CHINA CLASSIFICATION SOCIETY

RULES FOR CLASSIFICATION OF SEA-GOING STEEL SHIPS

AMENDMENTS

2023

Effective from 1 July 2023

Beijing

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PART ONE
PROVISIONS OF CLASSIFICATION

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Section 2 RULES FOR CLASSIFICATION

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Appendix 1 LIST OF CLASS NOTATIONS FOR SEA-GOING SHIPS

Type Notations① **Table A**

Class notation	Description		Technical requirements②
Yacht	Pleasure craft	A boat used for being engaged in uncommercial entertainment activities such as touring, leisure and sightseeing. High speed yachts are to be assigned the High Speed Yacht notation. Sailing craft constructed in accordance with CCS Guidelines for Survey of Sailing Craft is to be assigned the Sailing Craft notation. According to the structural type, the following notations are to be added respectively: ① Mono-Hull ② Catamaran ③ Multi-hull According to the design category, the following notations are to be added respectively: ① Design Category I（Hs= ×× m）③ ② Design Category II（Hs= ×× m）	Rules for Construction and Classification of Yachts

① For high speed craft complying with the provisions of the Rules for Classification of Sea-going Boats, the suffix (HSC) will be added after the type notation.

② The technical requirements listed in this Table are the basic ones for ships assigned to the notation; in other special cases involving ship types, special consideration is to be given by CCS according to the ship's specific conditions.

③ "H_S=××m" means the design significant wave height corresponding to the design category.

Class notation	Description			Technical requirements[2]
		③ Design Category III（Hs= ×× m） ④ Design Category IV（Hs= ×× m） ⑤ Design Category V（Hs= ×× m）		
Oil FSV fixed at XXX Anchorage	Oil floating storage vessels fixed at anchorage	This notation is to be assigned to oil floating storage vessels (FSV) satisfying the following conditions: ~~(1) a laid-up double hull oil tanker, of which the cargo tanks and relevant systems have oil storage function;~~ ~~(2) a fixed anchorage in restricted marine environment with an offshore distance not exceeding 20 nautical miles~~ (1) Double hull oil tankers not engaged in cargo oil transportation between various ports / locations; (2) Berthing in a dedicated location, which means the sheltered water area designated by the Administration of the coastal State, or an anchorage location that enables the vessels to quickly move away from a severe weather conditions.		Guidelines for ~~Survey of~~ Oil Floating Storage Vessels Fixed at Anchorage
Wave Pierce Craft	Wave piercing craft	A special type of catamaran high speed craft with large aspect ratio and small waterplane area	HSC are ships with maximum speed not less than $3.7\nabla^{0.1667}$ m/s. For passenger ships as defined in 2.1.3.1(18) of Rules for Construction and Classification of Sea-Going High Speed Craft, the service notation Passenger A is to be added after type notation and where such ships are fitted with ro-ro spaces or special category spaces, the notation Ro-Ro Passenger A is to be added. For passenger ships as defined in 2.1.3.1(19) of Rules for Construction and Classification of Sea-Going High Speed Craft, the service notation Passenger B is to be added after type notation and where such ships are fitted with ro-ro spaces or special category spaces, the notation Ro-Ro Passenger B is to be added. For high speed cargo craft, the notation Cargo is to be added after type notation ~~High speed craft the main hull of which is made of fiber reinforced plastics and aluminum alloy materials may be assigned the class notation "FRP" and "ALY" respectively~~	Rules for Construction and Classification of Sea-Going High Speed Craft
Air Cushion Craft	Air cushion craft	High speed craft wholly supported by air cushion		
Surface Effect Ship	High speed surface effect craft (side wall hovercraft)	High speed craft with its air cushion being totally or partially retained by permanently immersed hard structure		
Trimaran HSC	High speed trimaran craft	A vessel with three hulls of displacement form, a main centre hull stabilized by two much smaller side hulls, connected by connection bridge		
Catamaran HSC	High speed catamaran craft	High speed craft with upper parts of two parallel hulls being connected by strength framing		
Mono-Hull HSC	High speed mono-hull craft	High speed craft with a single hull		
Hydrofoil Craft	Hydrofoil craft	Ships supported completely clear above water surface in non-displacement mode by hydrodynamic forces generated on foils		

Service or Service Restriction Notations

Table C

Class notation	Description			Technical requirements
R1	Service category 1	Within 200 (summer / tropical*) or 100 (winter*) n mile off the shore	1.*Seasonal areas as specified in Annex II to the International Convention on Load Lines, 1966. **Sheltered waters include the sea areas between an island and the shore and between islands with a distance of less than 10 n miles in between, which forms a comparatively good sheltered or similar condition with a little wave. 2.Working ships may be assigned service categories applicable for transit and operation respectively, e.g. R2 for Transiting and R3 for Operation. 3. For ships engaged on non-international voyages, notations for service category 1/2/3 are R1(D)/ R2(D)/ R3(D) respectively.	Chapter 0, Pt. 10 of the Rules
R2	Service category 2	Within 20 (summer / tropical*) or 10 (winter*) n mile off the shore		
R3	Service category 3	Sheltered waters**		

Cargo and Loading Characteristics Notations

Table D

Class notation	Description		Technical requirements
NEV Carriage（X）	Carriage of new energy vehicles	The notation is assigned to vehicle carriers and ro-ro passenger ships ro-ro carrying new energy vehicles which comply with the Technical Guidelines for the Safety of Ro-ro Carriage of New Energy Vehicles. X means the type of NEVs, which may be B, H, N, or a combination of them. B stands for lithium battery-powered electric vehicles, H for hydrogen-powered vehicles, and N for natural gas-powered vehicles.	Technical Guidelines for the Safety of Ro-ro Carriage of New Energy Vehicles

Special Features Notations

Table E

Class notation	Description		Technical requirements
Strengthened for Heavy Cargoes	Strengthened for heavy cargoes	Ships with longitudinal framing for strength deck and bottom within cargo area, and double bottom and strengthening for bottom framing within cargo area, may be assigned this notation	Sec. 22, Ch. 2, Pt. 2 of the Rules
MCRS	Corrosion resistant steel	Corrosion resistant steel is used as an alternative to protective coating for cargo oil tanks of crude oil tankers in accordance with IMO resolution MSC.289(87)	Relevant requirements of the Guidelines for Survey of Corrosion Resistant Steel of Cargo Oil Tanks ~~of~~in Crude Oil Tankers
DGP-F	Fire-fighting of dangerous goods in packaged form	This notation is assigned to domestic navigation container ships carrying dangerous goods in packaged form that meet the Guidelines for Fire Fighting and Stowage of Domestic Container Ships Carrying Dangerous Goods in Packaged Form	Guidelines for Fire Fighting and Stowage of Domestic Container Ship Carrying Dangerous Goods in Packaged Form
ALY	Aluminum alloy	This notation is	The following	Guidelines for Structure of

Class notation	Description			Technical requirements
	materials	assigned to ships the main hull of which is made of aluminum alloy materials	sea-going ships of 20 meters and above in length and engaged in restricted service: (1) passenger ship; (2) ferry; (3) traffic ship; (4) public affair ship.	Non-high-speed All-aluminum Alloy Sea-going Ships
			High speed crafts of 20 meters and above in length	Rules for Construction and Classification of Sea-Going High Speed Craft
			Yachts engaged in uncommercial entertainment activities such as touring, leisure and sightseeing	Rules for Construction and Classification of Yachts
FRP	fiber reinforced plastics	This notation is assigned to ships the main hull of which is made of fiber reinforced plastics	High speed craft of 20 meters and above in length	Rules for Construction and Classification of Sea-Going High Speed Craft
			Yachts engaged in uncommercial entertainment activities such as touring, leisure and sightseeing	Rules for Construction and Classification of Yachts

Special Equipment and System Notations **Table G**

Class notation	Description		Technical requirements
~~OMBO~~	~~One man bridge operation~~	~~Arrangement of bridge and wheelhouse together with navigational equipment and system are suitable for one man bridge operated ships~~	~~Ch. 4, Pt. 8 of the Rules~~
BDE-1	Bridge design and equipment	The design and working environment of the bridge and equipment provided for each workstation comply with the basic requirements	Ch. 4, Pt. 8 of the Rules
BDE-2		Ships required to be maneuvered at the workstation for docking on the basis of BDE-1	
BDE-3		Ships provided with the Integrated Bridge System (IBS) in addition to complying with the applicable requirements of BDE-2	
Bow Loading System*	Bow loading system	For oil tankers fitted with bow loading system, this notation may be added	Sec. 9, Ch. 27, Pt. 8 of the Rules
DFD	Dual fuel engines	This notation may be assigned to liquefied gas carriers fitted with dual fuel engines in compliance with the requirements of the Guidelines for Design and Installation of Gas Fuel Engine Systems of Liquefied Gas Carriers	Guidelines for Design and Installation of Gas Fuel Engine Systems of Liquefied Gas Carriers
GF	Gas fuel only engine	This notation may be assigned to liquefied gas carriers fitted with gas fuel only engines in compliance with the requirements of the Guidelines for Design and Installation of Gas Fuel Engine Systems of Liquefied Gas Carriers	Guidelines for Design and Installation of Gas Fuel Engine Systems of Liquefied Gas Carriers
Natural Gas Fuel	Using natural gas fuels	The notation may be assigned to the ships of which the main propulsion and/or auxiliary machinery uses natural gas or natural gas and oil fuel as a fuel, except for liquefied gas carriers	Rules for Ships Using Natural Gas Fuels
DFDR	Natural gas fuel ready system	A ship assigned with the class notation of DFDR may has one or more suffix(es) of X_N. The meanings of X_N are as follows: H: the hull structures have been strengthened in	Guidelines for Natural Gas Fuel Ready Ships

		accordance with the relevant requirements of natural gas fuel powered ships T: the natural gas fuel containment system (bunkers/fuel tanks) and its supporting members have been installed M: the main engine installed in ship's construction is a dual fuel engine m: main engine installed in ship's construction may be converted to a dual fuel engine in future A: the auxiliary engine installed in ship's construction is a dual fuel engine a: the auxiliary engine installed in ship's construction may be converted to a dual fuel engine in future B: the boiler installed in ship's construction is a dual fuel boiler P: the arrangement in ship's construction has been considered the approaching installation of natural gas fuel supply system and related to, including the arrangement of piping, bunkering station, compressor room, gas valve unit, fire-fighting system, etc. E: the power distribution system has been reserved for the equipment related to natural gas fuel powered system in ship's construction D: the gas dangerous zones have been taken into consideration in ship's construction	
SEC(EGCS)	SOx emission control (exhaust gas cleaning system)	Ships installed with the EGC systems for reduction of SOx emission can be assigned with SEC(EGCS) notation	Guidelines for Design and Installation of Exhaust Gas Cleaning Systems
EGC Ready (X)	Exhaust gas cleaning systems (EGC) Ready	For EGC Ready (X) class notation, the symbol X stands for the type of the EGC system, including: (1) dry desulfurization system, expressed by the capital letter D; (2) open loop exhaust gas cleaning system, expressed by the capital letter O; (3) closed loop exhaust gas cleaning system, expressed by the capital letter C; (4) open-closed hybrid composite system, expressed by the capital letter H. X is to be replaced by one of the four letters above based on the type of the EGC system intended to be installed	Guidelines for Exhaust Gas Cleaning System Ready
LSDF	Low sulphur distillate fuel	Ships intended to use low sulphur distillate fuel with sulphur content not exceeding 0.10% (m/m) may be assigned this notation if the requirements of the Guidelines for Use of Low Sulphur Distillate Fuels in Ships are complied with	Guidelines for Use of Low Sulphur Distillate Fuels in Ships
NEC (SCRS)	NOx emission control (Selective catalytic reduction system)	This notation may be assigned to ships installed with the SCR systems for reduction of NOx emission may be assigned n	Guidelines for Application of Selective Catalytic Reduction (SCR) System Onboard Ships
NEC (EGRS)	NOx emission control (Exhaust Gas Recirculation system)	This notation may be assigned to ships installed with the EGR systems for reduction of NOx emission	Guidelines for Application of Exhaust Gas Recirculation (Egr) Systems Onboard Ships
SCR Ready (X)	Selective catalytic reduction system (SCR) Ready	In assigning class notation SCR Ready(X), X is to be replaced by U or A, the meaning of which are as follows: U: SCR with reductant using aqueous urea solution; A: SCR with reductant using aqueous ammonia	

AMPS	AC shore connection system	The class notation may be assigned to a ship fitted with an AC shore connection system with rated voltages of 15 kV or less for power supply to ships in port. Such systems are capable of transferring load between the shore supply and the ship's electrical power via blackout or temporary parallel running, so as to ensure normal operation of equipment intended to be used when generating sets of the ship are stopped	1. Ch.19, Pt. 8 of Rules for Classification of Sea-going Steel Ships for ship length ≥20 m 2. Rules for Classification of Sea-going Boats for ship length <20 m
~~AMPS~~	~~Ship shore connection system~~	~~For ships fitted with shipborne devices of ship shore connection system, this notation may be added~~	~~Rules for Classification of Sea-going Boats~~
SPV	Solar photovoltaic system	For ships fitted with solar photovoltaic system, this notation may be added	1. Ch.2 of Survey Guidelines of Solar Photovoltaic System and Lithium Iron Phosphate Battery System for ship length ≥20 m 2. Rules for Classification of Sea-going Boats for ship length <20 m
~~SPV~~	~~Solar photovoltaic system~~	~~For ships fitted with solar photovoltaic system, this notation may be added~~	~~Rules for Classification of Sea-going Boats~~
Battery(Power)	Pure Battery-Powered Propulsion	For ships using pure battery-powered propulsion, this notation may be added	1. Guidelines for Surveys of Pure Battery Powered Ships for ship length ≥20 m 2. Rules for Classification of Sea-going Boats for ship length <20 m
~~Battery(Power)~~	~~Pure Battery-Powered Propulsion~~	~~For ships using pure battery-powered propulsion, this notation may be added~~	~~Rules for Classification of Sea-going Boats~~
Hybrid	Hybrid system	Ships with various sources of energy (excluding sails) which can serve as main propulsion power simultaneously, this notation may be assigned.	Guidelines for Survey of Hybrid Ships
WAP(RWS)	Rigid Wing Sails	This notation may be assigned to wind assisted propulsion unit complying with the requirements of the Guidelines for Evaluation and Survey of Marine Rigid Wing Sails (excluding Chapter 4)	Guidelines for Evaluation and Survey of Marine Rigid Wing Sails
ALDR	Air lubrication drag reduction system	This notation may be assigned, where air lubrication for drag reduction technology is applied on the ship and the requirements of Chapters 1 and 2 of the Guidelines for Surveys of Air Lubrication System for Drag Reduction of Ships are complied with	Guidelines for Surveys of Air Lubrication System for Drag Reduction of Ships
~~Methyl/ Ethyl Alcohol Fuel~~ Methanol/Ethanol Fuel	Fueled by ~~methyl/ethyl/ alcohol~~ methanol/ethanol	This notation may be assigned to power ships the main propulsion system of which is fueled by ~~methyl/ethyl/ alcohol~~ methanol/ethanol	~~Pt. 1 of Guidelines for Ships Using Alternative Fuel Guidelines for~~ Ships Using Methanol/Ethanol Fuel
Electrical Propulsion System	Electrical propulsion systems	For ships fitted with electrical propulsion system, this notation may be added	Ch. 15, Pt. 8 of the Rules For DC power distribution propulsion system, see the Guidelines for Survey of DC Distribution Electrical Propulsion Systems
~~LPG Fuel System~~	~~Using liquefied petroleum gas as~~	~~For ships using liquefied petroleum gas as fuel, this notation may be added~~	~~Guidelines for Survey of Ships Powered by Gas~~

