Hybrid Tandem	Double-sided hybrid	Weld illustration
LS 1	$1 \le t \le 3$			–	–	+	+	–	–	–	–	
	$3 < t \le 6$					+	+	+	–	+	–	
	$6 < t \le 12$					–	+	+	–	+	–	
LS 2	$8 < t \le 16$			–	$3 \le c \le 5$	+	+	–	–	–	–	
	$16 < t \le 32$				$3 \le c \le 8$	+	+	–	–	–	–	
LS 3	$12 < t \le 16$			30° ≤ α ≤ 60°	$8 \le c \le 10$	–	–	+	-	+	–	
	$16 < t \le 26$				$8 \le c \le 14$	–	–	+	+	+	–	
LS 4	$26 < t \le 50$			30° ≤ α ≤ 60°	$8 \le c \le 16$	–	–	+	+	+	–	

Table 2.15.4.2-2

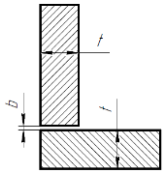
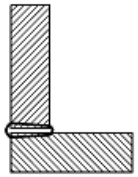
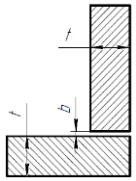
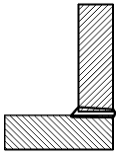
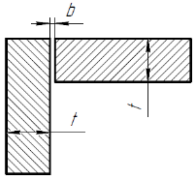
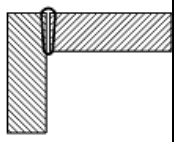
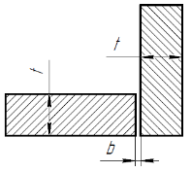
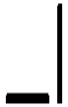
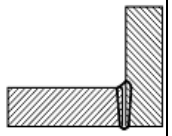
Preparation of welded joints and applicability of welding methods for horizontal butt welds

Designation of joint	Metal thickness t, mm	Structural elements of prepared edges	Groove type	Groove angle, degree	Thickness of root face (c), mm	Applicability of welding methods						
						Laser	Laser + electrode	Hybrid	Hybrid + arc	Hybrid Tandem	Double-sided hybrid	Weld illustration
LG 1	$1 \le t \le 3$			–	–	+	+	-	–	–	–	
	$3 < t \le 6$					+	+	+	–	–	–	
	$6 < t \le 12$					–	+	+	–	+	–	
LG 2	$12 < t \le 26$			$30° \le \alpha \le 60°$	$8 \le c \le 12$	–	–	+	–	+	–	
LG 3	$26 < t \le 50$			$30° \le \alpha \le 60°$	$c \le 30$	–	–	–	–	–	+	
LG 4[1]	$26 < t \le 50$			$30° \le \alpha \le 60°$	$c \le 30$	–	–	–	–	–	+	

[1] Welded joint LG 4 is welded by double-sided hybrid process with the weld pool held on both sides by water-cooled copper slide blocks.

Table 2.15.4.2-3

Preparation of welded joints and applicability of welding methods for fillet welds and T-joints welds

Designation of joint	Metal thickness t, mm	Structural elements of prepared edges	Groove type	Groove angle, degree	Thickness of root face (c), mm	Applicability of welding methods						
						Laser	Laser + electrode	Hybrid	Hybrid + arc	Hybrid Tandem	Double-sided hybrid	Weld illustration
LU 1	$1 \le t \le 3$			-	-	+	+	–	–	–	–	
	$3 < t \le 6$					+	+	+	–	+	–	
	$6 < t \le 12$					–	+	+	–	+	+	
	$12 < t \le 16$					–	–	+	–	+	+	
LU 2	$1 \le t \le 3$			-	-	+	+	–	–	–	–	
	$3 < t \le 6$					+	+	+	–	+	–	
	$6 < t \le 12$					–	+	+	–	+	–	
	$12 < t \le 16$					–	–	+	–	+	–	
LU 3	$1 \le t \le 3$			-	-	+	+	–	–	–	–	
	$3 < t \le 6$					+	+	+	–	+	–	
	$6 < t \le 12$					–	+	+	–	+	–	
	$12 < t \le 16$					–	–	+	–	-	–	
LU 4	$1 \le t \le 3$			-	-	+	+	-	–	-	–	
	$3 < t \le 6$					+	+	+	–	+	–	
	$6 < t \le 12$					–	+	+	–	+	–	
	$12 < t \le 16$					–	–	+	–	–	–	

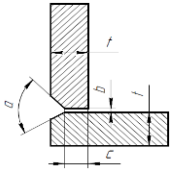
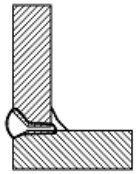
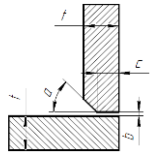
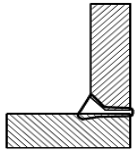
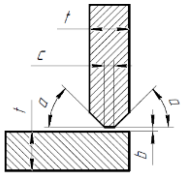
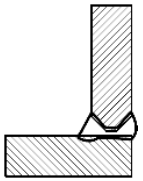
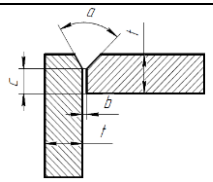
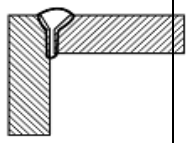
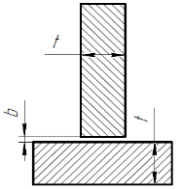
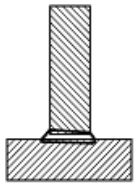
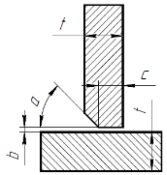
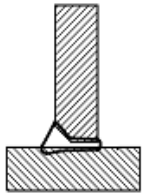
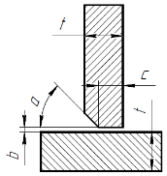
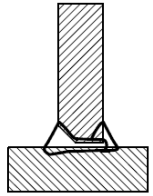
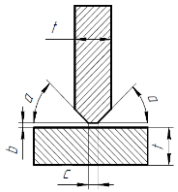
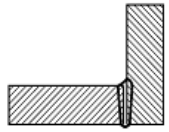
Designation of joint	Metal thickness t, mm	Structural elements of prepared edges	Groove type	Groove angle, degree	Thickness of root face (c), mm	Applicability of welding methods						
						Laser	Laser + electrode	Hybrid	Hybrid + arc	Hybrid Tandem	Double-sided hybrid	Weld illustration
LU 5	12 ≤ *t* ≤ 16			30° ≤ *α* ≤ 60°	6 ≤ *c* ≤ 10	–	–	+	+	+	+	
	16 < *t* ≤ 26				8 ≤ *c* ≤ 12	–	–	+	+	+	+	
	26 < *t* ≤ 32				16 ≤ *c* ≤ 20	–	–	+	+	+	+	
	32 < *t* ≤ 50					–	–	+	+	+	+	
LU 6	16 < *t* ≤ 26			15° ≤ *α* ≤ 45°	8≤ *c* ≤10	–	–	+	+	+	–	
	26 < *t* ≤ 32				8≤ *c* ≤12	–	–	+	+	+	–	
	32 < *t* ≤ 50				12 ≤ *c* ≤ 16	–	–	+	+	+	–	
LU 7	16 < *t* ≤ 26			15° ≤ *α* ≤ 45°	10 ≤ *c* ≤ 16	–	–	+	+	+	+	
	26 < *t* ≤ 32				*c* ≤ 20	–	–	+	+	+	+	
	32 < *t* ≤ 50				*c* ≤ 25	–	–	+	+	+	+	
LU 8	16 < *t* ≤ 26			30° ≤ *α* ≤ 60°	8 ≤ *c* ≤ 12	–	–	+	+	+	–	
	26 < *t* ≤ 32				8 ≤ *c* ≤ 12	–	–	+	+	+	–	
	32 < *t* ≤ 50				8 ≤ *c* ≤ 12	–	–	+	+	+	–	

Table 2.15.4.2-4

Preparation of welded joints and applicability of welding methods for fillet welds and T-joints welds