	~~fuel~~		~~Fuel~~
~~LPG Fuel~~	~~Using liquefied petroleum gas as fuel~~	~~For ships using liquefied petroleum gas as fuel, this notation may be added~~	~~Rules for Classification of Sea-going Boats~~
LPG Fuel	Using liquefied petroleum gas as fuel	For ships the main propulsion system of which is fueled by liquefied petroleum gas, this notation may be assigned	1. Chapters 1-13 of the Guidelines for Ships Using Liquefied Petroleum Gas as Fuel for ship length ≥20 m 2. Rules for Classification of Sea-going Boats for ship length <20 m
LPGF Ready 1	LPG fuel ready ships	This notation may be assigned when the relevant equipment is not installed onboard and only design and approval of principal plans of LPG fuel ready ships are carried out	Chapter 14 of the Guidelines for Ships Using Liquefied Petroleum Gas as Fuel
LPGF Ready 2	LPG fuel ready ships	This notation may be assigned when the relevant equipment is not installed onboard and design and approval of detailed plans of LPG fuel ready ships are carried out	Chapter 14 of the Guidelines for Ships Using Liquefied Petroleum Gas as Fuel
LPGF Ready 2(X)	LPG fuel ready ships	This notation may be assigned when some of the relevant equipment and system are already installed onboard in addition to compliance with the requirements for LPGF Ready 2. The meanings of the suffix X are as follows: ① the capital letter S indicates that the relevant hull structure and fuel tank support structure have been reinforced; ② the capital letter T indicates that the LPG fuel tank and its containment system have been installed; ③ the capital letter M indicates that the main propulsion engine using LPG fuel has been installed; ④ the capital letter P indicates that the LPG fuel piping system has been installed; ⑤ the capital letter D indicates that the electrical equipment of the fuel power system in relevant dangerous zones is to be explosion-proof	Chapter 14 of the Guidelines for Ships Using Liquefied Petroleum Gas as Fuel
Telescope Gangway	Telescope Gangway	This notation may be assigned to ships provided with telescope gangway	Guidelines for Marine Telescope Gangway

Special Survey Notations **Table H**

Class notation	Description		Technical requirements
DDV	Ship Digital Survey	This notation may be assigned if the ship has the conditions to carry out inspection by means of digital survey	Guidelines for Application of Ship Digital Survey

Class Notations for Green Eco-Ships ① **Table I-1**

Class notation	Description		Technical requirements
G-ECO	Ecological protection	The "G-ECO" class notation may be assigned to sea-going ships engaged on international voyages in compliance with applicable international conventions and codes only	Rules for Green Eco-Ships
G-ECO (X)		Where it is necessary to indicate further the level of ecological protection, "X" is used to represent the sub-elements as follows: CDx-- CO_2 emission design index for newbuildings, where "x" represents the percentage ratio of the ship's Attained	

① Sea-going ships engaged on international voyages.

		EEDI value lower than the reference line value for that ship; CDEx-- CO_2 emission design index for ships in service, where "x" represents the percentage ratio of the ship's Attained EEDI value lower than the reference line value for that ship; COM-- CO_2 emission operation management; BWM（T）-- ballast water treatment; BWM（Es）-- ballast water sequential method; BWM（Ef）-- ballast water flow-through method; BWM（Ed）-- ballast water dilution method; BWM（O）-- other management method of ballast water; BIO-- biofouling management; VIBx-- comfort onboard (vibration), where x is 1 or 2 or 3, and 3 means the highest grade; NOIx-- comfort onboard (compartment noise), where x is 1 or 2 or 3, and 3 means the highest grade; CLx-- comfort onboard (indoor climate), where x is 1 or 2 or 3, and 3 means the highest grade; UW-- underwater noise; RN-- ambient noise.	

Class Notations for Green Eco-Ships ① **Table I-2**

Class notation	Description		Technical requirements
Gd-ECO (X)	Ecological protection	The "Gd-ECO(X)" class notation may be assigned to sea-going ships engaged on domestic voyages in compliance with applicable requirements of the Rules for Green Eco-Ships, where "X" represents the sub-elements as follows: CDx-- CO_2 emission design index, where "x" represents the percentage ratio of the ship's Attained EEDI value lower than the reference line value (RLV) for that ship; COM-- O_2 emission operation management; VIBx-- comfort onboard (vibration), where x is 1 or 2 or 3, and 3 means the highest grade; NOIx-- comfort onboard (compartment noise), where x is 1 or 2 or 3, and 3 means the highest grade; CLx-- comfort onboard (indoor climate), where x is 1 or 2 or 3, and 3 means the highest grade; UW-- underwater noise; RN-- ambient noise.	Rules for Green Eco-Ships

~~**Class Notations for Green Eco-Technologies** **Table I-3**~~

~~Class notation~~	~~Description~~		~~Technical requirements~~
~~DFD~~	~~Dual fuel diesel engine used as power plant~~	~~The class notation may be assigned to liquefied gas carriers fitted with dual fuel diesel engines as power plant in compliance with the requirements of the Rules for Green Eco-Ships~~	~~Rules for Green Eco-Ships~~
~~GF~~	~~Gas fuel only engines used as power plant~~	~~The class notation may be assigned to liquefied gas carriers fitted with gas fuel only engines as power plant in compliance with the requirements of the Rules for Green Eco-Ships~~	~~Rules for Green Eco-Ships~~
~~Natural Gas Fuel~~	~~Natural gas used as fuel~~	~~This notation may be assigned to ships of which main propulsion and/or auxiliary machinery uses natural gas or fuel oil and natural gas as fuel, except for liquefied gas carriers~~	~~Rules for Green Eco-Ships~~

① Sea-going ships engaged on domestic voyages.

DFDR	Natural gas fuel ready system	A ship assigned with the class notation of DFDR may has one or more suffix(es) of XN. The intention of XN is as follows: H: the hull structures have been strengthened in accordance with the relevant requirements of natural gas fuel powered ships T: the natural gas fuel containment system (bunkers/fuel tanks) and its supporting members have been installed M: the main engine installed in ship's construction is a dual fuel engine m: main engine installed in ship's construction may be converted to a dual fuel engine in future A: the auxiliary engine installed in ship's construction is a dual fuel engine a: the auxiliary engine installed in ship's construction may be converted to a dual fuel engine in future B: the boiler installed in ship's construction is a dual fuel boiler P: the arrangement in ship's construction has been considered the approaching installation of natural gas fuel supply system and related to, including the arrangement of piping, bunkering station, compressor room, gas valve unit, fire-fighting system, etc. E: the power distribution system has been reserved for the equipment related to natural gas fuel powered system in ship's construction D: the gas dangerous zones have been taken into consideration in ship's construction Note: It must be alternative to the suffixes M or m; it is optional for the other suffixes.	Rules for Green Eco-Ships
SEC (EGCS)	SO_x emission control (Exhaust gas cleaning system)	Ships installed with the EGC systems for reduction of SO_x emission may be assigned this notation	Rules for Green Eco-Ships
EGC Ready (X)	Exhaust gas cleaning systems (EGC) Ready	For EGC Ready (X) class notation, the symbol X stands for the type of the EGC system, including: (1) dry desulfurization system, expressed by the capital letter D; (2) open loop exhaust gas cleaning system, expressed by the capital letter O; (3) closed loop exhaust gas cleaning system, expressed by the capital letter C; (4) open-closed hybrid composite system, expressed by the capital letter H. X is to be replaced by one of the four letters above based on the type of the EGC system intended to be installed	Rules for Green Eco-Ships
LSDF	Low sulphur distillate fuel	Ships intended to use low sulphur distillate fuel with sulphur content not exceeding 0.10% (m/m) may be assigned this notation if the requirements of the Rules for Green Eco-Ships are complied with	Rules for Green Eco-Ships
NEC (SCRS)	NO_x emission control (Selective catalytic reduction system)	Ships installed with the SCR systems for reduction of NO_x emission may be assigned this notation	Rules for Green Eco-Ships
SCR Ready (X)	Selective catalytic reduction system (SCR) Ready	In assigning class notation SCR Ready(X), X is to be replaced by U or A, the meaning of which are as follows: U: SCR with reductant using aqueous urea solution; A: SCR with reductant using aqueous ammonia	Rules for Green Eco-Ships
AMPS	AC shore connection	The class notation may be assigned to a ship fitted with an AC shore connection system with rated voltages of 15 kV	Rules for Green Eco-Ships

	system	or less for power supply to ships in port. Such systems are capable of transferring load between the shore supply and the ship's electrical power via blackout or temporary parallel running, so as to ensure normal operation of equipment intended to be used when generating sets of the ship are stopped	
SPV	Solar photovoltaic system	For ships fitted with solar photovoltaic system, this notation may be added	Rules for Green Eco-Ships
Battery（Power）	Pure Battery-Powered Propulsion	When only batteries are used as propulsion power in ship's normal operation and relevant requirements in the Rules for Green Eco-Ships are met, with shipowner's application, this notation maybe assigned.	Rules for Green Eco-Ships
Hybrid	Hybrid system	Ships with various sources of energy (excluding sails) which can serve as main propulsion power simultaneously, this notation may be assigned.	Rules for Green Eco-Ships
FC-FULL	Fuel cell power system	This notation may be assigned provided that: the ship is not provided with other power source except the fuel cell power system, and the fuel cell power system provides power to all equipment onboard the ship (propulsion, steering gears and other essential equipment, emergency equipment as well as other equipment)	Rules for Green Eco-Ships
FC-POWER 1		This notation may be assigned provided that: the ship is provided with the diesel generating set and the fuel cell power system, and the fuel cell power system provides power to essential equipment of the ship	
FC-POWER 2		This notation may be assigned provided that: the ship is provided with the diesel generating set and the fuel cell power system, and the fuel cell power system provides power to non-essential equipment and non-emergency equipment	
WAP（RWS）	Rigid Wing Sails	This notation may be assigned upon request by the shipowner, where relevant requirements of the Rules for Green Eco-Ships are satisfied	Rules for Green Eco-Ships
ALDR	Air lubrication drag reduction system	This notation may be assigned upon request by the shipowner, where relevant requirements of the Rules for Green Eco-Ships are satisfied	Rules for Green Eco-Ships

CHAPTER 3 INSPECTIONS OF PRODUCTS

Appendix 1A LIST OF CERTIFICATION REQUIREMENTS FOR CLASSED MARINE PRODUCTS

No.	Product name	Document		Approval mode				Plan approval	Remark
		C/E	W	DA	TA-B	TA-A	WA	PA	
Material									
2	Non-metallic material								Refer to Appendix 1D for the requirements for non-metallic materials for liquefied natural gas cargo tanks and fuel tanks
2.6	Heat-insulating material	–	X	–	–	–	X	–	Applicable to ~~LNG carrier and~~ refrigerated ship
Machinery (including machinery equipment of refrigerated vessels)									
8	Pumps and piping								Refer to Appendix 1D for the additional requirements for pumps and piping included in liquefied natural gas specialized products
10	Machinery equipment								
10.10	Cargo compressor	X	–	–	–	–	–	X	Including compressor for gas fuel, for use by ~~LNG and~~ LPG carriers; refer to Appendix 1D for LNG carriers or LNG dual fuel powered ships
Electrical installations and automatic equipment									
13	Electrical installations								
13.11	Electrical control box (associated with essential equipment)	X	–	–	–	–	–	X	For the definition of essential equipment, refer to paragraph 1.1.2.1(1), Chapter 1, PART FOUR of the Rules; for marine propulsion power limitation
13.17	Uninterrupted Power Supply (UPS) (50 kVA and over)	X	–	–	X	O	–	X	For application, refer to 3.9.1, Chapter 3, PART FOUR of the Rules; for marine propulsion power limitation
13.18	Uninterrupted Power Supply (UPS) (below 50 kVA)	—	X	—	X	O	—	X	For application, refer to 3.9.1, Chapter 3, PART FOUR of the Rules; for marine propulsion power limitation
13.21	Distribution panel for ~~high voltage~~ shore power connection	X	–	–	–	–	–	X	~~Applicable to ships applying for class notation of shore power~~
13.22	Control panel for ~~high voltage~~ shore power switch in	X	–	–	–	–	–	X	~~Applicable to ships applying for class notation of shore power~~
13.23	Lighting fitting	–	X	–	X	–	–	X	
~~13.33~~	~~Low voltage shore power box~~	~~X~~	~~—~~	~~—~~	~~—~~	~~—~~	~~—~~	~~X~~	~~Applicable to ships applying for class notation of shore power~~
14	Automatic equipment								
14.8	Shaft power meter	–	X	–	X	O	–	X	For ships applying for EOM notation; for marine propulsion power limitation

Symbols:

1) C – Marine Products Certificate; E – Equivalent document; W – Manufacturer's document; X – Applicable; O – Optional.

2) DA – Design approval; TA-B – Type approval B; TA-A – Type approval A; WA – Works approval.

3) X[1]: The certification requirements for such explosion-proof product are consistent with those for the existing non

explosion-proof product of the same type.

Appendix 1B LIST OF CERTIFICATION REQUIREMENTS FOR STATUTORY MARINE PRODUCTS①

No.	Product name	Document		Approval mode				Plan approval	Remark
		C/E	W	DA	TA-B	TA-A	WA	PA	
3	Fire-resisting material, structure and fire-fighting equipment								
3.50	Fixed oxygen analyzing and gas detecting equipment	X	–	–	X	O	–	X	Refer to Appendix 1D for LNG carriers or LNG dual fuel powered ships
3.51	Fixed hydrocarbon gas detection system	X	–	–	X	O	–	X	Refer to Appendix 1D for LNG carriers or LNG dual fuel powered ships
10	IBC and IGC Codes								
10.1	Cargo hose	O	X	–	X	O	–	X	Refer to Appendix 1D for cargo hoses provided for LNG carriers

Symbols:
1) C – Marine Products Certificate; E – Equivalent document; W – Manufacturer's document; X – Applicable; O – Optional.
2) DA – Design approval; TA-B – Type approval B; TA-A – Type approval A; WA – Works approval.
Note: Other statutory marine products with certification requirements of the Administration are to be implemented as required by the Administration.

① If the list is not consistent with the requirements of the flag State Government, the provisions of the flag State Government are to prevail.

Appendix 1D LIST OF CERTIFICATION REQUIREMENTS FOR NATURAL GAS SPECIALIZED PRODUCTS

No.	Product name	Document		Approval mode				Plan approval	Remark
		C/E	W	DA	TA-B	TA-A	WA	PA	
Liquefied natural gas carrier cargo containment system （membrane cargo tank）									
1	Materials/Component								
1.1	Adhesive	—	X	—	—	—	X	—	Used for bonding insulation materials and components.
1.2	Glass wool	—	X	—	—	—	X	—	
1.3	Glass cloth	—	X	—	—	—	X	—	
1.4	load bearing mastic	—	X	—	—	—	X	—	
1.5	Reinforced polyurethane foam	X	—	—	—	—	X	—	
1.6	Perlite	—	X	—	—	—	X	—	
1.7	Insulating material	—	X	—	—	—	X	—	
1.8	Plywood	X	—	—	—	—	X	—	
1.9	Plywood Cleat	X	—	—	—	—	X	X[1]	
1.10	Paint for inner hull protection	—	X	—	—	—	X	—	
1.11	Thermal protection		X	—	—	—	X	—	Used for thermal insulation protection of weld backside
1.12	Stainless steel sheets	X	—	—	—	—	X	—	
1.13	Stainless steel studs, nuts&washers	—	X	—	—	—	X	—	Works approval is only for material approval. If C/E is provided for forged steel parts, approval is not required.C/E doesn't require approval
1.14	Collar studs(forging)	X	—	—	—	—	X	X[1]	Works approval is only for material approval. If C/E is provided for forged steel parts, approval is not required.C/E doesn't require approval
1.15	Self-locked nuts	—	X	—	—	—	X	—	
1.16	Spring washers	—	X	—	—	—	X	—	
1.17	Coupler rods,setting plates	X	—	—	—	—	X	X[1]	
1.18	Coupler base socket(forging)	X	—	—	—	—	X	X[1]	Works approval is only for material approval. If C/E is provided for forged steel parts, approval is not required.C/E doesn't require approval
1.19	Staples	—	X	—	—	—	X	—	Category 1 and 2 staples specified by the patent holder
1.20	Secondary barrier components	X	—	—	—	—	X	X[1]	Three-in-one sheet, including rigid secondary barrier and flexible secondary barrier
1.21	Fe-36% Ni alloy strips	X	—	—	—	—	X	—	

No.	Product name	Document		Approval mode				Plan approval	Remark
		C/E	W	DA	TA-B	TA-A	WA	PA	
1.22	Aluminium for reinforcement elements	X	—	—	—	—	X	X[1]	
2	Prefabricated elements								
2.1	Insulating boxes	X	—	—	X	—	—	X[1]	
2.2	Anchor strips	X	—	—	X	—	—	X[1]	
2.3	Primary barrier components	X	—	—	X	—	—	X[1]	Include flat, corner, corner area and end stainless steel corrugated plates
2.4	Top bridge pads prefabricated elements	X	—	—	X	—	—	X[1]	
2.5	Flat wall panels prefabricated elements	X	—	—	X	—	—	X[1]	
2.6	Corner panels prefabricated elements	X	—	—	X	—	—	X[1]	
2.7	Stainless steel corners	X	—	—	X	—	—	X[1]	
2.8	Single legs prefabricated elements	X	—	—	X	—	—	X[1]	
2.9	Fe-36% Ni alloy tubes and other prefabricated components	X	—	—	—	—	—	X[1]	
Liquefied natural gas carrier cargo containment system （independent cargo Tank type C ）									
3.1	Rolled steel	X	—	—	—	—	X	—	
3.2	Forgings	X	—	—	—	—	X	—	
3.3	Pipes,forgings,castings and fittings(bend, three-way,pipe nipple and tapered pipe, etc.) for natural gas piping	X	—	—	—	—	X	—	Applicable to cargo and process piping for design temperature below 0℃
3.4	End plate	X	—	—	—	—	X	X[1]	As purchased parts
3.5	Welding consumables	—	X	—	—	—	X	—	
3.6	Heat-insulating material	—	X	—	—	—	X	—	
3.7	Cargo bearer	—	X	—	—	—	X	—	
3.8	Structural adhesives	—	X	—	—	—	X	—	
3.9	Domes，fluid well	X	—	—	—	—	—	X[1]	As purchased parts
3.10	Electrical penetrations	—	X	—	X	—	—	X	Air -tight electrical penetrations for submerged pump cables
3.11	Safety valve	X	—	—	X	O	—	X	
Cargo and fuel operation system structure									
4.1	Pump tower	X	—	—	—	—	—	X[1]	For membrane cargo tank.If the shipyard has a subcontract agreement with the product factory, the product is inspected by CCS newbuilding surveyor, and C/E may not be required
4.2	Pump tower lower guiding unit (pump tower support)	X	—	—	—	—	—	X[1]	For membrane cargo tank.If the shipyard has a subcontract agreement with the product factory, the product is inspected by

No.	Product name	Document		Approval mode				Plan approval	Remark
		C/E	W	DA	TA-B	TA-A	WA	PA	
									CCS newbuilding surveyor, and C/E may not be required
4.3	Gas dome	X	—	—	—	—	—	X[1]	For membrane cargo tank.If the shipyard has a subcontract agreement with the product factory, the product is inspected by CCS newbuilding surveyor, and C/E may not be required
4.4	Vent mast	X	—	—	—	—	—	X[1]	Fire net or safety cover at vent mast
Cargo operation system and cargo as fuel supply system of liquefied natural gas carrier									
5.1	Cryogenic cargo pump	X	—	—	X	O	—	X	
5.2	Cryogenic stripping/spray pump	X	—	—	X	O	—	X	
5.3	Fuel pump	X	—	—	X	O	—	X	
5.4	Cryogenic emergency pump	X	—	—	X	O	—	X	
5.5	Vacuum pump for barrier	X	—	—	X	O	—	X	
5.6	Cryogenic flexible hose assembly	X	—	—	X	O	—	X	For reliquefaction device，nitrogen purging, barrier space cleaning, cargo transfer, etc.
5.7	Cargo pipe insulation and external protection materials	—	X	—	—	—	X	—	
5.8	Cryogenic valve	X	—	—	X	—	—	X	Applicable to valves for working temperature below -55℃
5.9	Cryogenic safety valve	X	—	—	X	—	—	X	
5.10	High velocity valve	X	—	—	X	O	—	X	
5.11	Pipes,forgings,castings and fittings(bend, , three-way,pipe nipple and tapered pipe, etc.) for natural gas piping	X	—	—	—	—	X	—	Applicable to fuel and process piping for design temperature below 0℃
5.12	Flowmeter	—	X	—	X	—	—	X	For natural gas and liquefied natural gas pipings
5.13	Cryogenic expansion joint	X	—	—	X	—	—	X	
5.14	Cryogenic flange gasket	—	X	—	—	—	X	—	
5.15	HD compressor	X	—	—	X	—	—	X	
5.16	LD compressor	X	—	—	X	—	—	X	

No.	Product name	Document		Approval mode				Plan approval	Remark
		C/E	W	DA	TA-B	TA-A	WA	PA	
5.17	BOG compressor	X	—	—	X	—	—	X	For reliquefaction device
5.18	LNG vaporizer	X	—	X	O	O	—	X	
5.19	Forced evaporator	X	—	X	O	O	—	X	
5.20	Warming up heater	X	—	X	O	O	—	X	
5.21	Fuel gas heater	X	—	X	O	O	—	X	
5.22	Inert gas generator	X	—	—	X	O	—	X	
5.23	Nitrogen generator	X	—	—	X	—	—	X	
5.24	Nitrogen buffer tank	X	—	—	—	—	O	X	
5.25	Glycol water heater (steam)	X	—	X	O	O	—	X	
5.26	Electrical glycol water heater	X	—	—	—	—	—	X	
5.27	Water sprinkler and Cryogenic sprinkler	—	X	—	X	—	—	X	
5.28	Gas combustion unit	X	—	—	—	—	—	X	
5.29	Gas valve unit(Gas valve train)	X	—	O	—	—	—	X	GVU, GVT
5.30	Reliquefaction device	X	—	—	O	—	—	X	Contains cryogenic device
5.31	Double walled pipe for natural gas	X	—	—	—	—	—	X	
5.32	Vacuum insulated double walled pipe	X	—	—	X	—	—	X	
5.33	Integrated gas pressure regulation	X	—	O	—	—	—	X	
5.34	Filter	X	—	—	—	—	—	X	For natural gas and liquefied natural gas pipings
Liquefied natural gas fuel supply and related systems for dual fuel ships									
6	Liquefied natural gas fuel supply system								
6.1	Vaporizer and heater skid	X	—	—	—	—	—	X	Applicable to supply in skid mode
6.2	BOG compressor skid	X	—	—	—	—	—	X	Applicable to supply in skid mode
6.3	Pressure vessel	X	—	—	—	—	X	X	Including gas buffer tank,mist Separator and Knock-out drum,etc.
6.4	Heat exchanger	X	—	X	O	O	—	X	Including vaporizer,heater and cooler,etc.
6.5	Fuel pump	X	—	—	X	O	—	X	Including submerged pump,deep well pump and booster pump,etc.
6.6	BOG compressor	X	—	—	X	—	—	X	
6.7	Fan	X	—	X	O	O	—	X	For double walled pipe
6.8	Cryogenic pump pool	X	—	—	—	—	—	X	Including pumps and pump

No.	Product name	Document		Approval mode				Plan approval	Remark
		C/E	W	DA	TA-B	TA-A	WA	PA	
									pool
6.9	Emergency shut-down valve	X	—	—	X	—	—	X	
6.10	Master gas valve	X	—	—	X	—	—	X	
6.11	Tank master valve	X	—	—	X	—	—	X	
6.12	Gas valve unit(Gas valve train)	X	—	O	—	—	—	X	GVU, GVT
6.13	Integrated gas pressure regulation	X	—	O	—	—	—	X	
6.14	Tank connection space	X	—	—	—	—	—	X	
6.15	Safety valve	X	—	—	X	O	—	X	For natural gas piping and pressure vessel
7	Liquid natural gas bunkering and storage system								
7.1	Bunkering station skid	X	—	—	—	—	—	X	Applicable to supply in skid mode
7.2	Type C independent tanks	X	—	—	—	—	X	X	See LNG carrier cargo containment system independent cargo Tank type C for certification requirements
7.3	Membrane tanks	—	—	—	—	—	—	X	See LNG carrier cargo containment system membrane tanks for certification requirements
7.4	Safety valve	X	—	—	X	O	—	X	For natural gas piping and pressure vessel
7.5	Emergency shut-down valve	X	—	—	X	—	—	X	
7.6	Hydraulic power plant	X	—	—	—	—	—	X	For driving emergency shut-down valve
8	Glycol water heater system								
8.1	Glycol water heater skid	X	—	—	—	—	—	X	Applicable to supply in skid mode
8.2	Glycol water pump	X	—	—	X	O	—	X	
8.3	Glycol water heat exchanger	X	—	X	O	O	—	X	
8.4	Electrical glycol water heater	X	—	—	—	—	—	X	
8.5	Glycol water balancing vessel	X	—	—	—	—	X	X	Applicable to equipment belonging to pressure vessel
9	Nitrogen generator and supply system								
9.1	Nitrogen generator skid	X	—	—	—	—	—	X	Applicable to supply in skid mode

No.	Product name	Document		Approval mode				Plan approval	Remark
		C/E	W	DA	TA-B	TA-A	WA	PA	
9.2	Nitrogen generator	X	—	—	X	—	—	X	
9.3	Nitrogen tank	X	—	—	—	—	O	X	
9.4	Air compressor	X	—	X	O	O	—	X	
10	Piping, valve and fittings								
10.1	Cryogenic valve	X	—	—	X	—	—	X	Applicable to valves for working temperature below -55℃
10.2	Pipes,forgings,castings and fittings(bend, , three-way,pipe nipple and tapered pipe, etc.) for natural gas piping	X	—	—	—	—	X	—	Applicable to fuel and process piping for design temperature below 0℃
10.3	Double walled pipe for natural gas	X	—	—	—	—	—	X	
10.4	Vacuum insulated double walled pipe	X	—	—	X	—	—	X	
10.5	Filter	X	—	—	—	—	—	X	For natural gas and liquefied natural gas pipings
10.6	Flowmeter	—	X	—	X	—	—	X	For natural gas and liquefied natural gas pipings
10.7	Vent mast cap	X	—	—	—	—	—	X	
10.8	Cryogenic flange gasket	—	X	—	—	—	X	—	
10.9	Flexible hose assembly	X	—	—	X	O	—	X	For natural gas and liquefied natural gas pipings
10.10	Expansion joint and corrugated pipe	X	—	—	X	—	—	X	
10.11	Pipe insulation and external protection materials	—	X	—	—	—	X	—	
Electrical installations and automationt									
11.1	Cargo switchboard	X	—	—	—	—	—	X	
11.2	Pressure control and monitoring, alarm system	X	—	—	X	O	—	X	Applicable to inert gas system
11.3	Integrated antomatic system	X	—	—	X	O	—	X	Refer to the definition of CCS"Rules For Construction and Equipment of ships carrying liquefied gases in bulk","IAS" for short
11.4	Fuel tank monitoring and control system	X	—	—	X	O	—	X	
11.5	Liquefied natural gas supply electrical	X	—	—	X	O	—	X	including control, alarm and safety system

No.	Product name	Document		Approval mode				Plan approval	Remark
		C/E	W	DA	TA-B	TA-A	WA	PA	
	control system								
11.6	Electrical control box	X	—	—	—	—	—	X	Electrical control box of the fan, water glycol pump /electric heater, water glycol emergency pump, Liquefied natural gas pump, compressor, etc
11.7	Fixed gas detection system	X	—	—	X	O	—	X	Applicable to flammable gas detection,toxic gas detection,oxygen levels detection,carbon dioxide gas detection.including controller and detector
11.8	Ship-Shore/Ship Link-System	X	—	—	—	—	—	X	If the product is included in the Integrated Automatic System (IAS), there is no duplicate requirement to hold the certificate
11.9	Emergency shutdown system(ESD)	X	—	—	—	—	—	X	If the product is included in the Integrated Automatic System (IAS), there is no duplicate requirement to hold the certificate

Symbols:

1) C – Marine Products Certificate; E – Equivalent document; W – Manufacturer's document; X – Applicable; — – Not Applicable; O – Optional.

2) DA – Design approval; TA-B – Type approval B; TA-A – Type approval A; WA – Works approval; PA – Plan approval

3)X^1: Inspection is to be carried out according to approved integral product/system (ship, product) drawing.

4) Membrane cargo tanks mean MARK III and NO96 membrane cargo tanks with GTT patented technology.

CHAPTER 4 SURVEYS DURING CONSTRUCTION①

Appendix 1 HULL SURVEY FOR NEW CONSTRUCTION

Annex 1 Shipyard Review Record

1 Details of any management systems

Obtained approval	Certified by	Expiry date	Remarks (scope, etc.)
ISO-9001			
ISO 14001			
ISO ~~18001~~45001			
Other			

① The requirements for initial classification surveys of ships under construction are given in 5.14.2 of Section 14 of Chapter 5.

CHAPTER 5 SURVEYS AFTER CONSTRUCTION

Section 4 HULL AND EQUIPMENT SURVEYS

5.4.4 Special surveys

5.4.4.2 Survey items for all ships

(6) Hydraulic test for some tanks, when found difficult, may be substituted by airtightness test. Where hydraulic test is difficult to be carried out on the shipway or within the dock, it may be carried out while the ship is afloat. Appropriate means of examination before launching such as leakage test or internal examination of tank bottom while the ship is afloat are to be carried out for parts that cannot be examined after launching and underwater parts of the hull.

Section 6 ADDITIONAL REQUIREMENTS FOR HULL AND EQUIPMENT SURVEYS OF OIL TANKERS

5.6.4 Special surveys

5.6.4.5 Extent of tank testing

~~(6) Tanks may be pressure tested while the ship is afloat provided that their internal examination is also carried out while the ship is afloat.~~

Section 7 ADDITIONAL REQUIREMENTS FOR HULL AND EQUIPMENT SURVEYS OF BULK CARRIERS

5.7.1 General requirements

5.7.1.1 Application

(7) For existing bulk carriers, where owners may select to coat or recoat cargo holds as required by ~~1.6.1.4~~1.6.1.3 of Chapter 1, PART TWO of the Rules, consideration may be given to the extent of the close-up and thickness measurement surveys. Prior to the coating of cargo holds of such ships, scantlings are to be ascertained in the presence of a Surveyor.