Designation of joint	Metal thickness t, mm	Structural elements of prepared edges	Groove type	Groove angle, degree	Thickness of root face (c), mm	Applicability of welding methods						
						Laser	Laser + electrode	Hybrid	Hybrid + arc	Hybrid Tandem	Double-sided hybrid	Weld illustration
LT 1	$1 \le t \le 3$			-	-	+	–	–	–	–	–	
	$3 < t \le 6$					+	+	+	–	+	–	
	$6 < t \le 12$					–	+	+	–	+	+	
	$12 < t \le 16$					–	–	+	–	+	+	
LT 2	$12 < t \le 26$			$15° \le \alpha \le 45°$	$6 \le c \le 12$	–	–	+	–	+	–	
LT 3	$12 \le t \le 16$			$15° \le \alpha \le 45°$	$6 \le c \le 10$	–	–	+	+	+	-	
	$16 < t \le 26$				$8 \le c \le 12$	–	–	+	+	+	+	
	$26 < t \le 32$				$8 \le c \le 16$	–	–	+	+	+	+	
	$32 < t \le 50$				$8 \le c \le 16$	–	–	+	+	+	+	
LT 4	$16 \le t \le 26$			$15° \le \alpha \le 45°$	$10 \le c \le 16$	–	-	+	+	+	+	
	$26 < t \le 32$				$c \le 20$	–	–	+	+	+	+	
	$32 < t \le 50$				$c \le 25$	–	–	+	+	+	+	

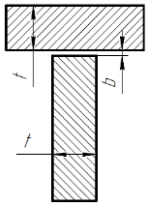
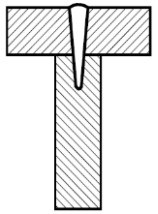
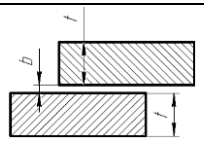
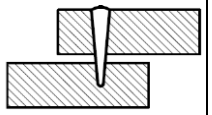
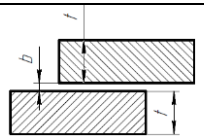
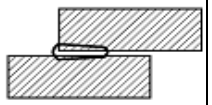
Designation of joint	Metal thickness t, mm	Structural elements of prepared edges	Groove type	Groove angle, degree	Thickness of root face (c), mm	Applicability of welding methods						
						Laser	Laser + electrode	Hybrid	Hybrid + arc	Hybrid Tandem	Double-sided hybrid	Weld illustration
LT 5	$3 \le t \le 12$			–	–	–	+	+	–	–	–	

Table 2.15.4.2-5

Preparation of welded joints and applicability of welding methods for overlap joints

Designation of joint	Metal thickness t, mm	Structural elements of prepared edges	Groove type	Groove angle, degree	Thickness of root face (c), mm	Applicability of welding methods						
						Laser	Laser + electrode	Hybrid	Hybrid + arc	Hybrid Tandem	Double-sided hybrid	Weld illustration
LN 1	$3 < t \le 12$			–	–	+	+	–	–	+	–	
LN 3	$t < 8$			–	–	+	+	+	–	–	–	

2.15.6 Welding processes approval.

2.15.6.1 Approval of laser welding processes shall be based on the requirements of the following standards:

ISO 15609-4:2009 "Specification and qualification of welding procedures for metallic materials. Welding procedure specification. Part 4. Laser beam welding";

ISO 15614-11:2002 "Specification and qualification of welding procedures for metallic materials. Welding procedure test. Part 11. Electron and laser beam welding".

2.15.6.2 Approval of laser-arc hybrid welding processes shall be based on the requirements of the following standards:

ISO 15609-6:2013 "Specification and qualification of welding procedures for metallic materials. Welding procedure specification. Part 6. Laser-arc hybrid welding";

ISO 15614-14:2013 "Specification and qualification of welding procedures for metallic materials. Welding procedure test. Part 14. Laser-arc hybrid welding of steels, nickel and nickel alloys".

2.15.6.3 For each welding process and type of welded joint, a welding procedure specification (WPS) must be prepared and approved as a part of a Welding Procedure Approval Test Certificate (СОТПС). Welding of products is allowed only under its availability.

2.15.6.4 Laser or laser-arc hybrid welding processes shall be approved by the Register in accordance with the provisions of Section 6, Part III "Technical Supervision During Manufacture of Materials" of the Rules for Technical Supervision During Construction of Ships and Manufacture of Materials and Products for Ships.

2.15.7 Non-destructive testing and quality assessment of welded joints.

2.15.7.1 Non-destructive testing of welded joints performed by laser or laser-arc hybrid welding in the production process shall be completed as follows:

visual examination and measurements — 100% of the weld length;

RT or PAUT (for thicknesses of 6 mm and more) — at least 10% of the length of welded joints.

2.15.7.2 The quality assessment of welded joints performed by laser welding shall be carried out in accordance with ISO 13919-1:2019 "Electron and laser-beam welded joints. Requirements and recommendations on quality levels for imperfections. Part 1. Steel, nickel, titanium and their alloys" for steels, nickel, titanium and their alloys and ISO 13919-2:2021 " Electron and laser-beam welded joints. Requirements and recommendations on quality levels for imperfections. Part 2. Aluminium, magnesium and their alloys and pure copper" for aluminium and magnesium alloys and pure copper.

2.15.7.3 The quality assessment of welded joints performed by laser-arc hybrid welding shall be carried out in accordance with ISO 12932:2013 "Welding. Laser-arc hybrid welding of steels, nickel and nickel alloys. Quality levels for imperfections" for steels, nickel and nickel alloys.

2.15.7.4 Defective areas of welded joints may be repaired by:

.1 laser welding without/ with filler wire for seams performed by laser welding;

.2 laser welding without/ with filler wire, arc or laser arc welding seams performed by laser-arc hybrid welding.

2.15.7.5 Welded seam areas shall be re-tested by non-destructive testing in the scope specified in 2.15.7.1.

2.15.8 Welding consumables.

2.15.8.1 Welding consumables for laser and laser-arc hybrid welding shall be selected in accordance with the base material and approved by the Register with drawing up a Certificate of Approval of Welding Consumables (COCM) or C in accordance with applicable provisions of Section 4 for welding consumables intended for welding normal and higher strength shipbuilding steels, corrosion resistant (high alloy austenitic steels), titanium, copper and aluminium alloys.

2.15.8.2 Welded samples for welding consumables approval shall be welded by laser or laser-arc hybrid welding depending on the welding process for which the welding consumables approval is being performed.

2.15.8.3 Designations of shielding gases and gas mixtures used for laser and laser-arc hybrid welding shall comply with the requirements of ISO 14175:2008 and listed in Table 2.15.8.3.

Table 2.15.8.3

Shielding gases and gas mixtures used during laser and laser-arc hybrid welding in accordance with standard ISO 14175:2008

Base material	Shielding gas/gas mixture	Gas flow rate, l/min
Low-carbon steel, ferritic stainless steel	C1, M20, M21, M22, M26	12 — 30
Austenitic steel	M12, M13, M22, R1, N1[1], I2[1]	
Aluminium, copper and titanium alloys	I1, I2, I3	
[1] Nitrogen (N1) and helium (I2) are used for laser welding		

2.15.9 Qualification of welders and welding operators.

2.15.9.1 Welders and welding operators of laser and laser-arc hybrid welding equipment shall be properly trained by qualified personnel in the specified processes. The training shall enable welders and welding operators to properly set up and operate welding equipment. The training shall include basic knowledge of laser and laser-arc hybrid welding and instructions how to draw up and follow technical requirements of welding procedure and laser safety requirements. In case of training and qualification of welders and welding operators of laser and laser-arc hybrid welding for third-party organizations, the certification centre shall be recognized by the Register.

2.15.9.2 For the certification of laser and laser-arc hybrid welding, the requirements for fully mechanized and automatic welding are specified in ISO 14732:2013 and in applicable provisions of Section 4, Part III "Technical Supervision during Manufacture of Materials" of the Rules for Technical Supervision during Construction of Ships and Manufacture of Materials and Products for Ships.

Qualification of welders and welding operators shall be approved by a Welder Approval Test Certificate (СДС) specifying all test conditions.