5.7.4 Special surveys

5.7.4.5 Extent of thickness measurement

Minimum Requirements for Thickness Measurements at Special Hull Survey of Bulk Carriers not Having the Notation ESP (Including Double Skin Bulk Carriers)

Table 5.7.4.5(1)③

Age ≤ 10	10 < age ≤ 15	Age > 15
1. Suspect areas throughout the ship	1. Suspect areas throughout the ship	1. Suspect areas throughout the ship
	2. Within the cargo length: a. Each deck plate outside line of cargo hatch openings. b. Two transverse sections, one in the 0.5L amidship area, outside line of cargo hatch openings. c. All wind and water strakes	2. Within the cargo length: a. Each deck plate outside line of cargo hatch openings. b. Three transverse sections, one in the 0.5L amidship area, outside line of cargo hatch openings. c. Each bottom plate
	3. Selected wind and water strakes outside the cargo area	3. All cargo hold hatch covers and coamings (plating and stiffeners)
		4. Internals in forepeak and afterpeak ballast

Age ≤ 10	10 < age ≤ 15	Age > 15
		tanks
		5. All exposed main deck plating full length
		6. Representative exposed superstructure deck plating (poop, bridge, and forecastle deck)
		7. Lowest strake and centre strakes in way of ~~'tween decks of~~ all transverse bulkheads in cargo spaces together with internals in way
		8. All wind- and water strakes, port and starboard, full length
		9. All keel plates full length. Also, additional bottom plates in way of cofferdams, machinery space, and aft end of tanks
		10. Plating of sea chests. Shell plating in way of overboard discharges as considered necessary by the attending Surveyor

Section 8 ADDITIONAL REQUIREMENTS FOR HULL AND EQUIPMENT SURVEYS OF CHEMICAL TANKERS

5.8.4 Special surveys

5.8.4.4 Extent of thickness measurement

Minimum Requirements for Thickness Measurements at Special Survey of Chemical Tankers not Having the Notation ESP **Table 5.8.4.4(1)b**

Age ≤ 10	10 < age ≤ 15	Age > 15
1. Suspect areas throughout the ship	1. Suspect areas throughout the ship	1. Suspect areas throughout the ship
	2. Within the cargo area: a) Each deck plate b) Two transverse sections c) All wind and water strakes	2. Within the cargo area: a) Each deck plate b) Three transverse sections c) Each bottom plate
	3. Selected wind and water strakes outside the cargo area	3. Internals in forepeak and afterpeak ballast tanks
		4. All exposed main deck plating full length
		5. Representative exposed superstructure deck plating (poop, bridge, and forecastle deck)
		6. Lowest strake ~~and strakes in way of 'tween decks~~ of all transverse bulkheads in cargo spaces together with internals in way
		7. All wind- and water strakes, port and starboard, full length
		8. All keel plates full length. Also, additional bottom plates in way of cofferdams, machinery space, and aft end of tanks
		9. Plating of sea chests. Shell plating in way of overboard discharges as considered necessary by the attending Surveyor

5.8.4.5 Extent of tank testing
~~(6) Tanks may be pressure tested while the ship is afloat provided that their internal examination is also carried out while the ship is afloat.~~

Section 13 BOILER SURVEYS

5.13.5 Surveys of steam pipes

Section 18 ADDITIONAL REQUIREMENTS FOR SURVEYS OF LIVESTOCK CARRIERS

5.18.1 General requirements
5.18.1.1 In addition to applicable survey items in ~~5.4.2.2~~Section 4 of this Chapter, livestock carriers are to satisfy relevant provisions of this Section.

Appendix 8 PROCEDURAL REQUIREMENTS FOR SERVICE SUPPLIERS

4. Application
4.1 This procedure applies to the approval of the following categories of service suppliers:
4.1.1 Statutory services
(1) Firms engaged in servicing inflatable liferafts, inflatable lifejackets, hydrostatic release units~~, inflatable rescue boats,~~ and marine evacuation systems

5. Procedure for approval and certification
5.2 General requirements
5.2.2 Training of personnel – The supplier is responsible for the qualification and training of its personnel to a recognized national, international or industry standard as applicable. Where such standards do not exist, the supplier is to define standards for the training and qualification of its personnel relevant to the functions each is authorized to perform. The personnel are also to have adequate experience and to be familiar with the operation of any necessary equipment. Operators/technicians/inspectors are to have had a minimum of one year tutored on-the-job training. Where it is not possible to perform internal training, a program of external training may be considered as acceptable.
5.4 Certification is conditional on a practical demonstration of the performance of the specific service as well as satisfactory reporting being carried out. At initial audits, when the service supplier is already certified by other QSCS certified Society according to the provision of this Appendix, this may be verified through documentary review that a practical demonstration has already been carried out. At renewal audits, verification by documentary review of jobs undertaken since the previous audit and that have been accepted by a QSCS certified Society is acceptable and is sufficient to satisfy this requirement. ~~At renewal audits, evidence of performance, verified by class surveyor, since the previous audit is sufficient to satisfy this requirement.~~

Annex 1
Special Requirements for Various Categories of Service Suppliers

4. Firms engaged in inspection and maintenance of fire extinguishing equipment and systems
4.4 Reference documents − The service supplier is to have access to the following documents:
— SOLAS, MSC.1/Circular.1318/Rev.1 (Revised Guidelines for the Maintenance and Inspections of Fixed Carbon Dioxide Fire-Extinguishing Systems), International Code for Fire Safety Systems (FSS Code), ISO 6406 (Periodic inspection and testing of seamless steel gas cylinders), and any documentation specified in the authorization or license from the equipment manufacturer;

— MSC/Circ.799 ((Guidelines for the Performance and Testing Criteria and Surveys of Expansion Foam Concentrates for Fixed Fire-Extinguishing Systems of Chemical Tankers);
— MSC.1/Circ.1432 (Revised Guidelines for the Maintenance and Inspection of Fire Protection Systems and Appliances, as amended by MSC.1/Circ.1516);

5. Firms engaged in servicing inflatable liferafts, inflatable lifejackets, hydrostatic release units, inflatable rescue boats and marine evacuation systems

5.1 Extent of engagement:

— servicing of inflatable liferafts, inflatable lifejackets, hydrostatic release units and/or inflatable rescue boats;

5.5 Reference documents − The service supplier is to have access to the following documents:

— Type approval certificates, showing any conditions that may be appropriate during the servicing and/or maintenance of inflatable liferafts, inflatable rescue boats, inflatable lifejackets, and hydrostatic release units;

13. Firms engaged in maintenance, thorough examination, operational testing, overhaul and repair of lifeboats and rescue boats, launching appliances and release gear

13.1 Extent of engagement – Maintenance, thorough examination, operational testing, overhaul and repair of:

.1 lifeboats (including free-fall lifeboats), all rescue boats (including inflated rescue boats and fast rescue boats) and fast rescue boats; and

18. Firms engaged in Commissioning Testing of Ballast Water Management Systems (BWMS)

18.3 Operators – Service Suppliers are expected to be able to perform both the biological sampling and assessment of self-monitoring parameters and has responsibility for document that the requirements to the operator are satisfied. Therefore, operators who conduct commissioning testing are to:

- (*) be trained in the proper use of detailed analysis methods and equipment in case the Service Supplier offers detailed analysis. Review of training records and/or interviews should be conducted to confirm the equipment will be properly used during testing.

18.4 Equipment and facilities

Equipment, procedures and methods for detailed analysis, where applicable, are to be in accordance with relevant International standard and/or accepted Industry standards. Laboratories conducting sample enumeration are to be certified accredited to ISO/IEC 17025 standard, or equivalent.

18.5 Sampling and Analysis

Service Suppliers shall maintain a record of:

— Applicable self-monitoring parameters.

In case the commissioning testing requires the Service Supplier's personnel to work in hazardous areas (e.g., pump room for tankers, etc.), the Service Supplier shall either have equipment certified for use in such the spaces or provide the Surveyor with a list of vessels for which they would not be able to conduct testing.

18.7 Reference Documents

The Service Supplier is to have access to the following documents, as may be amended:

• IMO Resolution MEPC.279(70) - 2016 Guidelines for Approval of Ballast Water Management Systems (G8)

• IMO Resolution A.1120(30)A.1156(32) – Survey Guidelines under the Harmonized System of Survey and verification (HSSC), as amended 2017 (for BWMS that were Type Approved to the 2016 G8)

CHAPTER 6 SURVEYS RELATED TO CLASS NOTATIONS

Section 5 SURVEYS RELATED TO CLASS NOTATIONS FOR GREEN ECO-SHIPS

(This Section is deleted)

~~**6.5.1 Class notations for environmental protection of green eco-ships**~~

~~6.5.1.1 This paragraph applies to ships assigned the following class notations related to environmental protection:~~

~~(1) G-EP/Gd-EP—environmental protection~~

~~(2) G-EP(X), environmental protection, where X represents one or more of the following sub-elements:~~

~~① OILx control of discharge of oil pollutants, where x is 1 or 2;~~

~~② EAL environmental acceptable lubricants;~~

~~③ IBTS integrated bilge water treatment system;~~

~~④ NLSx control of discharge of noxious liquid substances, where x is 1 or 2;~~

~~⑤ SC control of discharge of sewage;~~

~~⑥ GWC control of discharge of grey water;~~

~~⑦ RC control of discharge of garbage;~~

~~⑧ NECx control of NOx emission, where x is 1 or 2;~~

~~⑨ SEC control of SOx emission;~~

~~⑩ VCS/VCS-T VOC emission control;~~

~~⑪ RSCx control of refrigeration system;~~

~~⑫ INC emission control of incineration operation on board;~~

~~⑬ BC20/BC 70 emission control of black carbon;~~

~~⑭ AFS/AFS+ anti-fouling systems;~~

~~⑮ GPR/GPR+ green passport;~~

~~GPR(EU)/GPR(EU)+ green passport (EU).~~

~~(3) Gd-EP(X) , environmental protection, where X represents one or more of the following sub-elements:~~

~~① OILx control of discharge of oil pollutants, where x is 1 or 2;~~

~~② EAL environmental acceptable lubricants;~~

~~③ IBTS integrated bilge water treatment system;~~

~~④ NLSx control of discharge of noxious liquid substances, where x is 1 or 2;~~

~~⑤ SC control of discharge of sewage;~~

~~⑥ GWC control of discharge of grey water;~~

~~⑦ RC control of discharge of garbage;~~

~~⑧ NECx control of NOx emission, where x is 1 or 2;~~

~~⑨ SEC control of SOx emission;~~

~~⑩ VCS/VCS-T VOC emission control;~~

~~⑪ RSCx control of refrigeration system;~~

~~⑫ INC emission control of incineration operation on board;~~

~~⑬ GBEC emission control of diesel engine exhaust pollutant;~~

~~⑭ AFS/AFS+ anti-fouling systems;~~

~~⑮ GPR green passport.~~

~~6.5.1.2 Initial classification~~

~~(1) Plans and information~~

~~① For ships intended to apply for the G-EP class notation, plans and information are to be submitted in accordance with the provisions of 3.2.2, Chapter 3 of CCS Rules for Green Eco-Ships.~~

~~② For ships intended to apply for the G-EP(X) class notation, plans and information required by the corresponding X sub-element are to be submitted in accordance with the provisions of 3.3.6, 3.4.7 and 3.5.3, Chapter 3 of CCS Rules for Green Eco-Ships.~~

③ For ships intended to apply for the Gd-EP class notation, plans and information are to be submitted in accordance with the provisions of 5.2.2, Chapter 5 of CCS Rules for Green Eco-Ships.

④ For ships intended to apply for the Gd-EP(X) class notation, plans and information required by the corresponding X sub-element are to be submitted in accordance with the provisions of 5.3.6, 5.4.6 and 5.5.3, Chapter 5 of CCS Rules for Green Eco-Ships.

(2) The initial classification survey is to cover the following:

① For assignment of the G-EP class notation, initial surveys applicable to the ship as specified in the following conventions and codes are to be completed and the requirements of 3.2.1, Chapter 3 of CCS Rules for Green Eco-Ships are to be satisfied:

a. MARPOL Convention;

b. AFS Convention;

c. other international codes or guidelines referred to in 3.2.1, Chapter 3 of CCS Rules for Green Eco-Ships.

② For assignment of the Gd-EP class notation, initial surveys referred to in PART ONE of Regulations for Statutory Surveys of Ships and Offshore Installations (Technical Regulations for Statutory Surveys of Sea-going Ships Engaged on Domestic Voyages) (hereinafter referred to as Regulations for Domestic Ships) of the Maritime Safety Administration of the People's Republic of China are to be completed and the requirements of chapters and sections corresponding to PART FIVE of Regulations for Domestic Ships are to be satisfied.

③ For assignment of the G-EP(X)/ Gd-EP(X) class notation, surveys mentioned in 6.5.1.2(2)① or ②of this Chapter are to be completed and the compliance with technical requirements corresponding to a specific X sub-element is to be verified.

④ For assignment of the G-EP (BC20/BC70) class notation, it is to be confirmed that applicable engines use or are fitted with black carbon emission reduction technology/equipment, they are subject to emission comparative test required in 3.4.3, Chapter 3 of CCS Rules for Green Eco-Ships and approved by CCS (engine components, setting or operating values, fuel oil specification and their limits are to be indicated in the test report). Onboard verification survey is to be carried out in accordance with 6.2, Chapter 6 of CCS Guidelines for Testing and Survey of Emission of Nitrogen Oxides from Marine Diesel Engines.

⑤ For assignment of the G-EP (VCS/VCS-T)/ Gd-EP (VCS/VCS-T) class notation, surveys mentioned in 6.3.1.2 of this Chapter are to be completed.

6.5.1.3 Annual surveys

(1) For the G-EP class notation, annual surveys applicable to the ship as specified in the following conventions and codes are to be completed and the requirements of 3.2.1, Chapter 3 of CCS Rules for Green Eco-Ships are to be satisfied:

① MARPOL Convention;

② other international codes or guidelines referred to in 3.2.1, Chapter 3 of CCS Rules for Green Eco-Ships.

(2) For the Gd-EP class notation, annual surveys referred to in PART ONE of Regulations for Domestic Ships are to be completed and the requirements of chapters and sections corresponding to PART FIVE of Regulations for Domestic Ships are to be satisfied.

(3) For the G-EP(X)/ Gd-EP(X) class notation, surveys mentioned in 6.5.1.3(1) or (2) of this Chapter are to be completed and the compliance with technical requirements corresponding to a specific X sub-element is to be verified.

(4) For the G-EP (BC20/BC70) class notation, it is to be confirmed that applicable engines are not subject to any major modification in the intervening period; the engine parameter record book and bunker delivery notes are to be checked to confirm that the engines have not undergone any modification or adjustment outside the options and ranges permitted in the test report approved by CCS, or non-compliant fuel oil has not been used, since the last survey.

(5) For the G-EP (VCS/VCS-T)/ Gd-EP (VCS/VCS-T) class notation, surveys mentioned in 6.3.1.3 of this Chapter are to be completed.

(6) It is to be confirmed that the ship has valid certificates or documents of compliance, record books and approved procedural documents required in Chapter 3 or 5 of CCS Rules for Green Eco-Ships.

6.5.1.4 Intermediate surveys

(1) For the G-EP/Gd-EP class notation, intermediate surveys applicable to the ship as specified in conventions and codes or Regulations for Domestic Ships mentioned in 6.5.1.3 above are to be completed.

(2) For the G-EP(X)/ Gd-EP(X) class notation, surveys mentioned in 6.5.1.4(1) of this Chapter are to be completed and the compliance with technical requirements corresponding to a specific X sub-element is to be verified.

(3) For the G-EP (BC20/BC70) class notation, the provisions of 6.5.1.3(4) of this Chapter are to be implemented.

(4) For the G-EP (VCS/VCS-T)/ Gd-EP (VCS/VCS-T) class notation, surveys mentioned in 6.3.1.3 of this Chapter are to be completed.

(5) It is to be confirmed that the ship has valid certificates or documents of compliance, record books and approved procedural documents required in Chapter 3 or 5 of CCS Rules for Green Eco-Ships.