2.15.9.3 Processes of laser and laser-arc hybrid welding are specified in Table 2.15.9.3.

Table 2.15.9.3

Processes of laser and laser-arc hybrid welding (HLAW)

Designation per ISO 4063:2023	Welding processes
Laser welding 52	Laser welding; laser welding with filler material
Laser-arc hybrid welding 52 + 131[1]	Laser-arc hybrid welding (laser — MIG welding with solid wire electrode)
Laser-arc hybrid welding 52 + 133[1]	Laser-arc hybrid welding (laser – MIG welding with metal cored electrode)
Laser-arc hybrid welding 52 + 135[1]	Laser-arc hybrid welding (laser – MAG welding with solid wire electrode)
Laser-arc hybrid welding 52 + 138[1]	Laser-arc hybrid welding (laser – MAG welding with metal cored electrode)
Laser-arc hybrid welding 52 + 141[1]	Laser-arc hybrid welding (laser – TIG welding with solid filler material)
Laser-arc hybrid welding 52 + 142[1]	Laser-arc hybrid welding (laser – Autogenous TIG welding)

Designation per ISO 4063:2023	Welding processes
Laser-arc hybrid welding 52 + 154[1]	Laser-arc hybrid welding (laser – Plasma arc welding with non-transferred arc)
[1] For laser-arc hybrid welding, the combination of process designations in the form of digits (for example, 521 + 131) indicates the arc sequence of hybrid process, but not that it is a combined welding process. To designate a combined welding process an additional numeric designation of filling process is given, for example, (521 + 131)/138.	

2.15.9.4 Range of approval of WATC (СДС) for base metal thickness shall be specified in compliance with the requirements of Table 2.15.9.4.

Table 2.15.9.4

Range of approval of WATC (СДС) for base metal thickness for butt welds performed by LW and LAHW

Base metal[1]	Thickness of the test assembly metal *t*, mm	Range of approval for base metal thickness and weld metal, mm
	$t \le 3$	up to 3
Steels	$3 \le t < 10$	3 — 12
	$10 \le t < 16$	10 — 26
	$16 \le t < 20$	16 — 40[1]
Alluminium and its alloys	$t \le 6$	up to 8
	$6 < t \le 12$	6 — 15
Copper and copper alloys	$t \le 3$	up to 5
Titanium and titanium alloys	$t \le 3$ $3 \le t < 6$	up to 6 up to 8
[1] For base metal thicknesses greater than 40 mm, a separate certification is required which shall be noted in WATC (СДС) and in a test report.		

2.15.9.5 Non-destructive testing of welded samples made by laser or laser-arc hybrid welding shall be carried out in the scope of visual and measurement inspection along the entire length of the joints on both sides and subsequent radiographic or phased array ultrasonic testing (PAUT) for thicknesses from 6 mm and above.".

3 TESTING OF WELDED JOINTS

3.3 SCOPE OF NON-DESTRUCTIVE TESTING

Para 3.3.1 is amended as follows:

"**3.3.1** The scope of non-destructive testing of hull welds in the inspection plan approved by the Register shall be determined in accordance with. 3.3.1.

Table 3.3.1

Nos	Test location	Type of welded joint	Scope of testing		
			visual testing, [1,2], %	radiographic and ultrasonic testing, number of radiographs	
			Ship area		
			Fore-and-aft	Within 0,4*L* amidships	outside 0,4*L* amidships
1	Plating butts (mainly intersections with seams): of strength deck outside hatch line of sheerstrake (in area 0,1D below strength deck) of bilges (in area 0,1D above bottom) of bottom Butts: of hatch side coamings of thickened deck plates in way of hatchway corners and at ends of superstructures of longitudinal bulkheads (in area 0,1D below strength deck)	Butt weld	100	About 0,60N	Random[3]
2	Hull plating butts — remaining[4] (mainly intersections with seams)	Butt weld	100	About 0,20N	Random[3]
3	Hull plating seams	Butt weld	100	About 0,20N	Random[3]
4	Welded joints of longitudinal stiffeners (in longitudinal framing): of strength deck outside hatch line of sheerstrake (in area 0,1D below strength deck) of bilge (in area 0,1D above bottom) of longitudinal bulkheads (in area 0,1D below strength deck) of bottom	Butt weld	100	1 radiograph per 5 butts (mainly mounting butts)	Random [3]
5	Welded joints of longitudinal stiffeners (in longitudinal framing) in other places not specified under item 4	Butt weld	100	1 radiograph per 10 butts (mainly mounting butts)	Random [3]
6	Welded joints of transverse stiffeners (in transverse framing)	Butt weld	100	1 radiograph per 10 butts	Random [3]
7	Welded joints on strenframe	Butt weld	100		50 % of hull plating welded joints in way of sterntube[5]
8	Welded joints between deck stringer and sheerstrake[6] (in way of intersection with but welds)	Fillet weld or T-joint, full penetration	100	4 controlled lengths along the 1st plate	Random [3]
9	Welded joints on the welded stem	Butt, fillet weld or T-joint, full penetration	100		50 % of hull plating welded joints with stem plates, 50 % of welded joints of stem plates

[1] Where there are doubts as to the results of visual testing, penetrant or magnetic particle testing may be carried out.
[2] All welded joints (including those not specified in the table) shall undergo testing.
[3] The number of weld lengths undergoing testing shall be up to 20 % of the lengths specified for the area 0,4L amidships.
[4] Where ice strengthened, the ice belt butts shall mainly be tested.
[5] Intersections between seams and butts shall be tested.
[6] Ultrasonic testing is recommended.

~~Block construction welds performed in the yards, or at subcontracted yards/facilities, shall be primarily considered in selecting checkpoints. For other hull structures and offshore installations the extent shall be agreed with the Register.~~

The number of weld lengths in shell plating for 0,4*L* amidships to undergo radiographic or ultrasonic testing shall be determined by the following formula:

$$N = \frac{L(B+D)}{45}\, T, \qquad (3.3.1)$$

where N =number of controlled weld lengths;
L, B, D = length, breadth, depth of ship, in m;

T=	factor depending on ship type and manufacturing conditions and determined at the approval of the inspection plan. Following are the maximum values of the factor T for various ship types:
up to 0,7	for ships having the length L < 60 m;
up to 0,9	for ships having the length 60 ≤ L < 80 m;
up to 1,1	for dry cargo ships, bulk carriers, special purpose ships, supply vessels, fishing vessels and ro-ro ships;
up to 1,2	for ships for carriage of heavy bulk cargoes, ore carriers, ore or oil carriers and oil or bulk dry cargo carriers;
up to 1,3	for oil tankers and container ships.

For ships not listed above, the factor T is determined in agreement with the Register.

It is assumed in the calculation that the controlled weld length is 0,5 m.

~~The scope of the non-destructive testing of welded joints using the radiographic or ultrasonic testing for type ships (when applying the manufacture of new products, and also during repair, modification and conversion) may be increased as compared to the values determined by Formula (3.3.1) and given in Table 3.3.1 by the Register or designer's demand.~~

When specifying the areas subject to radiographic or ultrasonic examination, particular attention shall be paid to testing welds in highly stressed areas and welds in material class II and III structures in accordance with 1.2.3.7, Part II "Hull".

The scope of non-destructive testing shall include areas of radiographic and ultrasonic testing of welded joints, as follows:

welded joints in highly stressed areas, critical structural areas;

welded joints in cyclical loads areas;

other important (load-bearing) structural elements;

welds which are inaccessible or very difficult to inspect in service;

field erected welds;

suspected problem areas.

In view of the above, radiographic or ultrasonic checkpoints shall be considered for block construction (block-to-block and intersectional) welds and sectional welds.

Welds control scheme (testing plan) shall be available only to the personnel responsible for radiographic and ultrasonic testing of welds.

Where structural elements are welded into a rigid contour into cutouts with the ratio of the minimum dimension (width) or diameter of cutout to a ~~shell~~ plate thickness of 60 and less), the fully penetrated butt and tee-joints of the main hull ~~plating~~ shall be checked along their entire length, and the remaining structures, to the extent of at least 20 % of their length using the radiographic or ultrasonic testing (for thicknesses from 8 mm and above). Main hull of a ship is the ship's hull bounded by the upper deck.

The radiographic or ultrasonic testing of the welded joints of the structures subjected to treatment under pressure (bending, stamping, etc.) shall be executed along the entire length of the welded joints of these structures after treatment under pressure. When the structures are subjected to heat treatment after treatment under pressure, the radiographic or ultrasonic testing shall be carried out thereafter.".

Para 3.3.9 is amended as follows:

"**3.3.9** For the purpose of conversion and repair of ships ~~and craft,~~ the number of controlled weld lengths of boilers, pressure vessels and heat exchangers is determined ~~by the Register~~ proceeding from the scope of welding and the importance of structures ~~bearing the above in mind~~ in accordance with Table 3.3.3, and pipeline welds — in accordance with Table 3.3.4. The scope of non-destructive testing of hull structures is determined in accordance with requirements of 5.1.15, Annex 2 of the Annexes to the Rules for the Classification Surveys of Ships in Service.".