6.5.1.5 Special surveys

(1) For the G-EP/Gd-EP class notation, special surveys applicable to the ship as specified in conventions and codes or Regulations for Domestic Ships mentioned in 6.5.1.4 above are to be completed.

(2) For the G-EP(X)/ Gd-EP(X) class notation, surveys mentioned in 6.5.1.5(1) of this Chapter are to be completed and the compliance with technical requirements corresponding to a specific X sub-element is to be verified.

(3) For the G-EP (BC20/BC70) class notation, the provisions of 6.5.1.3(4) of this Chapter are to be implemented.

(4) For the G-EP (VCS/VCS-T)/ Gd-EP (VCS/VCS-T) class notation, surveys mentioned in 6.3.1.4 of this Chapter are to be completed.

(5) It is to be confirmed that the ship has valid certificates or documents of compliance, record books and approved procedural documents required in Chapter 3 or 5 of CCS Rules for Green Eco-Ships.

6.5.1.6 For ships to which CCS is not authorized to carry out statutory services, it is to confirm that the ship has all relevant valid statutory certificates or documents, a general assessment of the items related to the statutory certificates is to be conducted, and verification of compliance of the ship with the requirements of this Chapter for class notations is to be carried out so as to confirm the compliance with all relevant requirements of this Chapter.

6.5.2 Class notations for ecological protection of green eco-ships

6.5.2.1 This paragraph applies to ships assigned the following class notations related to ecological protection:

(1) G-ECO ecological protection

(2) G-ECO(X) ecological protection, where X represents one or more of the following sub-elements:

① CDx CO_2 emission design index, where "x" represents the percentage ratio of the ship's Attained EEDI value lower than the reference line value for that ship;

② COM CO_2 emission operation management;

③ BWM(T) ballast water treatment;

④ BWM（Es） ballast water exchange-sequential method;

⑤ BWM（Ef） ballast water exchange-flow-through method;

⑥ BWM（Ed） ballast water exchange-dilution method;

⑦ BWM（O） other management method of ballast water;

⑧ BIO biofouling management;

⑨ VIBx comfort onboard (vibration), where x is 1 or 2 or 3;

⑩ NOIx comfort onboard (compartment noise), where x is 1 or 2 or 3;

⑪ CLx comfort onboard (indoor climate), where x is 1 or 2 or 3;

⑫ UW underwater noise;

⑬ RN ambient noise.

(3) Gd-ECO(X), ecological protection, where X represents one or more of the following sub-elements:

① CDx CO_2 emission design index, where "x" represents the percentage ratio of the ship's Attained EEDI value lower than the Required EEDI value for that ship;

② COM——CO2 emission operation management;

③ VIBx——comfort onboard (vibration), where x is 1 or 2 or 3;

④ NOIx——comfort onboard (compartment noise), where x is 1 or 2 or 3;

⑤ CLx——comfort onboard (indoor climate), where x is 1 or 2 or 3;

⑥ UW——underwater noise;

⑦ RN——ambient noise.

6.5.2.2 Initial classification

(1) Plans and information

① For ships intended to apply for the G-ECO class notation, plans and information are to be submitted in accordance with the provisions of 2.2.2, Chapter 2 of CCS Rules for Green Eco-Ships.

② For ships intended to apply for the G- ECO (X) class notation, plans and information required by the corresponding X sub-element are to be submitted in accordance with the provisions of 2.3.4, 2.4.3 and 2.5.6, Chapter 2 of CCS Rules for Green Eco-Ships.

③ For ships intended to apply for the Gd- ECO (X) class notation, plans and information required by the corresponding X sub-element are to be submitted in accordance with the provisions of 4.2.4 and 4.3.6, Chapter 4 of CCS Rules for Green Eco-Ships.

(2) The initial classification survey is to cover the following:

① For assignment of the G-ECO class notation, initial surveys applicable to the ship as specified in the following conventions and codes are to be completed and the requirements of 2.2.1, Chapter 2 of CCS Rules for Green Eco-Ships are to be satisfied:

a. regulations on energy efficiency for ships in MARPOL Annex VI;

b. BWM convention;

c. other international codes or guidelines referred to in 2.2.1, Chapter 2 of CCS Rules for Green Eco-Ships.

② For assignment of the G-ECO(X) class notation, surveys required for the following specific X sub-elements are to be completed and the compliance with corresponding technical requirements is to be verified:

a. CDx: CCS guidelines mentioned in 2.3.2, Chapter 2 of CCS Rules for Green Eco-Ships;

b. COM: IMO guidelines and CCS rules mentioned in 2.3.3, Chapter 2 of CCS Rules for Green Eco-Ships;

c. BWM(T/Ex/O): initial surveys specified in the BWM convention;

d. BIO: IMO guidelines mentioned in 2.4.2, Chapter 2 of CCS Rules for Green Eco-Ships;

e. VIBx: 2.5.1.2, Chapter 2 of CCS Rules for Green Eco-Ships;

f. NOIx: 2.5.2.2, Chapter 2 of CCS Rules for Green Eco-Ships;

g. CLx: 2.5.3.3, Chapter 2 of CCS Rules for Green Eco-Ships;

h. UW: 2.5.4.2, Chapter 2 of CCS Rules for Green Eco-Ships;

i. RN: 2.5.5.2, Chapter 2 of CCS Rules for Green Eco-Ships.

③ For assignment of the Gd-ECO(X) class notation, surveys required for the following specific X sub-elements are to be completed and the compliance with corresponding technical requirements is to be verified:

a. CDx: 4.2.2, Chapter 4 of CCS Rules for Green Eco-Ships;

b. COM: 4.2.3, Chapter 4 of CCS Rules for Green Eco-Ships;

c. VIBx: 4.3.1, Chapter 4 of CCS Rules for Green Eco-Ships;

d. NOIx: 4.3.2, Chapter 4 of CCS Rules for Green Eco-Ships;

e. CLx: 4.3.3, Chapter 4 of CCS Rules for Green Eco-Ships;

f. UW: 4.3.4, Chapter 4 of CCS Rules for Green Eco-Ships;

g. RN: 4.3.5, Chapter 4 of CCS Rules for Green Eco-Ships.

6.5.2.3 Annual surveys

(1) For the G-ECO and G-ECO (BWM (T/Ex/O)) class notations, annual surveys applicable to the ship as specified in the BWM convention are to be completed and the requirements of 2.2.1 or 2.4.1, Chapter 2 of CCS Rules for Green Eco-Ships are to be satisfied.

(2) It is to be confirmed that the ship has valid certificates or documents of compliance, record books and approved procedural documents in Chapter 2 or 4 of CCS Rules for Green Eco-Ships.

~~6.5.2.4 Intermediate surveys~~

~~(1) For the G-ECO and G-ECO (BWM (T/Ex/O)) class notations, intermediate surveys applicable to the ship as specified in the BWM convention are to be completed.~~

~~(2) It is to be confirmed that the ship has valid certificates or documents of compliance, record books and approved procedural documents in Chapter 2 or 4 of CCS Rules for Green Eco-Ships.~~

~~6.5.2.5 Special surveys~~

~~(1) For the G-ECO and G-ECO (BWM (T/Ex/O)) class notations, renewal surveys applicable to the ship as specified in the BWM convention are to be completed.~~

~~(2) It is to be confirmed that the ship has valid certificates or documents of compliance, record books and approved procedural documents in Chapter 2 or 4 of CCS Rules for Green Eco-Ships.~~

~~6.5.2.6 For ships to which CCS is not authorized to carry out statutory services, it is to confirm that the ship has all relevant valid statutory certificates or documents, a general assessment of the items related to the statutory certificates is to be conducted, and verification of compliance of the ship with the requirements of this Chapter for class notations is to be carried out so as to confirm the compliance with all relevant requirements of this Chapter.~~

CHINA CLASSIFICATION SOCIETY

RULES FOR CLASSIFICATION OF SEA-GOING STEEL SHIPS

AMENDMENTS

2023

PART TWO HULL

CONTENTS

CHAPTER 1 GENERAL

Section 1 GENERAL PROVISIONS

1.1.2 Definitions

1.1.2.21 Position 1 is~~,~~ as defined in Regulation 13 of Annex I to the International Convention on Load Lines, 1966~~, upon exposed freeboard and raised quarterdecks, and upon exposed superstructure decks situated forward of a point located a quarter of the load line length from the forward perpendicular~~.

1.1.2.22 Position 2 is~~,~~ as defined in Regulation 13 of Annex I to the International Convention on Load Lines, 1966~~, upon exposed superstructure decks situated abaft a quarter of the ship's length from the forward perpendicular and located at least one standard height of superstructure above the freeboard deck, and upon exposed superstructure decks situated forward of a quarter of the load line length from the forward perpendicular and located at least two standard heights of superstructure above the freeboard deck~~.

Section 4 WELD DESIGN FOR HULL STRUCTURES

1.4.2 Welding consumables

1.4.2.3 Low hydrogen ~~electrodes~~ welding consumables are to be used for the welding of the following structural members and components:

(1) Circumferential butt welds in the joining of block sections and butt welds of girders;

(2) End and side joints of the shell of ships with ice strengthening;

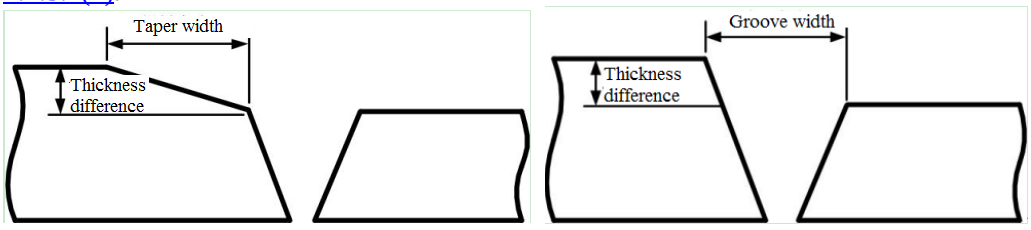
(3) Masts, derricks, boat davits, bollards and other outfits subjected to heavy loads and all other highly stressed fittings;

(4) Components for which high rigidity is required, such as stems, stern frames, propeller shaft brackets, and joints between them and the shell plating and the hull framing;

(5) Main engine seatings and the associated structural members.

1.4.3 Butt, lap and slot welds

1.4.3.1 Where plates of different thicknesses are to be butt welded and the difference in thickness is ~~equal to or~~ greater than 4 mm, the edge of the thicker plate is to be tapered so as to ensure a uniform transition. The width of taper is not to be less than 3 times the difference in thickness, as shown in Figure 1.4.3.1(1). Where the difference in thickness is ~~less~~ more than 4 mm and the groove width is not less than 3 times the difference in thickness, taper may not be necessary and the transition may be achieved within the width of the weld, as shown in Figure 1.4.3.1(2).



(1) (2)

Figure 1.4.3.1 Butt welding of steel plates of different thickness

1.4.4 Fillet welds

1.4.4.13 Single-sided continuous fillet welding may be acceptable for dry spaces in deckhouse. Where this is adopted, the fillet leg length K is to be 2 times the value calculated in 1.4.4.2, where d / l is to be taken as 1.

CHAPTER 2 HULL STRUCTURES

Section 15 STRENGTHENING AT ENDS OF SHIP

2.15.1 Fore peak strengthening

2.15.1.6 Where a fore peak space is used as a tank and the breadth of the tank at its widest point exceeds 0.5B (B being the breadth of ship), efficient supporting members or wash bulkheads are to be fitted to support the panting beams. The wash bulkheads are to comply with the requirements of 2.13.10.2 of this Chapter.

2.15.1.7 Where the length of the fore peak space exceeds 10 m, additional transverse strengthening in the form of transverse wash bulkheads or web frames is to be provided. Transverse wash bulkheads are to comply with the provisions in 2.13.10.2 of this Chapter while web frames are to comply with the provisions in 2.7.2.8 of this Chapter.

Section 20 HATCHWAYS AND HATCH COVERS

2.20.2 Weathertight steel hatch covers

2.20.2.4 Strength calculation

(2) General requirements for FEM calculations

For strength calculations of hatch covers by means of finite elements, the cover geometry is to be idealized as realistically as possible. Element size is to be appropriate to account for effective breadth. In no case element width is to be larger than stiffener spacing. In way of force transfer points and cutouts the mesh has to be refined where applicable. The ratio of element length to width is not to exceed 4.

The element height of webs of primary supporting members is not to exceed one-third of the web height. Stiffeners and supporting plates against pressure loads have to be included in the idealization. Stiffeners may be modelled using shell elements, plane stress elements or beam elements. Buckling stiffeners may be disregarded for the stress calculation.

① A right-handed coordinate system is to be used with:
the *x*-axis measured in the longitudinal direction, positive forward;
the *y*-axis measured in the transverse direction, positive to port from the centerline;
the *z*-axis measured in the vertical direction, position upward.

② The FEM is to be performed with net scantlings.

③ The finite element model is to be limited as follows:

(a) for symmetry of the hatch cover girders, ~~or~~ loads and supporting boundary conditions about only the x-axis or y-axis, it may be limited to a half of the hatch cover for check;

(b) for non-symmetry of hatch cover girders, ~~or~~ loads or supporting boundary conditions about any of the axes, the whole hatch cover may be taken for strength evaluation, see Figure 2.20.2.4(1).

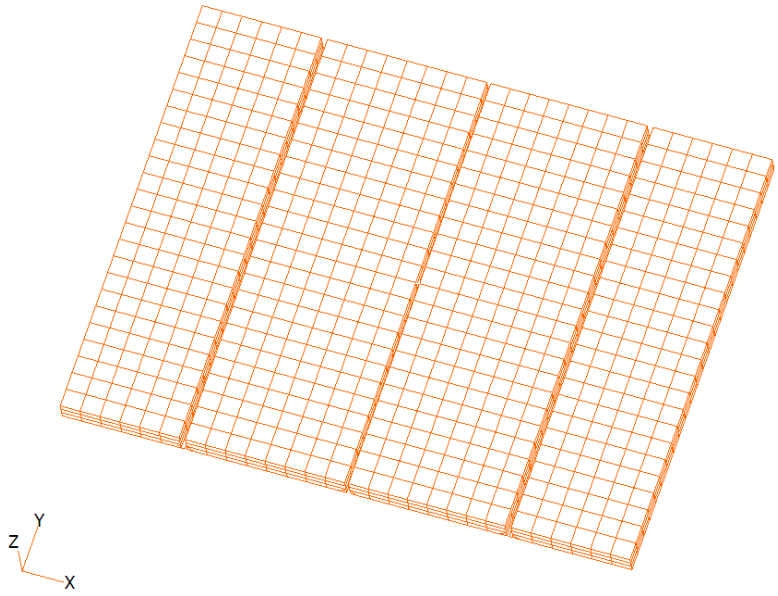


Figure 2.20.2.4(1) Finite Element Hatch Cover Model

④ The model element is to comply with the following requirements:

(a) all plating, including girders and stiffeners, is to be represented by the finite element model;

(b) all plating, such as top plates, bottom plates, brackets, and girder webs, face plates of primary supporting members is to modeled using plate elements, triangular elements are to be avoided where possible;

(c) all stiffeners are to be modeled using beam, rod or plate elements.

⑤ The element mesh size is to be controlled as follows:

(a) the mesh size is not to be greater than the spacing of stiffeners;

(b) the girders are to be represented by at least 3 elements in the depth;

(c) triangular and distorted quadrilateral elements with corner angles less than 60 degrees and greater than 120 degrees are to be avoided.