PART XVI. STRUCTURE AND STRENGTH OF FIBER-REINFORCED PLASTIC SHIPS

5 HULL STRENGTH AND SUPERSTRUCTURES

5.5 LOCAL HULL STRENGTH

Para 5.5.17 is deleted.

PART XVII. DISTINGUISHING MARKS AND DESCRIPTIVE NOTATIONS IN THE CLASS NOTATION SPECIFYING STRUCTURAL AND OPERATIONAL PARTICULARS OF SHIPS

2 TECHNICAL REQUIREMENTS FOR ESCORT TUGS

2.1 GENERAL

Para 2.1.3 is replaced with the following text:

"**2.1.3 Technical documentation.**
Technical documentation specified in 3.2.17.1 of Part I "Classification" shall be submitted to the Register for review to confirm compliance with the requirements for escort tugs and to assign the distinguishing mark **Escort tug** in the class notation.".

Para 2.1.3.1 is deleted.

3 REQUIREMENTS FOR THE EQUIPMENT OF SHIPS IN COMPLIANCE WITH THE DISTINGUISHING MARKS ECO AND ECO-S IN THE CLASS NOTATION

3.1 GENERAL

Para 3.1.1.4 is amended as follows:

"**.4** Regulation (EU) No. 1257/2013 of the European Parliament and of the Council of 20 November 2013 on Ship Recycling and Hong Kong International Convention for the Safe and Environmentally Sound Recycling of Ships, 2009 (the Hong Kong Convention);".

3.4 CERTIFICATES AND TECHNICAL DOCUMENTATION REQUIRED FOR ASSIGNING THE DISTINGUISHING MARKS ECO OR ECO-S IN THE CLASS NOTATION

Para 3.4.2 is amended as follows:

"**3.4.2 Operating procedures and the ship's technical documentation in respect of air pollution prevention:**
.1 approved Technical File of the engine on the NO_x emission for each engine subject to survey in accordance with the NO_x Technical Code, including the engine fitted with NO_x-reducing device as an engine component;
.2 approved EGCS — SO_x Technical Manual (ETM) (where applicable);

~~**.3** drawings of any exhaust gas cleaning system which shall be approved in compliance with the IMO Guidelines;~~

~~**.4**~~**3** approved Onboard Monitoring Manual (OMM) (where applicable);

~~**.5**~~**4** approved SO_x Emission Compliance Plan (SECP) (where applicable);

~~**.6**~~**5** Record Book of SO_x-Reducing Device Parameters;

~~**.7**~~**6** approved documentation on the ship's fuel oil system confirming possibility of ready change over to low-sulphur content fuel oil when approaching SO_x emission control areas established under Annex VI to MARPOL 73/78 or Directive 99/32/EU accordingly (where applicable);

~~**.8**~~**7** procedure for preparing the ship's fuel oil system for operation in the SO_x emission control area (SECA) (where applicable);

~~**.9**~~**8** Fuel Oil Management Plan, Fuel Oil Record Book;

~~**.10** incinerator systems diagram;~~

~~**.11**~~**9** refrigerating operations management procedure;

~~**.12** refrigerating systems diagrams, list of refrigerants used;~~

~~**.13** fire-fighting systems diagrams, list of fire extinguishing media used in these systems;~~

~~**.14**~~**10** Volatile Organic Compound (VOC) Management Plan;

~~**.15** Energy Efficiency Design Index (EEDI) Technical File (where applicable);~~

~~**.16**~~**11** Ship Energy Efficiency Management Plan (SEEMP)~~.~~;

.12 technical documentation specified in 3.2.17.2.1 of Part I "Classification".".

Para 3.4.3.6 is amended as follows:

"**.6** Certificate on Inventory of Hazardous Materials (for the ships covered by the requirements of the Regulation (EU) No. 1257/2013 of the European Parliament and of the Council of 20 November 2013 on Ship Recycling and operating under the EU flag) or Statement of Compliance (for ships flying flags other than EU flags, calling ports or at anchorage within EU states) and/or International Certificate on the Inventory of Hazardous Materials or, if applicable, Statement on Inventory of Hazardous Materials (for ships covered by the Hong Kong ~~International~~ Convention ~~for the Safe and Environmentally Sound Recycling of Ships, 2009, if no documents shall be issued under the Regulation (EU) No. 1257/2013 of the European Parliament and of the Council of 20 November 2013 on Ship Recycling~~), issued upon the results of the ship survey in compliance with the provisions of relevant conventions, regulations.

The documents mentioned above shall be supplemented by Part I of the Inventory of hazardous materials. The Certificate/Statement with Part I of the Inventory of hazardous materials shall be permanently available on board throughout the ship's operating life. Part I of the Inventory of hazardous materials shall be kept updated and appropriately revised, especially after any repair, ship conversion or sale.

The following documents shall be available on board to confirm the readiness for recycling:

Ready for recycling certificate (in accordance with the Regulation (EU) No. 1257/2013 of the European Parliament and of the Council of 20 November 2013 on Ship Recycling); or

International Ready for Recycling Certificate or, if applicable, Ready for recycling statement (in compliance with the requirements of the Hong Kong ~~International~~ Convention ~~for the Safe and Environmentally Sound Recycling of Ships, 2009, and on the grounds of authorization from the Maritime Administration~~).

The documents mentioned above shall be drawn up upon the results of the final survey in accordance with the applicable provisions of the conventions, EU regulation;".

Para 3.4.4 is amended as follows:

"**3.4.4 Operating procedures and the ship's technical documentation in respect of marine environment pollution prevention:**

~~**.1** the ship's general arrangement plan and tanks plan;~~

~~**.2** approved documentation confirming compliance of the oil tanker with the requirements for double hull construction in accordance with regulation 19 of Annex I to MARPOL 73/78;~~

~~**.3** approved documentation confirming compliance of the ship with the requirements for protective location of fuel oil tanks (refer to 3.5.3.9.3 — 3.5.3.9.5 and 3.6.3.9.2);~~

.41 approved Shipboard Oil Pollution Emergency Plan or Shipboard Marine Pollution Emergency Plan (for Oil and Noxious Liquid Substances) considering regulation 37.4 of Annex I to MARPOL 73/78 in relation to fast access to computerized shore-based software for calculation of damage stability and residual structural strength, as well as Oil Record Book of Parts I and II (regulations 17 and 36 of Annex I to MARPOL 73/78);

.52 approved Shipboard Marine Pollution Emergency Plan for Noxious Liquid Substances (regulation 17 of Annex II to MARPOL 73/78), approved Procedures and Arrangement Manual (regulation 14 of Annex II to MARPOL 73/78) and Cargo Record Book (regulation 15 of Annex II to MARPOL 73/78);

.63 approved Transfer of Oil Cargo between Oil Tankers at Sea (STS Operations) Plan (for oil tankers, where available);

.74 approved Ballast Water Management Plan;

~~**.8** approved The ship's Guidelines for Safe Water Ballast Exchange at Sea (where applicable);~~

.95 Ballast Water Record Book;

.**10**6 approved the ship's software for planning water ballast exchange at sea (where applicable);

.117 Biofouling Management Plan and Biofouling Record Book in compliance with IMO resolution MEPC.207(62);

.128 Sewage Management Plan and procedure for sewage record keeping;

~~**.13** sewage system diagram and sanitary and domestic waste waters system diagram;~~

.149 procedure for keeping records on detection and elimination of impermissible operating leakages of petroleum products i.e. fuel oil, hydraulic oil, etc.;

~~**.15** diagrams of manifolds in cargo areas, as well as branch pipes and flanges for fuel oil and oil bunkering, oil residues and oily water discharge indicating the trays and appliances for prevention of spillage of Oil and Noxious Liquid Substances carried in bulk;~~

~~**.16** diagrams and drawings of fuel oil system, bilge system, oil discharge, monitoring and control system for ballast and flushing water, ballast water system;~~

.1710 Garbage Management Plans, placards and Garbage Record Book, diagrams and drawing of equipment for the prevention of pollution by garbage~~.~~;

.11 technical documentation specified in 3.2.17.2.2 of Part I "Classification".".

3.6 TECHNICAL REQUIREMENTS FOR ASSIGNING THE DISTINGUISHING MARK ECO-S IN THE CLASS NOTATION

Para 3.6.4 is amended as follows:

"**3.6.4 Prevention of pollution at ship recycling.**

The ships covered by the requirements of the Regulation (EU) No. 1257/2013 of the European Parliament and of the Council of 20 November 2013 on Ship Recycling and/or the Hong Kong Convention shall carry onboard Certificate on Inventory of Hazardous Materials

or Statement of Compliance or International Certificate on the Inventory of Hazardous Materials or Statement on Inventory of Hazardous Materials, as applicable. ~~Other ships shall carry onboard Statement on Inventory of Hazardous Materials in accordance with the requirements of the Hong Kong International Convention for the Safe and Environmentally Sound Recycling of Ships, 2009.~~ The documents mentioned above shall be drawn up according to the requirements in 3.4.3.6.".