⑥ Boundary conditions are to be determined as follows:

(a) for symmetry of the hatch cover girders and loads about the x-axis, the longitudinal displacement of nodes in the symmetric plane and the rotations about the *y* and *z* axes are to be taken as 0 respectively, i.e. $\delta_x = \theta_y = \theta_z = 0$, as shown in Figure 2.20.2.4(2);

(b) for symmetry of the hatch cover girders and loads about the *y*-axis, the transverse displacement of nodes in the symmetric plane and rotation about the *x* and *z* axes are to be taken as 0 respectively i.e. $\delta_y = \theta_x = \theta_z = 0$, as shown in Figure 2.20.2.4(2);

(c) boundary nodes in way of bearing pads on the hatch coamings are generally to be fixed against displacement in the *z* direction, i.e. $\delta_z = 0$;

(d) lifting stoppers are to be fixed against displacements in the direction determined by the stoppers;

(e) hinges in folding type hatch covers are to be represented as rigid links which tie together displacements in the *z* direction.

Section 22 STRENGTHENED FOR HEAVY CARGOES

2.22.1 General requirements

2.22.1.1 ~~Dry cargo ships~~ Ships complying with the requirements of this Section will be assigned the class notation: Strengthened for Heavy Cargoes.

2.22.1.2 Ships of loading rate γ not greater than $0.833 m^3/t$ (see 1.1.2.15 of Chapter 1) are to comply with the requirements of this Section, except when loaded by steel coils on a wooden support.

2.22.1.3 Special considerations are to be given to strengthening requirements where the inner bottom plating of the cargo hold is loaded by bulky cargo or bearing concentrated load.

Section 25 ~~INNER BOTTOM~~STRUCTURAL STRENGTHENING LOADED BY STEEL COILS ON A WOODEN SUPPORT

2.25.1 General requirements

2.25.1.1 The thickness of inner bottom plating, bilge hopper sloping plate and inner hull plating up to a height not less than the one corresponding to the top of upper tier in touch with hopper or inner hull plating as well as section modulus and shear area of stiffeners for ships intended to carry steel coils are to comply with the requirements of this Section.

2.25.1.2 The provision is determined based on the assumption of Figure 2.25.1.2 as the standard means of securing steel coils on the dunnage.

2.25.1.3 All steel coils are presumed to be of the same characters.

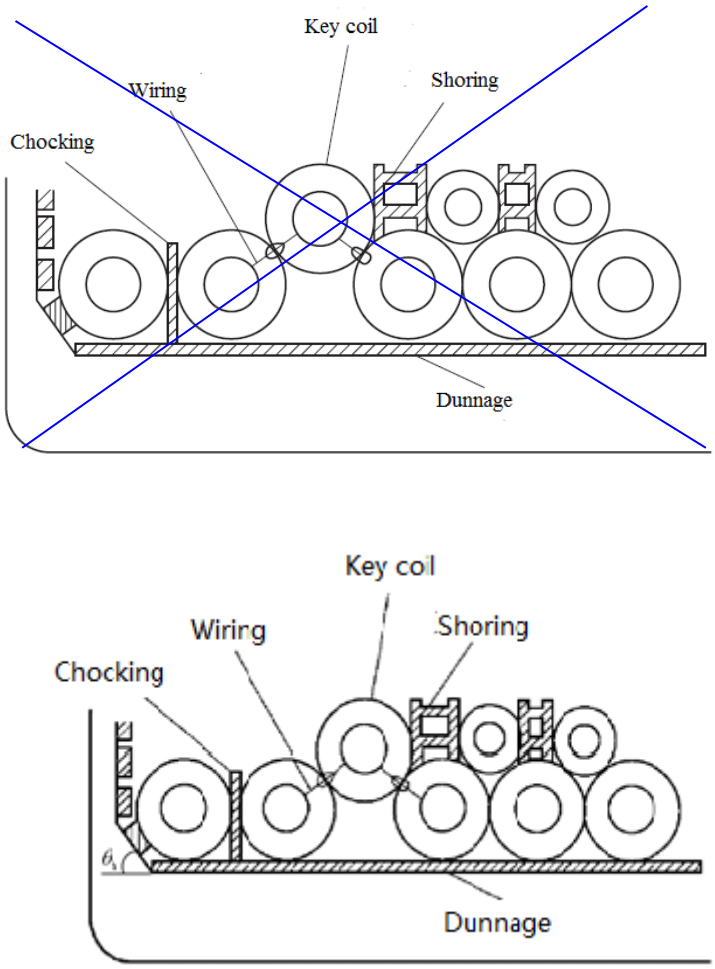


Figure 2.25.1.2 Inner Bottom Loaded by Steel Coils

2.25.2 Accelerations

2.25.2.1 In order to calculate the accelerations, the following coordinates are to be used for the transverse and vertical positions of calculated point:

$$y_{G-SC} = \begin{cases} B_h/4 & \text{for port} \\ -B_h/4 & \text{for starboard} \end{cases}$$

$$z_{G-SC} = h_{DB} + \left\{1 + (n_1 - 1)\frac{\sqrt{3}}{2}\right\}\frac{d_{SC}}{2}$$

where: B_h — breadth in m, at the mid of the hold, of the cargo hold at the level of connection of bilge hopper plate with side shell or inner hull;

d_{sc} — diameter of steel coils, in m;

h_{DB} — depth of double bottom, in m.

Vertical acceleration a_v, in m/s^2, are to be calculated by the formulae defined in 1.5.2 of Section 5, Chapter 1 of this PART and tangential acceleration a_R due to roll, in m/s^2, is to be calculated by the following formula:

$$a_R = \varphi_m \left(\frac{2\pi}{T_R}\right)^2 \sqrt{y_{G-SC}{}^2 + R^2}$$

where: φ_m, maximum angle of roll, T_R, roll period — see the formulae defined in 1.5.2 of Section 5, Chapter 1 of this PART;

$$R = z_{G-SC} - \min\left(\frac{D}{4} + \frac{d}{2}, \frac{D}{2}\right)$$

where: d — draught, in m.

2.25.3 Inner bottom plating

2.25.3.1 The thickness of plating of longitudinally framed inner bottom is not to be less than the value obtained, in mm, from the following formula:

~~$t = K_1\sqrt{\dfrac{(g + 0.5a_v)F_{SC}K}{235\lambda_p}} + 2.5$ mm~~

$$t = K_1\sqrt{\frac{(g + 0.5a_v)F_{SC}}{\lambda_p R_{eH}}} + t_c \text{ mm}$$

where: K_1— coefficient taken equal to:

$$K_1 = \sqrt{\frac{1.7slK_2 - 0.73s^2K_2^2 - (l - l')^2}{2l'(2s + 2lK_2)}}$$

t_c ——corrosion addition, in mm, generally taken 2.5mm, to be taken 5 mm where the cargo holds are designed for loading/unloading by grabs;

a_v ——vertical acceleration, in m/s^2, calculated according to the formula defined in 1.5.2, Section 5, Chapter 1 of this PART;

g ——acceleration due to gravity, g = 9.81 m/s^2;

F_{SC} ——equivalent mass of steel coils, in kg, taken equal to:

$$F_{SC} = K_S\frac{W_{SC}n_1n_2}{n_3}, \text{ for } n_2 \le 10 \text{ and } n_3 \le 5$$

~~$F_{SC} = K_S n_1 W_{SC}\dfrac{l}{l_s}$, for $n_2 > 10$ and $n_3 > 5$~~

λ_p ——permissible bending stress coefficient of plating, generally taken 0.8, to be taken 0.9 as the calculated structural member is not contributing to the hull girder longitudinal strength;

l — length of long edge of elementary plate panel taken along the side length, in m;

s — length of short edge of elementary plate panel taken along the side length in way of middle of span l, in m;

K_s— coefficient, taken equal to:

K_s =1.4 when steel coils are lined up in one tier with a key coil;

K_s =1.0 in other cases;

W_{SC}— mass of one steel coil, in kg;

~~K — material factor;~~

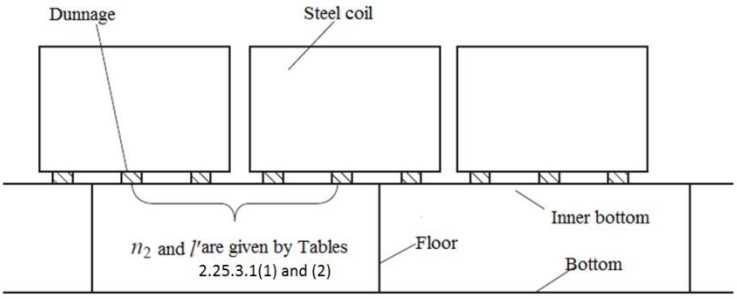
R_{eH}——minimum yield stress of material, in N/mm^2;

n_1— number of tiers of steel coils;

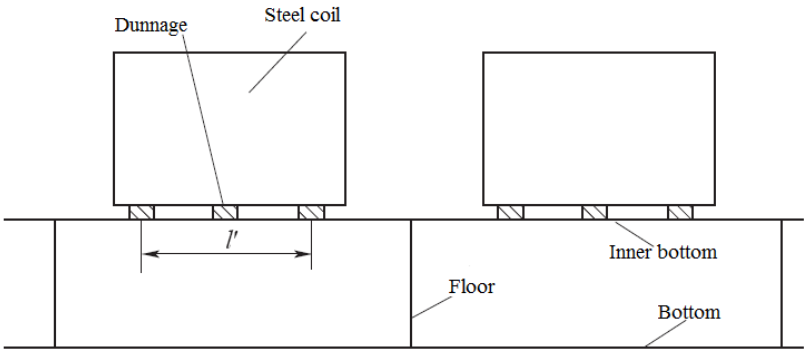
n_2— number of load points per elementary plate panel of inner bottom (see Figure 2.25.3.1). ~~When n3 ≤ 5, n_2 may be obtained from Table 2.25.3.1(1) according to values of n3 and l/ls.~~ For steel coil loading related to floor plates of inner bottom (see Figure 2.25.3.1(2)), $n_2 = n_3$; for steel coil loading irrelevant to floor plates of inner bottom (see Figure 2.25.3.1(1)), n_2 is to be consistent with Table 2.25.3.1(1). For cases not included in Table 2.25.3.1(1), n_2 is to be determined in accordance with the following formula:

$$\frac{n_2 - 1}{n_3} + INT\left(\frac{n_2 - 1}{n_3}\right) \cdot 0.2 < \frac{l}{l_s} \le \frac{n_2}{n_3} + INT\left(\frac{n_2}{n_3}\right) \cdot 0.2$$

where: $INT(\ )$ is the integral function, taking the integral parts of values.



(1)



(2)

Figure 2.25.3.1 Loading Condition of Steel Coils

n_3 — number of dunnages supporting one steel coil;

l_s — length of a steel coil, in m;

K_2— coefficient taken equal to:

$$K_2 = -\frac{s}{l} + \sqrt{\left(\frac{s}{l}\right)^2 + 1.37\left(\frac{l}{s}\right)^2\left(1 - \frac{l'}{l}\right)^2 + 2.33}$$

l'— distance, in m, between outermost load points per elementary plate panel in ship's length (see Figure 2.25.3.1). ~~When n2 ≤10 and n3 ≤ 5, l5 may be obtained from Table 2.25.3.1(2), according to the values of l, ls, n2 and n3. When n2 > 10 or n3 > 5, l' is to be taken equal to l.~~ For steel coil loading related to floor plates of inner bottom

(see Figure 2.25.3.1(2)), l' is to be the distance between the dunnages of the external ends supporting the steel coils; for steel coil loading irrelevant to floor plates of inner bottom (see Figure 2.25.3.1(1)), l' is to be consistent with Table 2.25.3.1(2). For cases not included in Table 2.25.3.1(2), l' is to be determined in accordance with the following formula:

$$l' = \left(\frac{n_2 - 1}{n_3} + 0.2 \cdot INT\left(\frac{n_2}{n_3}\right)\right) l_s$$

where: $INT(\ )$ is the integral function, taking the integral parts of values.

Number *n*2 of Load Points per Elementary Plate Panel **Table 2.25.3.1(1)**

n_2	$n_3 = 2$	$n_3 = 3$	$n_3 = 4$	$n_3 = 5$
1	$0 < \frac{l}{l_s} \le 0.5$	$0 < \frac{l}{l_s} \le 0.33$	$0 < \frac{l}{l_s} \le 0.25$	$0 < \frac{l}{l_s} \le 0.2$
2	$0.5 < \frac{l}{l_s} \le 1.2$	$0.33 < \frac{l}{l_s} \le 0.67$	$0.25 < \frac{l}{l_s} \le 0.5$	$0.2 < \frac{l}{l_s} \le 0.4$
3	$1.2 < \frac{l}{l_s} \le 1.7$	$0.67 < \frac{l}{l_s} \le 1.2$	$0.5 < \frac{l}{l_s} \le 0.75$	$0.4 < \frac{l}{l_s} \le 0.6$
4	$1.7 < \frac{l}{l_s} \le 2.4$	$1.2 < \frac{l}{l_s} \le 1.53$	$0.75 < \frac{l}{l_s} \le 1.2$	$0.6 < \frac{l}{l_s} \le 0.8$
5	$2.4 < \frac{l}{l_s} \le 2.9$	$1.53 < \frac{l}{l_s} \le 1.87$	$1.2 < \frac{l}{l_s} \le 1.45$	$0.8 < \frac{l}{l_s} \le 1.2$
6	$2.9 < \frac{l}{l_s} \le 3.6$	$1.87 < \frac{l}{l_s} \le 2.4$	$1.45 < \frac{l}{l_s} \le 1.7$	$1.2 < \frac{l}{l_s} \le 1.4$
7	$3.6 < \frac{l}{l_s} \le 4.1$	$2.4 < \frac{l}{l_s} \le 2.73$	$1.7 < \frac{l}{l_s} \le 1.95$	$1.4 < \frac{l}{l_s} \le 1.6$
8	$4.1 < \frac{l}{l_s} \le 4.8$	$2.73 < \frac{l}{l_s} \le 3.07$	$1.95 < \frac{l}{l_s} \le 2.4$	$1.6 < \frac{l}{l_s} \le 1.8$
9	$4.8 < \frac{l}{l_s} \le 5.3$	$3.07 < \frac{l}{l_s} \le 3.6$	$2.4 < \frac{l}{l_s} \le 2.65$	$1.8 < \frac{l}{l_s} \le 2.0$
10	$5.3 < \frac{l}{l_s} \le 6.0$	$3.6 < \frac{l}{l_s} \le 3.93$	$2.65 < \frac{l}{l_s} \le 2.9$	$2.0 < \frac{l}{l_s} \le 2.4$

Distance between Load Points in Ship Length Direction per Elementary Plate Panel of Inner Bottom

Table 2.25.3.1(2)

n_2	n_3			
	2	3	4	5
1	Actual breadth of dunnage			
2	$0.5l_s$	$0.33l_s$	$0.25l_s$	$0.2l_s$
3	$1.2l_s$	$0.67l_s$	$0.50l_s$	$0.4l_s$
4	$1.7l_s$	$1.20l_s$	$0.75l_s$	$0.6l_s$
5	$2.4l_s$	$1.53l_s$	$1.20l_s$	$0.8l_s$
6	$2.9l_s$	$1.87l_s$	$1.45l_s$	$1.2l_s$

7	$3.6l_s$	$2.40l_s$	$1.70l_s$	$1.4l_s$
8	$4.1l_s$	$2.73l_s$	$1.95l_s$	$1.6l_s$
9	$4.8l_s$	$3.07l_s$	$2.40l_s$	$1.8l_s$
10	$5.3l_s$	$3.60l_s$	$2.65l_s$	$2.0l_s$

2.25.4 Bilge hopper sloping plate and inner hull plate

2.25.4.1 The thickness of plating of longitudinally framed bilge hopper sloping plate and inner hull is not to be less than the value obtained, in mm, from the following formula:

~~$t = K_1\sqrt{\frac{a_{hopper}F'_{SC}K}{235\lambda_p}} + 2.5$ mm~~

$$t = K_1\sqrt{\frac{a_{hopper}F'_{SC}}{\lambda_p R_{eH}}} + t_c \text{ mm}$$

where: *K1*— coefficient, defined in 2.25.3;

t_c ——corrosion addition, in mm, generally taken 2.5 mm, to be taken 3.5 mm for bilge hopper sloping plate and inner hull plate within 1.5 m height from the lowest point of inner bottom where the cargo holds are designed for loading/unloading by grabs;

~~*K* — material factor;~~

R_{eH} ——minimum yield stress of material, N/mm^2;

a_{hopper} ——factor taken equal to:

$$a_{hopper} = -a_R \sin\left(\tan^{-1}\left|\frac{y_{G-SC}}{R}\right| - \theta_h\right) + g\cos\left(\theta_h - \varphi_m\right)$$

θ_h ——angle, in degree, between inner bottom plate and bilge hopper sloping plate or inner hull plate, see Figure 2.25.1.2;

φ_m — in degree, see formula specified in 1.5.2 of Section 5, Chapter 1 of this PART;

a_R— tangential acceleration defined in 2.25.2;

g — acceleration due to gravity, g = 9.81 m/s^2;

y_{G-SC}— centre of gravity in transverse direction, in m, defined in 2.25.2;

R— factor, defined in 2.25.2;

F'_{SC}—equivalent mass of steel coils, in kg, taken equal to:

$$F'_{SC} = C_k \cdot \frac{W_{SC}n_2}{n_3} \quad \text{~~for } n_2 \le 10 \text{ and } n_3 \le 5$$

~~$F'_{SC} = C_k W_{SC}\frac{l}{l_s}$ for $n_2 > 10$ and $n_3 > 5$~~

λ_p ——permissible bending stress coefficient of plating, defined in 2.25.3;

C_k ——coefficient, taken equal to:

~~$C_k = 2.2$~~ $C_k = 3.2$, when steel coils are lined up two or more tier, or when steel coils are lined up one tier and key coil is located second or third from bilge hopper sloping plate or inner hull plate;

~~$C_k = 1.2$~~ $C_k = 2.0$, in other cases.

2.25.5 Stiffeners of inner bottom

2.25.5.1 The section modulus *W* and the shear area *A* of single span stiffeners located on inner bottom plating are not to be less than the values obtained from the following formulae:

~~$W = K_3 \dfrac{(g + 0.5a_v) F_{SC} K}{2820}$ cm^3~~

~~$A = \dfrac{4(g + 0.5a_v) F_{SC}}{\tau_a \sin\phi} \times 10^{-3}$ cm^2~~

$W = 1.1K_3 \dfrac{(g + 0.5a_v) F_{SC}}{8\lambda_s R_{eH}}$ cm^3

$A = \dfrac{5(g + 0.5a_v) F_{SC}}{0.9\tau_{eH} \sin\phi} \times 10^{-3}$ cm^2

where: K_3— coefficient, defined in Table 2.25.5.1, to be taken as ~~$2l/3$~~ $2l_e/3$ for $n_2 > 10$;

~~l — length of long edge of elementary plate panel taken along the side length, in m;~~

l_e ——effective span of stiffeners, in m, see 1.2.3, Section 2, Chapter 1 of this PART;

a_v— vertical acceleration, in m/s^2, calculated according to the formula defined in 1.5.2, Section 5, Chapter 1 of this PART;

g — acceleration due to gravity, g = 9.81 m/s^2;

F_{SC}—equivalent mass of steel coils, in kg, defined in 2.25.3;

~~K — material factor;~~

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

λ_s ——permissible bending stress coefficient of stiffeners, taken 0.9;

~~τ_a~~ τ_{eH} ——shear yield stress of material ~~strength~~, in N/mm^2, taken equal to:

~~$\tau_a = \dfrac{235}{\sqrt{3}K}$~~

$\tau_{eH} = \dfrac{R_{eH}}{\sqrt{3}}$

ϕ ——angle between stiffener web and shell plating, in degree, to be taken at the middle of span of stiffener.

Coefficient K_3 **Table 2.25.5.1**

n_2	1	2	3	4	6	7	8	9	10
K_3	l	$l - \dfrac{l'^2}{l}$	$l - \dfrac{2l'^2}{3l}$	$l - \dfrac{5l'^2}{9l}$	$l - \dfrac{7l'^2}{15l}$	$l - \dfrac{4l'^2}{9l}$	$l - \dfrac{3l'^2}{7l}$	$l - \dfrac{5l'^2}{12l}$	$l - \dfrac{11l'^2}{27l}$

n_2	1	2	3	4	6	7	8	9	10
K_3	l_e	$l_e - \dfrac{l'^2}{l_e}$	$l_e - \dfrac{2l'^2}{3l_e}$	$l_e - \dfrac{5l'^2}{9l_e}$	$l_e - \dfrac{7l'^2}{15l_e}$	$l_e - \dfrac{4l'^2}{9l_e}$	$l_e - \dfrac{3l'^2}{7l_e}$	$l_e - \dfrac{5l'^2}{12l_e}$	$l_e - \dfrac{11l'^2}{27l_e}$

2.25.6 Stiffeners located on bilge hopper sloping plate or inner hull plate

2.25.6.1 The section modulus W and the net shear area A of single span stiffeners located on bilge hopper sloping plate and inner hull plate are not to be less than the values obtained from the following formulae:

~~$W = K_3 \dfrac{a_{hopper} F'_{SC} K}{2820}$ cm^3~~

~~$A = \dfrac{4a_{hopper} F'_{SC}}{\tau_a \sin\phi} \times 10^{-3}$ cm^2~~

$$W = 1.1K_3 \frac{a_{hopper} F_{SC}^{'}}{8\lambda_s R_{eH}} \quad \text{cm}^3$$

$$A = \frac{5a_{hopper} F_{SC}^{'}}{0.9\tau_{eH} \sin\phi} \times 10^{-3} \quad \text{cm}^2$$

where: K_3— coefficient, defined in Table 2.25.5.1, to be taken as ~~$2l/3$~~ $2l_e/3$ for $n_2 > 10$;

l_e ——effective span of stiffeners, in m, see 1.2.3, Section 2, Chapter 1 of this PART;

~~K material factor;~~

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

a_{hopper} ——coefficient, defined in 2.25.4.1;

~~τ_a~~ τ_{eH} ——shear yield stress of material ~~strength~~, in N/mm^2, see 2.25.5.1;

λ_s ——permissible bending stress coefficient of stiffeners, see 2.25.5.1;

$F_{SC}^{'}$ ——equivalent mass of steel coils, in kg, defined in 2.25.4;

ϕ ——angle, in degree, defined in 2.25.5.

CHAPTER 3 EQUIPMENT AND OUTFITS

Section 1 RUDDERS

3.1.4 Rudder stock scantlings

3.1.4.3 Before significant reductions in rudder stock diameter due to the application of steels with specified minimum yield stresses exceeding 235 N/mm^2 are granted, CCS may require the evaluation of the rudder stock deformations. Large deformations of the rudder stock are to be avoided in order to avoid excessive edge pressures in way of bearings.

3.1.6 Rudder stock couplings

3.1.6.3 Cone couplings with key

(5) Notwithstanding the requirements of 3.1.6.3(2) and 3.1.6.3(4), where a key is fitted to the coupling between stock and rudder and it is considered that the entire rudder torque is transmitted by the key at the couplings, the scantlings of the key as well as the push-up force and push-up length are to be ~~subject to special consideration~~ calculated according to the torque transmitted (not to be greater than the design yielding torque of the rudder stock.

3.1.7 Pintles

3.1.7.4 Pintle housing

The length of the pintle housing in the gudgeon is not to be less than the pintle diameter d_p. d_p is to be measured on the outside of ~~liners~~ shaft sleeves.

The thickness of the pintle housing is not to be less than 0.25 d_p.

Section 7 SUPPORT STRUCTURE FOR DECK EQUIPMENT

3.7.3 Supporting structure for cranes, derricks and lifting masts

3.7.3.11 For calculation and analysis requirements and modeling method, refer to 3.7.2.5 and 3.7.2.6 of this Section. The thicknesses of structural members in the model are as built ones.

Permissible Stress **Table 3.7.3.12**

Type of element	Permissible stress
Grillage	Direct stress: $[\sigma] = 0.67R_{eH}$ Shear stress: $[\tau] = 0.39R_{eH}$
Plate element	Equivalent stress: $[\sigma_e] = 0.80R_{eH}$

where: R_{eH} – yield stress of material, in N/mm^2.

3.7.4 Supporting structures for components used in emergency towing arrangements

3.7.4.7 For calculation and analysis requirements and modeling method, refer to 3.7.2.5 and 3.7.2.6 of this Section. The thicknesses of structural members in the model are as built ones.

3.7.5 Supporting structures for other deck equipment or fittings which are subject to specific approval

3.7.5.2 Support for lifting appliances for personnel is to be provided as follows:

(1) in general, lifesaving appliances (lifeboats, life rafts and rescue boats) are to be stowed on a purpose built cradle, seat or deployment appliance. The design load imposed on the ship structure is to be established by the supplier of the lifesaving appliance (to include 2.2 times of bearing reaction and torque under maximum working load as a minimum). For calculation and analysis requirements and modeling method, refer to 3.7.2.5 and 3.7.2.6 of this Section. The thicknesses of structural members in the model are as built ones. The calculated stresses are not to exceed the permissible values given in Table 3.7.3.12. The supplier of the life-saving appliance is to provide corresponding calculation information;

Appendix 1 GUIDELINES FOR CALCULATION OF BENDING MOMENT AND SHEAR FORCE DISTRIBUTION

2 The Forces on Rudder–Rudder Stock

2.5 Semi spade rudder with 2-conjugate elastic support

……

Rudder horn shear stress calculation

For a generic section of the rudder horn, located between its lower and upper bearings, the following stresses are to be calculated:

τ_s ——shear stress, in N/mm2, to be obtained from the following formula:

$$\tau_s = \frac{F_{A1}}{A_H} \qquad \text{N/mm}^2$$

τ_T ——torsional stress, in N/mm2, to be obtained for hollow rudder horn from the following formula:

$$\tau_T = \frac{M_T 10^{-3}}{2F_T t_H} \qquad \text{N/mm}^2$$

For solid rudder horn, τ_T is to be ~~considered by CCS on a case by case basis~~ calculated based on the specific geometrical shape.

CHAPTER 12 BARGES

Section 1 GENERAL PROVISIONS

12.1.1 Application

12.1.1.1 The barges defined in this Chapter are non-self-propelled ships pushed or towed by other ships and divided into the following types:

(1) Barges carrying general dry cargo in cargo holds;

(2) Barges carrying cargo oil in cargo tanks;

(3) Shipborne barges carrying general dry cargo in cargo holds and carried on board a barge carrier;

(4) Specially designed pontoons for the carriage of cargo on deck.

(5) Barges dedicated to transporting marine engineering jacket structure and landing jacket into water by the stern for launching of jacket.

12.1.1.2 Where not covered by this Chapter, barges carrying cargo oil in bulk in cargo tanks are to comply with the relevant requirements of Chapter 5 or 6 of this PART according to its structural configuration and other barges are to comply with the relevant requirements of Chapter 2 of this PART.

12.1.1.3 For pontoons regarded as one of offshore floating facilities, the structure may be in accordance with the requirements of this Chapter for pontoon barges.

12.1.2 Class notations

12.1.2.1 Barges complying with the requirements of this Chapter are eligible to be assigned one of the following class notations:

(1) Barges: the notation Barge is to be assigned to the barges as defined in 12.1.1.1(1);

(2) Oil barges: the notation Oil Barge is to be assigned to the barges as defined in 12.1.1.1(2);

(3) Shipborne barges: the notation Shipborne Barge is to be assigned to the barges as defined in 12.1.1.1(3);

(4) Pontoon barges: the notation Pontoon Barge is to be assigned to the barges as defined in 12.1.1.1(4).

(5) Launch Barge: the notation Launch Barge is to be assigned to the barges as defined in 12.1.1.1(5).

CHAPTER 14 DREDGERS

Section 9 SPLIT HOPPER DREDGERS AND BARGES

14.9.3 Deck hinges and hydraulic installations

14.9.3.7 The dynamic load induced by the ship's motions in waves and acting on deck hinges and hydraulic installations is to be obtained from the dynamic calculation and statistic analysis in accordance with sea conditions for predicted operations. Where the significant wave height is no more than 3 m in sea conditions for predicted operations, the dynamic load may also be calculated in accordance with the following formulas:

Horizontal dynamic force of deck hinges: $F_{dh} = 0.28 fB^2 L$ kN

Vertical dynamic force of deck hinges : $F_{dv} = 0.055 fB^2 L^2 / d$ kN

where: L——ship length, in m;

B——ship width, in m;

d——distance between deck hinges, in m;

f——coefficient, taken f=1.5.

CHAPTER 20 MEMBRANE TANK LIQUEFIED GAS CARRIERS

Section 5 DECKS STRUCTURES

20.5.3 Deck girders

20.5.3.1 ~~Centre girders are to be fitted in double box trunk deck in way of longitudinal centreline with side girders fitted at both sides~~. ~~At least two~~ Side girders are to be fitted~~, including deck girders~~ at the knuckle line of inner deck in double box trunk deck~~, respectively at both sides of the centre girder~~. The ~~side~~deck girders are to be equally spaced so far as practicable.

Appendix 2 STRUCTURAL STRENGTH ASSESSMENT OF HULL AND PUMP TOWER UNDER SLOSHING LOADS

3 ASSESSMENT OF SCANTLING REQUIREMENTS FOR TANK STRUCTURE UNDER SLOSHING LOADS

3.2 Assessment of tank structure under level 1 and level 2 sloshing loads

3.2.1 Plating forming tank boundaries

The thickness of plating forming tank boundaries, t, subjected to sloshing pressures is not to be less than that obtained from the following formula:

$$t = 0.0174\alpha_p s\sqrt{\frac{P}{C_a R_{eH}}} \text{ mm}$$

where: $\alpha_p = 1.2 - \frac{s}{2100 l_p}$, but to be taken not greater than 1.0;

s — stiffener spacing, in mm;

l_p — length of plate panel, to be taken as the spacing of primary members, unless carlings are fitted, in m;

P — sloshing load, to be taken as the greater of P_1 and P_2, in kN/m^2;

C_a — permissible plate bending stress coefficient, see Table 3.2.1;

R_{eH} — yield stress of the material, in N/mm^2.

CHINA CLASSIFICATION SOCIETY

RULES FOR CLASSIFICATION OF SEA-GOING STEEL SHIPS

AMENDMENTS

2023

PART THREE
MACHINERY INSTALLATIONS

CONTENTS

CHAPTER 1 GENERAL

Section 2 GENERAL PROVISIONS

1.2.7 Automation of machinery installations

1.2.7.1 ~~Ships granted with automation notations~~ Automation for machinery installations are to ~~additionally~~ comply with the relevant requirements of PART SEVEN of the Rules.

1.2.11 Clean energy and power

1.2.11.4 Ships using methyl/ethyl as fuel are, in addition to the relevant provisions of this PART, to comply with relevant requirements of ~~Pt. 1 of the Guidelines for Ships Using Alternative Fuel~~ the Guidelines for Ships Using Methanol/Ethanol Fuel.

CHAPTER 2 PUMPING AND PIPING SYSTEMS

Appendix 1 PRODUCTION AND APPLICATION OF PLASTIC PIPING SYSTEMS ON SHIPS①

1.1 Terms and Definitions of this Appendix

1.1.3 "Joint" means the location at which two pieces of pipe or a pipe and a fitting are connected together. The joint may be made by adhesive bonding, laminating, welding, flanges, ~~etc.~~ and mechanical joints listed in Table 2.5.3.1(1), Chapter 2 of this PART.