3.5 TECHNICAL REQUIREMENTS FOR ASSIGNING THE DISTINGUISHING MARK ECO IN THE CLASS NOTATION

Para 3.5.3.6.5 is amended as follows:

"**3.5.3.6.5** All sewage discharges, whether to sea or to shore-based reception facilities shall be recorded in compliance with ~~3.4.4.12~~ 3.4.4.8 with indication of date, location and quantity of sewage discharged. In cases where untreated sewage is discharged to sea, the record shall include information on the ship's speed which shall correspond to the approved rate of discharge and the distance to the nearest shore (more 12 nautical miles[1]) at the moment of discharge.".

4 REQUIREMENTS FOR THE EQUIPMENT OF SHIPS IN COMPLIANCE WITH THE DISTINGUISHING MARK ANTI-ICE IN THE CLASS NOTATION

4.1 GENERAL

Para 4.1.3.1 is replaced by the following text:

"**4.1.3.1** Technical documentation specified in 3.2.17.3 of Part I "Classification" shall be submitted to the Register for review to confirm compliance with the requirements for ships, which design and equipment ensures effective icing protection and to assign the distinguishing mark **ANTI-ICE** in the class notation.".

5 REQUIREMENTS FOR THE EQUIPMENT OF OIL TANKERS FOR CARGO OPERATIONS WITH OFFSHORE TERMINALS

5.1 GENERAL

Para 5.1.3.1 is replaced by the following text:

"**5.1.3.1** Technical documentation specified in 3.2.17.4 of Part I "Classification" shall be submitted to the Register for review to confirm compliance with the requirements for oil tankers equipped for cargo operations with offshore terminals and to assign the distinguishing marks **BLS-SPM, BLS** or **SPM** in the class notation.".

New para 5.1.3.2 is introduced reading as follows:

"**5.1.3.2** BLS Operating Manual shall be provided on board of the ship equipped with the bow loading system (BLS).".

Existing para 5.1.3.2 and references thereto are renumbered **5.1.3.3** accordingly.

6 REQUIREMENTS FOR HELICOPTER FACILITIES

6.1 GENERAL

Para 6.1.1.4 is replaced by the following text**:**

"6.1.1.4 Fulfilment of the requirements of this Section does not exempt from compliance with the International Civil Aviation Organization (ICAO) and national requirements of a Flag State (if any) for ensuring safe operation of helicopters, at the stages of design, manufacture, confirmation of compliance, testing and operation of helicopter facilities.".

Para 6.1.3.1 is replaced by the following text:

"**6.1.3.1** Technical documentation specified in 3.2.17.5 of Part I "Classification" shall be submitted to the Register for review to confirm compliance with the requirements for helicopter facilities of ships and fixed offshore platforms and to assign one of the distinguishing marks **HELIDECK, HELIDECK-F** or **HELIDECK-H** in the class notation.".

6.2 HELIDECK DESIGN

Para 6.2.1 is replaced by the following text:

"**6.2.1** Helideck arrangement with regard to ensuring the horizontal and vertical sectors for helicopter approach, takeoff and landing shall be determined in accordance with the requirements of ICAO and aviation regulations of a Flag State (if any).".

6.5 SYSTEMS AND PIPING

Para 6.5.1.1 is replaced by the following text:

"**6.5.1.1** This chapter contains general requirements for shipboard helicopter refuelling systems with regard to their design and location on the ship. In terms of bunkering, storage, cleaning, quality control and fuel transfer, the Flag State aviation regulations shall be applied.".

6.6 ELECTRICAL EQUIPMENT

Chapter 6.6 is replaced by the following text:

"6.6 ELECTRICAL EQUIPMENT

6.6.1 General requirements.

6.6.1.1 Electrical equipment and electric wiring of hangars and spaces where helicopter refuelling and maintenance facilities are located shall comply with the requirements of 2.9, Part XI "Electrical Equipment".

6.6.1.2 The lighting and illumination means for helidecks shall at least provide for the following:

indication of the perimeter (boundaries) of the helideck;

illumination of the landing area;
indication of the elevated structures within the landing area.

6.6.1.3 Lights used for this purpose shall be protected to not lower than level IP56 and shall function reliably under environmental effects mentioned in Section 2, Part XI "Electrical Equipment".

6.6.1.4 All lighting and illumination means as well as other electrical equipment within helicopter refuelling stations and hangars shall be of certified safe type and designed to not lower than the temperature class T3 and subgroup IIA.

6.6.1.5 Lighting characteristics and arrangement shall be determined in accordance with the requirements of ICAO and the Flag State aviation regulations.

6.6.1.6 The lighting and illumination means mentioned in this Chapter shall be fed by uninterruptible power supply (UPS).

6.6.2 Perimeter lights.

6.6.2.1 The lights shall be divided into two independent circuits and supplied in such a manner that when the power to any one circuit fails, 50 % of lights to indicate the perimeter remain functioning.

6.6.3 Illumination of the landing area.

6.6.3.1 The landing area and wind direction indicator shall be properly illuminated. For this purpose, floodlights may be used.

6.6.3.2 Helideck floodlights shall be located so as to avoid glare to pilots during takeoff, landing and maneuvering.

6.6.4 Obstruction/warning lights.

6.6.4.1 To provide flight safety, all considerably elevated structures and items such as superstructure components, drill and production strings, etc. shall be marked by special obstruction/warning red lights.

6.6.4.2 Lights shall be divided into several independent circuits and supplied in such a manner that when power supply to one of the circuits fails, the basic part of the obstruction/warning lights remains functioning.".

6.7 COMMUNICATIONS

Para 6.7.1 is replaced by the following text:

"**6.7.1** List of the radio and meteorological equipment to ensure helicopter operation shall be determined in accordance with the requirements of ICAO and the Flag State aviation regulations (if any).".

7 REQUIREMENTS FOR SHIP EQUIPPED TO ENSURE LONG-TERM OPERATION AT LOW TEMPERATURE

7.1 GENERAL

Para 7.1.3.1 is replaced by the following text:

"**7.1.3.1** Technical documentation specified in 3.2.17.6 of Part I "Classification" shall be submitted to the Register for review to confirm compliance with the requirements for ships equipped to ensure long-term operation at a low temperature and to assign the distinguishing mark **WINTERIZATION(DAT)** in the class notation.".

8 REQUIREMENTS FOR PROPULSION PLANT REDUNDANCY

8.3 TECHNICAL DOCUMENTATION

Para 8.3.1 is replaced by the following text:

"**8.3.1** Technical documentation specified in 3.2.17.7 of Part I "Classification" shall be submitted to the Register for review to confirm compliance with the requirements for propulsion plant redundancy and to assign the distinguishing marks **RP-1, RP-1A, RP-1AS, RP-2** or **RP-2S** in the class notation.".

9 REQUIREMENTS FOR SHIPS EQUIPPED FOR USING GASES OR LOW-FLASHPOINT FUELS

9.1 GENERAL

Para 9.1.1 is replaced by the following text:

"**9.1.1 Scope of application.**

9.1.1.1 The requirements of this Section apply to ships using gases as fuel or other low-flashpoint fuels, with exception of:

.1 gas carriers carrying liquefied natural gas (methane), using cargo as fuel, for which the requirements in respect of the fuel use are given in the Rules for the Classification and Construction of Ships Carrying Liquefied Gases in Bulk and the International Code for the Construction and Equipment of Ships Carrying Liquefied Gases in Bulk (IGC Code);

.2 ships using methanol and ethanol as fuel, for which the requirements are given in Section 23 of this Part.

9.1.1.2 Chapters 9.2 — 9.12 of this Section specify requirements for the ships using natural gas as fuel. Except for ships referred to in 9.1.1.3, ships using gas other than natural gas as fuel or other low-flashpoint fuels, the level of safety shall be ensured equivalent to the requirements of this Section, which shall be confirmed during the engineering analysis, evaluation and approval of alternative design and arrangement, in accordance with 9.1.6.

9.1.1.3 For gas carriers designed for carrying liquefied gases in bulk, using cargo other than natural gas (methane) as fuel or other low-flashpoint fuels, the level of safety in respect of the fuel use shall be ensured equivalent to the requirements of the Rules for the Classification and Construction of Ships Carrying Liquefied Gases in Bulk and IGC Code, which shall be confirmed during the engineering analysis, evaluation and approval of alternative design and arrangement in accordance with 9.1.6.

9.1.1.4 Except for ships referred to in 9.1.1.3, in addition to the requirements of this Section, ships using gases as fuel or other low-flashpoint fuels shall comply with the requirements of the International Code of Safety for Ships Using Gases or Other Low-Flashpoint Fuels (IGF Code).

9.1.1.5 In addition to the sea-going ships, the requirements of this Section may be applied to other offshore facilities subject to the RS technical supervision, such as floating oil-and-gas product units, mobile offshore drilling units, fixed offshore platforms. For such facilities it shall also be required to consider the relevant applicable national requirements.".

Para 9.1.2 is amended as follows:

"**9.1.2 Class notation.**

Ships ~~fitted for the use of~~ equipped for using natural gas as fuel in compliance with this Section are assigned the distinguishing mark **GFS** (Gas Fuelled Ship) added to the character of classification.

Note. The distinguishing mark **GFS** shall also be added to the character of classification for gas carriers carrying liquefied natural gas (methane), using cargo as fuel and complying with the relevant requirements of the Rules for the Classification and Construction of Ships Carrying Liquefied Gases in Bulk (refer to 9.1.1.1.1 of this Part and 2.2.29 of Part I "Classification").

Ships for which the use of gas other than natural gas or other low-flashpoint fuel is approved in accordance with 9.1.1.2 or 9.1.1.3 shall have an entry into Section "Other characteristics" of the Classification Certificate specifying the fuel for which the ship is equipped.".

Para 9.1.4 is replaced by the following text:

"**9.1.4** Technical documentation specified in 3.2.17.8 of Part I "Classification" shall be submitted to the Register for review to confirm compliance with the requirements for ships equipped for using gases or low-flashpoint fuels and to assign the distinguishing mark **GFS** in the class notation.".

New para 9.1.5 is introduced reading as follows:

"**9.1.5 Risks analysis.**

9.1.5.1 A risk assessment shall be conducted in accordance with IACS Rec. No. 146 (Aug 2016) (the document is available on the IACS website (www.iacs.org.uk)), to ensure that risks arising from the use of low-flashpoint fuels affecting persons on board, the environment, the structural strength or the integrity of the ship are addressed. Consideration shall be given to the hazards associated with physical layout, operation and maintenance, following any reasonably foreseeable failure.

9.1.5.2 The risks shall be analysed using acceptable and recognized risk analysis techniques, and loss of function, component damage, fire, explosion and electric shock shall as a minimum be considered. The analysis shall ensure that risks are eliminated wherever possible.

Risks which cannot be eliminated shall be mitigated as necessary. Details of risks, and the means by which they are mitigated, shall be documented and submitted to the Register for the review.

The results of risks analysis shall be taken into account in the ship's operational documentation.

New para 9.1.6 is introduced reading as follows:

"**9.1.6 Alternative design and arrangements.**

9.1.6.1 Appliances and arrangements of low-flashpoint fuel systems may:

deviate from the requirements of this Section or the requirements referred to in 9.1.1.1.1 (as applicable); or

be designed for using gas other than natural gas as fuel, or using fuels other than ones referred to in 9.1.1.1.2.

Such appliances and arrangements can be used provided that they satisfy the intent of the relevant requirements and ensure the level of safety equivalent to such requirements.

In such cases, the engineering analysis, evaluation and approval of alternative appliances and arrangements shall be carried out in compliance with 9.1.6.2 — 9.1.6.6.

9.1.6.2 The engineering analysis shall be prepared on the basis of the Guidelines on Alternative Design and Arrangements (refer to IMO circular MSC.1/Circ.1212 as amended) and submitted to the Register for review.

9.1.6.3 The engineering analysis shall include, as a minimum, the following elements:

.1 determination of the ship type, machinery installations, electrical equipment and low-flashpoint fuel storage and distribution systems and space(s) concerned;

.2 identification of the prescriptive requirement(s), from which the machinery installations, electrical equipment and low-flashpoint fuel storage and distribution systems will deviate;

.3 identification of the reason for deviation of proposed design from the prescriptive requirements, considering its compliance with other technical standards recognized by the Register;

.4 determination of the performance criteria for the ship, machinery installation, electrical equipment and low-flashpoint fuel storage and distribution systems or the space(s) considered in the relevant prescriptive requirement(s);

.4.1 performance criteria shall provide the level of safety not lower than the relevant prescriptive requirements contained in this Section and IGF Code or in the Rules for the Classification and Construction of Ships Carrying Liquefied Gases in Bulk and IGC Code (as applicable);

.4.2 performance criteria shall be subject to quantitative analysis and measurement;

.5 detailed description of the alternative design and arrangements, including a list of the assumptions used in the design and any proposed operating limitations and conditions;

.6 technical justification demonstrating that the alternative design and arrangements satisfy the safety performance criteria; and

.7 risk assessment based on identification of possible failures and hazards associated with the proposal.

9.1.6.4 The engineering analysis required in 9.1.6.3 shall be assessed and approved by the Register.

9.1.6.5 Copies of the documents approved by the Register, indicating that the alternative design and arrangements comply with the Rules, shall be kept on board.

9.1.6.6 If the assumptions and operating limitations indicated in the description of the alternative design and arrangements are changed, then under the changed conditions the engineering analysis shall be carried out and approved by the Register.".

9.2 GENERAL REQUIREMENTS FOR SHIP STRUCTURE

Para 9.2.4.11 is amended as follows:

"**9.2.4.11** Requirements for fuel preparation room design.

Fuel preparation rooms shall be located on the open deck or within an open space unless those rooms are arranged and fitted in accordance with the requirements ~~for tank connection spaces~~ of 9.2.4.12.

In such case, regardless of the room location the following requirements shall be complied with:

.1 fuel preparation room~~, regardless of location,~~ shall be arranged to safely contain cryogenic leakages;

.2 material of the boundaries of the fuel preparation room shall have a design temperature corresponding with the lowest temperature it can be subjected to in a probable

maximum leakage scenario unless the structures forming the boundaries of the space, i.e. bulkheads and decks, are provided with suitable thermal protection;

.3 a fuel preparation room shall be arranged to prevent surrounding hull structure from being exposed to unacceptable cooling, in case of leakage of cryogenic liquids;

.4 a fuel preparation room shall be designed to withstand the maximum pressure build up during such a leakage. Alternatively, pressure relief venting to a safe location (mast) may be provided.".

New para 9.2.4.12 is introduced reading as follows:

"**9.2.4.12** The location of fuel preparation rooms below deck may be permitted if these rooms are arranged and equipped in accordance with the requirements for tank connection spaces considering the following:

.1 the requirement to have a bolted hatch in such room specified in 9.2.6.3 and the associated zone 2 hazardous area requirement according to 9.11.2.4 do not apply to a fuel preparation room located below deck unless that space can also be defined as a tank connection space using the definition in 9.1.3;

.2 a fuel preparation room opening into another enclosed space on the ship which is a non-hazardous space shall be fitted with an airlock according to 9.2.7;

.3 a fuel preparation room with direct access onto an open deck, or to a semi-enclosed space on deck, does not require an airlock. In the absence of an airlock, the area outside the door shall be classified as a hazardous area according to 9.11.2.3 and 9.11.2.4;

.4 the requirements of 9.10.2.4 apply to a fuel preparation room located below deck if such room contains sources of fuel release in the liquid phase.".

Para 9.2.7.3 is amended as follows:

"**9.2.7.3** The airlock shall be designed in a way that no gas can be released to safe spaces in case of the most critical event in the gas-dangerous space separated by the airlock. The events shall be evaluated in the risk analysis ~~according to 9.1.4.20~~ and shall be indicated in the documentation specified in 3.2.17.8.22 of Part I "Classification".".

11 REQUIREMENTS FOR LNG BUNKERING SHIPS

11.2 TECHNICAL DOCUMENTATION

Para 11.2.1 is replaced by the following text:

"**11.2.1** Technical documentation specified in 3.2.17.9 of Part I "Classification" shall be submitted to the Register for review to confirm compliance with the requirements for LNG bunkering ships and to assign the descriptive notation **LNG bunkering ship** in the class notation.".

12 REQUIREMENTS FOR SHIPS FOR COMPLIANCE WITH THE DISTINGUISHING MARK IWS IN THE CLASS NOTATION

12.2 TECHNICAL DOCUMENTATION

Chapter 12.2 is replaced by the following text:

"**12.2 TECHNICAL DOCUMENTATION**

12.2.1 Technical documentation specified in 3.2.17.10 of Part I "Classification" shall be submitted to the Register for review to confirm compliance with the requirements of this Section and to assign the distinguishing mark **IWS** in the class notation.".

12.2.2 The Register approved documentation, specified in 3.2.17.10 of Part I "Classification" shall be kept on board the ship and shall be available to RS surveyor and other responsible personnel during an in-water survey.".

13 ADDITIONAL REQUIREMENTS FOR SHIPS OF SPECIAL TYPES

13.3 ANCHOR HANDLING VESSELS

Para 13.3.2 is replaced by the following text:

"**13.3.2 Documentation.**

Technical documentation specified in 3.2.17.11 of Part I "Classification" shall be submitted to the Register for review to confirm compliance with the requirements for anchor handling vessels (the anchor handling, heaving up, and shifting) and to assign the descriptive notation **Anchor handling vessel** in the class notation.".

Paras 13.3.2.1 — 13.3.2.11 are deleted.

Para 13.3.4.1 is amended as follows:

"**13.3.4.1** Design loads of ~~arrangements specified in 13.3.2.3 to 13.3.2.5~~ anchor chain stoppers, towing pins and stern rollers shall be assumed in compliance with 5.4.2.2 of Part III "Equipment, Arrangements and Outfit". In such case, the stress in these components shall not exceed 0,8 yield strength of their material.".

14 REQUIREMENTS FOR SHIPS PREPARED FOR CONVERSION FOR THE USE OF GAS FUEL

14.4 TECHNICAL DOCUMENTATION

Chapter 14.4 is replaced by the following text:

"**14.4 TECHNICAL DOCUMENTATION**

14.4.1 Technical documentation specified in 3.2.17.8 of Part I "Classification" for ships with the distinguishing mark **GRS** as well as information related to the ship’s conversion as

per 3.2.17.12, "Classification" shall be submitted to the Register for review to confirm compliance with the requirements for ships prepared for conversion for the use of gas fuel and to assign the distinguishing mark **GFS** in the class notation.".

17 REQUIREMENTS FOR SHIPS EQUIPPED WITH HULL STRENGTH AND STABILITY MONITORING SYSTEMS

17.5 TECHNICAL DOCUMENTATION

Para 17.5.1 is replaced by the following text:

"**17.5.1** Technical documentation specified in 3.2.17.14 of Part I "Classification" shall be submitted to the Register for review to confirm compliance with the requirements for ships equipped with the automated monitoring system of hull strength and/or current stability and to assign the distinguishing mark **HMS** in the class notation.".

Para 17.5.2 is deleted.

Paras 17.5.3 — 17.5.7 and references thereto are renumbered **17.5.2 — 17.5.6** accordingly.

17.8 MEASURING CHANNELS AND MEASURING COMPONENTS

Para 17.8.6.3 is amended as follows:

"**17.8.6.3** The value of the base length of the measuring component for longitudinal and transverse bending shall be taken based on the design values of the maximum permissible the ship's hull deformation in the control area.

The maximum permissible hull deformation shall be determined based on the strength provision as per 1.4 and 3.1.4.1 (where applicable) of Part II "Hull" taking into consideration the actual section modulus of the hull in way of the sensor location and shall be specified in the Monitoring system operation manual ~~documentation required by 17.5.1.10~~.".

18 INDOOR HYGIENE AND SANITARY CONDITIONS

18.1 INDOOR CLIMATE

Para 18.1.3 is replaced by the following text:

"**18.1.3 Documentation.**

Technical documentation specified in 3.2.17.15 of Part I "Classification" shall be submitted to the Register for review to confirm compliance with the requirements for indoor climate and to assign the distinguishing mark **COMF(C)** in the class notation.".

On completion of the construction of the ship or later, but before a ship is put into service, measurement of climate parameters in all spaces specified in the measurement program taking into account 8.1.4 shall take place under the operating conditions. Measurement results shall be submitted to the Register for information in the form of a survey report.".

18.2 NOISE LEVEL IN SHIP'S SPACES

Para 18.2.3.1 is amended as follows:

"**18.2.3.1** ~~In addition to technical documentation specified in Section 3 of Part I "Classification", a measurement program shall be submitted to the RS Branch Office carrying out technical supervision during construction of a ship for approval prior to the commencement of the sea trials.~~Technical documentation specified in 3.2.17.15 of Part I "Classification" shall be submitted to the Register for review to confirm compliance with the requirements for a noise level in the ship's spaces and to assign the distinguishing mark **COMF(N-1,2,3), (N-S)** in the class notation.

On completion of the construction of the ship, but before a ship is put into service, measurement of noise levels in all spaces specified in the measurement program taking into account 18.2.5 or 18.2.6 (as applicable) shall take place under the operating conditions at sea trials and in port (refer to 3.3 and 3.4 of the Code). Measurement results shall be submitted to the ~~RS Branch Office~~ Register for information in the form of a noise survey report.".

18.3 SANITARY VIBRATION LEVEL IN SHIP'S SPACES

Para 18.3.3 is amended as follows:

"**18.3.3 Documentation.**

~~In addition to technical documentation specified in Section 3 of Part I "Classification", a measurement program shall be submitted to the RS Branch Office carrying out technical supervision during construction of a ship for approval. Measurement results shall be submitted to the RS Branch Office for information.~~

Technical documentation specified in 3.2.17.15 of Part I "Classification" shall be submitted to the Register for review to confirm compliance with the requirements for a sanitary vibration level in the ship's spaces and to assign the distinguishing mark **COMF(V-1,2,3)** in the class notation.

On completion of the construction of a ship or later, but before the ship is put into service, measurement of sanitary vibration levels in all spaces specified in the measurement program with regard for 18.3.4 or 18.3.5 shall take place under the operating conditions. Measurement results shall be submitted to the Register for information in the form of a survey report.".

20 REQUIREMENTS FOR SHIPS FITTED FOR LONG-TERM OPERATION WITHOUT DRY-DOCKING AND DESIGNED IN SUCH A WAY AS TO PROVIDE THE POSSIBILITY OF IN-WATER SURVEY

20.2 TECHNICAL DOCUMENTATION

Para 20.2.1 is replaced by the following text:

"**20.2.1** Technical documentation specified in 3.2.17.16 of Part I "Classification" shall be submitted to the Register for review to confirm compliance with the requirements for ships designed for long-term operation without dry-docking, with a possibility of in-water survey, and to assign one of the distinguishing marks **UWILD** or **UWILD-S** in the class notation.".

In addition to the technical documentation specified in 3.2.17.16 of Part I "Classification", a draft programme for in-water survey including the use of underwater television, with regard for the structural particulars of a ship shall be submitted for approval to the RS Branch Office

involved in technical supervision during construction. The draft programme shall define and substantiate the periods between in-water surveys using underwater television if they differ from those specified in 2.5 of Part II "Survey Schedule and Scope" of the Rules for the Classification Surveys of Ships in Service.".

20.3 TECHNICAL REQUIREMENTS

Para 20.3.1.4.1 is amended as follows:

"**20.3.1.4.1** The in-water survey shall be performed in due dates in compliance with the applicable requirements of Section 9 of Part II "Carrying out Classification Surveys of Ships" of the Guidelines on Technical Supervision of Ships in Service and Annex 1 thereto with account for the ~~RS-approved~~ RS-agreed draft programme for in-water survey using underwater television (refer to ~~20.2.1.7~~ 20.2.1)."

21 REQUIREMENTS FOR SHIPS AND OFFSHORE INSTALLATIONS EQUIPPED WITH POSITION-KEEPING/POSITION MOORING SYSTEMS

21.2 TECHNICAL DOCUMENTATION

Para 21.2.1 is amended as follows:

"**21.2.1** ~~To assign the distinguishing marks according to 21.1, the technical documentation in the scope specified in Section 4 of Part I "Classification" (as applicable) and Section 4 of Part III "Equipment, Arrangements and Outfit" of the Rules for the Classification and Construction of MODU shall be submitted to the Register for review and approval (agreement).~~Technical documentation specified in 3.2.17.17 of Part I "Classification" shall be submitted to the Register for review to confirm compliance with the requirements for ships equipped with position-keeping/position mooring systems and to assign one of the distinguishing marks **POSIMOOR** or **POSIMOOR-TA** in the class notation.".

22 ADDITIONAL REQUIREMENTS FOR MONITORING OF CRITICAL STRUCTURAL AREAS

Para 22.3.1 is amended as follows:

"**22.3.1** To assign the distinguishing mark **CON-M**, the critical structural areas monitoring plan (hereinafter referred to as Construction Monitoring Plan, refer to ~~3.2.2.24 or 3.4.1.16~~ 3.2.17.18 of Part I "Classification") shall be submitted to the Register prior to the commencement of ship construction. The plan is subject to review for compliance with 22.3.2 taking into account the shipbuilding quality standards for the hull structure agreed during the kick-off meeting according to the Guidelines on Technical Supervision of Ships under Construction, as well the Ship Structure Access Manual approved by the Register, which contains the full list of critical areas/locations identified by the designer as the result of the strength and fatigue design assessment of the project.".

23 REQUIREMENTS FOR SHIPS EQUIPPED TO USE METHANOL/ETHANOL AS FUEL

23.1 GENERAL

Para 23.1.3 is replaced by the following text:

"**23.1.3 Technical documentation.**
Technical documentation specified in 3.2.17.19 of Part I "Classification" shall be submitted to the Register for review to confirm compliance with the requirements for ships equipped to use methanol/ethanol as fuel and to assign one of the distinguishing marks **LFLFS (Me)** or **LFLFS (Et)** in the class notation.".

24 REQUIREMENTS FOR SHIPS CARRYING CONTAINERS AND FOR GENERAL CARGO SHIPS WITH PARTIALLY OR COMPLETELY HATCHCOVERLESS CARGO HOLDS

24.3 TECHNICAL DOCUMENTATION

Para 24.3.1 is replaced by the following text:

"**24.3.1** Technical documentation specified in 3.2.17.20 of Part I "Classification" shall be submitted to the Register for review to confirm compliance with the requirements for ships carrying containers and for general cargo ships with partially or completely hatchcoverless cargo holds and to assign the distinguishing mark **Open cargo hatch** in the class notation.".

25 ADDITIONAL REQUIREMENTS FOR SEMI-SUBMERSIBLE (DOCKLIFT) SHIPS AND SHIPS CARRYING HEAVY AND/OR BULKY CARGOS

25.3 TECHNICAL DOCUMENTATION

Para 25.3.1 is replaced by the following text:

"**25.3.1** Technical documentation specified in 3.2.17.21 of Part I "Classification" shall be submitted to the Register for review to confirm compliance with the requirements for semi-submersible (docklift) ships and ships carrying heavy and/or bulky cargos and to assign one of the descriptive notations **Heavy cargo carrier** or **Heavy cargo carrier Semi-submersible ship**.".

27 REQUIREMENTS FOR TANKERS EQUIPPED WITH AN EFFECTIVE CARGO TANK WASHING SYSTEM

Para 27.4 is replaced by the following text:

"**27.4** Technical documentation specified in 3.2.17.22 of Part I "Classification" shall be submitted to the Register for review to confirm compliance with the requirements for ships with descriptive notations listed in 27.1.1 equipped with an effective cargo tank washing system and to assign the distinguishing mark **ETW** in the class notation.".

29 REQUIREMENTS FOR CONTAINER SHIPS AND OTHER SHIPS OF 500 GROSS TONNAGE AND OVER DESIGNED FOR CARRIAGE OF CONTAINERS AND FITTED WITH ADDITIONAL FIRE-FIGHTING MEANS

29.1 GENERAL

Para 29.1.2 is replaced by the following text:

"**29.1.2 Technical documentation.**
Technical documentation specified in 3.2.17.24 of Part I "Classification" shall be submitted to the Register for review to confirm compliance with the requirements for container ships and other ships of 500 gross tonnage and over designed for carriage of containers and fitted with additional fire-fighting means and to assign one of the distinguishing marks **ACFP(P), ACFP(S)** or **ACFP(S,F)** in the class notation.".

Paras 29.1.2.1 and 29.1.2.2 are deleted.

30 REQUIREMENTS FOR CONTAINER SHIPS AND OTHER SHIPS OF 500 GROSS TONNAGE AND OVER INTENDED FOR CARRIAGE OF REFRIGERATED CONTAINERS

30.1 GENERAL

Para 30.1.2.1 is replaced by the following text:

"**30.1.2.1** Technical documentation specified in 3.2.17.25 of Part I "Classification" shall be submitted to the Register for review to confirm compliance with the requirements for container ships and other ships of 500 gross tonnage and over intended for carriage of refrigerated containers and to assign one of the distinguishing marks **RC-C, RC-A, RC-IA** or **RC-E** in the class notation.".

31 REQUIREMENTS FOR OFFSHORE SUPPLY VESSELS INTENDED TO CARRY LIMITED AMOUNT OF HAZARDOUS AND NOXIOUS LIQUID SUBSTANCES IN BULK

31.2 TECHNICAL DOCUMENTATION

Chapter 31.2 is replaced by the following text:

"31.2 TECHNICAL DOCUMENTATION

31.2.1 Technical documentation specified in 3.2.17.26 of Part I "Classification" shall be submitted to the Register for review to confirm compliance with the requirements for offshore supply vessels intended to carry limited amount of hazardous and noxious liquid substances in bulk and to assign the distinguishing mark **HNLS** in the class notation.".

32 REQUIREMENTS FOR OFFSHORE SUPPLY VESSELS WITH SPECIAL EQUIPMENT FOR WELL STIMULATION IN OIL AND GAS FIELDS INSTALLED ON BOARD OR SPECIALLY PREPARED FOR INSTALLATION OF SUCH EQUIPMENT

32.2 TECHNICAL DOCUMENTATION

Chapter 32.2 is replaced by the following text:

"32.2 TECHNICAL DOCUMENTATION

32.2.1 Technical documentation specified in 3.2.17.27 of Part I "Classification" shall be submitted to the Register for review to confirm compliance with the requirements for offshore supply vessels with special equipment for well stimulation in oil and gas fields installed on board or specially prepared for installation of such equipment and to assign one of the distinguishing marks **WSV1** or **WSV2** in the class notation.".

PART XXI. CYBER RESILIENCE

1 GENERAL

1.1 SCOPE OF APPLICATION

Para 1.1.8 is amended as follows:

"**1.1.8** If ships and offshore installations comply with the requirements specified in this Part, except for Section 4, the distinguishing mark **CYBER** given in 2.2.64, Part I "Classification" ~~is~~ may be added to the character of classification.".

New para 1.1.9 is introduced reading as follows:

"**1.1.9** Ships and offshore installations complying with the requirements for the distinguishing mark **CYBER** where, in accordance with Section 4, onboard CBS and information networks have been additionally verified for cyber security by the RS-recognized firm, the distinguishing mark **CYBER-A** given in 2.2.64, Part I "Classification" may be added to the character of classification.".

New Section 4 is introduced reading as follows:

"4 ADDITIONAL REQUIREMENTS FOR SHIPS AND OFFSHORE INSTALLATIONS, WHICH CYBER SECURITY HAS BEEN VERIFIED BY THE RS-RECOGNIZED FIRM

4.1 Requirements of this Section apply to the ships and offshore installations, which cyber security has been verified by the RS-recognized firm, and supplement the requirements of Sections 1—3.

4.2 Verification of cyber security of onboard CBS and networks* by the RS-recognized firm (code 22025000) is performed upon request of the shipowner to detect

* Hereinafter referred to as "the verification".

faults (known vulnerabilities, incorrect configuration, etc.) that may be used to implement threats to the information security, human safety, safety of the ship and cargo, or threats to the environment.

4.3 The verification shall include:

CBS inventory;

review of the CBS documentation and organizational and regulatory documents on cyber resilience;

review of software and hardware/software settings, including information security means;

detection of faults in software and hardware/software, including information security means, by analysis of the installed software and security updates using means of protection monitoring (analysis) and/or other information security means;

detection of faults in software and hardware/software, including information security means, network services available for interaction using means of protection monitoring (analysis).

In case the faults are detected, the system integrator shall implement measures to eliminate these faults and/or reduce the impact from the cyber incidents that may occur due to the detected faults.

4.4 The distinguishing mark **CYBER-A** is assigned to the ship or offshore installation upon verification according to 4.2 and 4.3 based on the report issued by the RS-recognized firm and confirming that there are no faults on the ship, or measures have been implemented on reduction of impact from the cyber incidents that may occur due to the detected faults.".

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