1.1.8 "Essential to the safety of ship" means all piping systems that in event of failure will pose a threat to personnel and the ship (piping systems essential to the safety are provided by Table 1.4.1).

1.1.9 "Essential services" are those services essential for propulsion and steering and safety of the ship as specified in 1.1.2, Chapter 1, PART FOUR of these Rules.

1.2 Scope

1.2.2 The use ~~Use~~ of mechanical ~~and flexible couplings which are accepted~~ joints approved for the use in metallic piping systems ~~is~~ only are not ~~addressed~~ applicable in this Appendix.

1.2.3 Piping systems intended for non-essential services are to meet only the requirements of recognized standards and 1.3.1(3)②, 1.4.2, 1.5.2~1.5.7 and 1.6 of this Appendix.

1.3 General Requirements

The specification of piping is to be in accordance with a recognized national or international standard acceptable to CCS. In addition, the following requirements apply:

1.3.1 Strength

(3) The nominal pressure is to be determined from the following conditions:

② External Pressure(for any installation which may be subject to vacuum conditions inside the pipe or a head of liquid acting on the outside of the pipe; and for any pipe installation required to remain operational in case of flooding damage, as per ~~Regulation II-1/8-1 of~~ SOLAS II-1/8-1 ~~1974 Convention, as amended by IMO Res. MSC.436(99)~~, or for any pipes that would allow progressive flooding to other compartments through damaged piping or through open ended pipes in the compartments)

1.4 Requirements for Pipes/Piping Systems Depending on Service and/or Locations

1.4.1 Fire Endurance

(1) Pipes and their associated joints and fittings whose integrity is essential to the safety of ships, including plastic piping required by SOLAS II-2~~, Reg.~~/21.4 ~~as amended by IMO Res. MSC.421(98)~~ to remain operational after a fire casualty, are required to meet the minimum fire endurance requirements of Appendix 1 or 2, as applicable, of IMO resolution A.753 (18) , as amended by IMO Res. MSC. 313(88) and IMO Res. MSC. 399(95).

(2) Unless instructed otherwise by the Administration, fire endurance tests are to be carried out with specimen representative for pipes, joints and fittings②:

① Pipes:

- for sizes with outer diameter < 200 mm the minimum outer diameter and wall thickness③
- for sizes with outer diameter ≥ 200 mm one test specimen for each category of t/d (D = outer diameter, t = structural wall thickness). A scattering of ±10% for t/D is regarded as the same group. Minimum size approved is equal to the diameter of specimen successfully tested.

② Joints

- Each type of joint applicable for applied fire endurance level tested on pipe to pipe specimen.

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① It is addressed by IACS according to the provisions of IMO resolution A.753(18), as amended by IMO Res. MSC.313(88) and IMO Res. MSC. 399(95).

② A test specimen incorporating several components of a piping system may be tested in a single test.

③ Test conditions are most demanding for minimum wall thickness and thus larger wall thickness is covered. A key factor determining the fire performance of a pipe component variant is the thickness-to-diameter (t/D) ratio and whether it is larger or smaller than that of the variant which has been fire-tested. If fire-protective coatings or layers are included in the variant used in the fire test, only variants with the same or greater thickness of protection, regardless of the (t/D) ratio, are to be qualified by the fire test.

(3) Means are to be provided to ensure a constant media pressure inside the test specimen during the fire test as specified in Appendix 1 or 2 of the IMO Res.A.753(18), as amended by IMO Resolutions MSC.313(88) and MSC.399(95). During the test it is not permitted to replace media drained by fresh water or nitrogen.

(4)~~(2)~~ Depending on the capability of a piping system to maintain its strength and integrity, there exist five different levels of fire endurance for piping systems.

① Level 1: Piping having passed the fire endurance test specified in Appendix 1 of IMO resolution A.753(18), as amended by IMO Res. MSC. 313(88) and IMO Res. MSC. 399(95) for duration of a minimum of one hour without loss of integrity in the dry condition is considered to meet level 1 fire endurance standard (L1).

② Level 1W: Piping systems similar to level 1 systems except these systems do not carry flammable fluid or any gas and a maximum 5% flow loss in the system after exposure is acceptable①, which is considered to meet level 1W fire endurance standard (L1W).

③ Level 2: Piping having passed the fire endurance test specified in Appendix 1 of IMO resolution A.753(18) , as amended by IMO Res. MSC. 313(88) and IMO Res. MSC. 399(95) for a duration of a minimum of 30 min in the dry condition is considered to meet level 2 fire endurance standard (L2).

④ Level 2W: Piping systems similar to level 2 systems except a maximum 5% flow loss in the system after exposure is acceptable①, which is considered to meet level 2W fire endurance standard (L2W).

⑤ Level 3: Piping having passed the fire endurance test specified in Appendix 2 of IMO resolution A.753(18), as amended by IMO Res. MSC. 313(88) and IMO Res. MSC. 399(95) for a duration of a minimum of 30 min in the wet condition is considered to meet level 3 fire endurance standard (L3).

~~(3)~~ (5) Permitted use of piping depending on fire endurance, location and piping system is given in Table 1.4.1.

~~(4)~~ (6) For Safe Return to Port purposes (SOLAS II-2~~, Reg./~~21.4), plastic piping can be considered to remain operational after a fire casualty if the plastic pipes and fittings have been tested to L1 standard.

N piping system		Parts										
		A	B	C	D	E	F	G	H	I	J	K
		Machinery space of category A	Other machinery space and pump tank	Cargo pump room	Ro-ro cargo hold	Other cargo hold	Cargo oil tank	Fuel oil tank	Ballast tank	Cofferdam, void, tunnel and duct	Accommodation and service spaces, control room	Open deck
1	2	3	4	5	6	7	8	9	10	11	12	13
33 Exhaust Gas Cleaning System Effluent Line		L3①	L3①	NA	NA	NA	NA	NA	NA	~~NA~~ O	L3①, ⑩ NA	~~NA~~O

Notes:

⑧ Scuppers serving open decks in positions 1 and 2, as defined in regulation 13 of the Protocol of 1988 relating to the International Convention on Load Lines, 1966~~, as amended by IMO Res. MSC.375(93),~~ should be "×" throughout unless fitted at the upper end with the means of closing capable of being operated from a position above the freeboard deck in order to prevent down-flooding.

⑨ For essential services, such as fuel oil tank heating and ship's whistle, "×" is to replace "O".

⑩ For tankers where compliance with paragraph 3.6, regulation 19 of Annex I of MARPOL~~, as amended by IMO Res. MEPC.314(74)~~ is required, "NA" is to replace "O".

⑬ For Passenger Ships subject to SOLAS II-2, Reg.21.4 (Safe return to Port), plastic pipes for services required to remain operative in the part of the ship not affected by the casualty thresholds, such as systems intended to support safe areas, are to be considered essential services. In accordance with MSC Circular MSC.1/Circ.1369, interpretation 12, for Safe Return to Port purposes, plastic piping can be considered to remain operational after a fire casualty if the plastic pipes and fittings have been tested to L1 standard.

Location Definition:

A —Machinery spaces of category A: Machinery spaces of category A as defined in SOLAS① ~~regulation~~ II-2/3.31.

1.6 Installation

1.6.10 Testing after Installation on Board

① The flow loss must be taken into account when dimensioning the system.

① SOLAS Chapter II-2 ~~as amended by IMO Res. MSC.421(98~~).

(1) Piping systems for essential services are to be tested to a pressure equal to 1.5 times the design pressure or 0.4 MPa, whichever is greater. Notwithstanding the requirement above, the requirement in 1.6.10(2) may be applied to open ended pipes (drains, effluent, etc.).

CHAPTER 11 SHAFTING AND PROPELLERS

Section 2 SHAFTING

11.2.2 Diameter of shafts

R_m — specified tensile strength of shaft material, in N/mm^2. For intermediate shaft, when carbon and manganese steel is used, it is to be taken as 760 N/mm^2 for R_m> 760 N/mm^2; when alloy steel is used, it is to be taken as 800 N/mm^2 for R_m> 800 N/mm^2. For special approval of alloy steel used for intermediate shaft material, the tensile strength of shaft material may be greater than 800 N/mm^2, but less than 950 N/mm^2, where such approval of the material comply with the relevant requirements for torsional fatigue test①, cleanliness②and inspection. The requirements of 5.1.1.1, 5.3.2.1, 5.3.2.3 and 5.3.4.5 for the cleanliness of material, and the requirements of 5.1.6 for the inspection in Chapter 5, PART ONE of CCS Rules for Materials and Welding are to be complied with. For screwshaft and tube shaft, it is to be taken as 600 N/mm^2 for R_m> 600 N/mm^2.

Section 3 SHAFT TRANSMISSION UNITS

11.3.7 Z propulsion arrangement

11.3.7.1 Z propulsion arrangement is to be provided with means to control its propulsion direction ~~controlled~~ from bridge, machinery control station (if any) and on the spot. Indicators of direction of thrust are to be provided in these control locations.

~~11.3.7.10 Hydraulic system is also to satisfy the relevant requirements in 13.1.7 of this PART.~~

11.3.7.1~~1~~0 Z propulsion arrangement together with its main parts and accessories are to be subject to material test and non-destructive test according to CCS Rules for Materials and Welding.

11.3.7.1~~2~~1 Steering gear of Z propulsion arrangement is to comply with the requirements of Section 1, Chapter 13 of this PART.

Section 4 PROPELLERS

11.4.4 Fitting of propellers to screwshafts

The outside diameter of the threaded end for the propeller retaining nut is not to be less than 60% of the calculated ~~major taper~~ diameter of the propeller shaft.

① Torsional fatigue test is to meet the requirements of ~~5.4.5~~7.4.6 of Guidelines for Inspection of Forged Steel.

② Cleanliness is to meet the requirements of ~~5.4.5~~7.4.6 of Guidelines for Inspection of Forged Steel.

CHAPTER 12 SHAFT VIBRATION AND ALIGNMENT

Section 2 TORSIONAL VIBRATION

R_m — specified tensile strength of shaft material, in N/mm^2. For intermediate shaft, when carbon and manganese steel is used, it is to be taken as 600 N/mm^2 for R_m> 600 N/mm^2; when alloy steel is used, it is to be taken as 800 N/mm^2 for R_m> 800 N/mm^2. For special approval of alloy steel used for intermediate shaft material, the tensile strength of shaft material may be greater than 800 N/mm^2, but less than 950 N/mm^2, where such approval of the material comply with the relevant requirements for torsional fatigue test①, cleanliness②and inspection. The requirements of 5.1.1.1, 5.3.2.1, 5.3.2.3 and 5.3.4.5 for the cleanliness of material, and the requirements of 5.1.6 for the inspection in Chapter 5, PART ONE of CCS Rules for Materials and Welding are to be complied with. For screwshaft and tube shaft, it is to be taken as 600 N/mm^2 for R_m> 600 N/mm^2;

Section 5 SHAFTING ALIGNMENT

12.5.5 Shafting alignment procedure

12.5.5.4 After stern bearing is pressed and fitted, slope at stern bearing is to be measured. After the integrated stern tubes are poured and installed, slope at stern bearing is to be measured.

① Torsional fatigue test is to meet the requirements of ~~5.4.5~~7.4.6 of Guidelines for Inspection of Forged Steel.

② Cleanliness is to meet the requirements of ~~5.4.5~~7.4.6 of Guidelines for Inspection of Forged Steel.

CHAPTER 13 STEERING GEAR AND WINDLASSES

Section 1 STEERING GEAR

13.1.2 Definitions

13.1.2.1 For the purpose of this Section:

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

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

13.1.9 Monitoring and alarms

13.1.9.1 The alarm and monitoring requirements for the steering gear are to be in accordance with Table 13.1.9.1 and comply with the relevant requirements of Section 4, Chapter 2, PART SEVEN of the Rules. The failures likely to cause uncontrolled movements of rudder as indicated in the Table below are to be clearly identified. In the event of detection of such failure, the rudder is to stop in the current position without manual intervention or is to return to the midship/neutral poistion. For mechanical failures such as sticking valves and failure of static components (pipes, cylinders), the system response without manual intervention is not mandatory, and the operator can follow instructions on the signboard in case of such failures, in accordance with the relevant requirements of 13.1.8.4 of this Section.

Section 2 WINDLASSES

13.2.1 General requirements

13.2.1.3 The design, construction and testing of windlasses are to conform to a standard or code of practice accepted by CCS. To be considered acceptable, the standard or code of practice is to specify criteria for stresses, performance and testing. The following are examples of standards recognized:

SNAME T & R Bulletin 3-15: 2018	Guide to the Design and Testing of Anchor Windlasses for Merchant Ships
ISO 7825: 2017	Deck machinery general requirements
ISO 4568: ~~2006~~2021	Shipbuilding - Sea-going vessels - Windlasses and anchor capstans
JIS F6714: 1995	Windlasses

13.2.5 Design and requirements

13.2.5.3 Other design loads

(1) Holding loads

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

(2) Inertia loads

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

(3) Driving loads

Each transmission component is to be able to withstand the maximum output torque of the prime mover.

13.2.5.6 Brake

(1) Cable lifter brake

The wildcats or reels of windlasses are to be provided with efficient brakes to stop the anchor and chain cable when paying out the chain cable. The force-bearing parts of the brakes, when fully applied, are to withstand the

following loads without permanent deformation and without brake slip.
~~(1)~~① For windlasses fitted with a chain stopper, the brake is to be able to withstand a static pull equal to 45% of the breaking load of the cable or wire or the maximum static load of the cable or wire;
~~(2)~~② For windlasses not fitted with a chain stopper, the brake is to be able to withstand a static pull equal to 80% of the breaking load of the cable or wire.
(2) Control brake
① Electric windlasses are to be provided with a fail-safe brake mechanism such that the brakes are automatically engaged when the operating device is in the stop or braking position, or when there is no power to the electric motors. The brake is to be able to function automatically and hold a load on the chain cable of 1.5 times the working load of the windlass.
② For other types of drives, a suitable fail-safe brake mechanism is to be used. The brake is to be able to hold a load on the chain cable of 1.3 times the working load of the windlass.

13.2.6 Testing

13.2.6.1 Testing at works

(4) After testing of each part and completion of general installation, the windlass is to be subject to final inspection and functional test to ensure that it complies with the design requirements in 13.2.5 above. Windlasses are to be inspected and witnessed by a Surveyor and include the following tests, as a minimum.

① No-load test

The windlass is to be run without load at nominal speed in each direction for a total of 30 minutes. If the windlass is provided with a gear change, additional run in each direction for 5 minutes at each gear change is required.

② Load test

The windlass is to be tested to verify that the continuous duty pull, overload capacity and hoisting speed as specified in 13.2.5.2 can be attained. For large windlass, where the manufacturing works does not have adequate facilities, load test (including the adjustment of the overload protection) can be carried out on board ship. In these cases, functional testing in the manufacturing works is to be performed under no-load conditions.

③ Brake capacity test.

The holding power of the cable lifter brake is to be verified either through testing or by calculation.

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PART FOUR ELECTRICAL INSTALLATIONS

CONTENTS

CHAPTER 1 GENERAL

Section 1 GENERAL PROVISIONS

1.1.3.1(3) Analysis for coordination of protective devices in compliance with the requirements of 2.5.1.1 and 2.5.4.1 of this PART (for ships with operational conditions of generators having a total capacity (including single generator operation, long-term parallel operation and short-term parallel transferred load) of more than 250 kVA, which may be omitted for non-self-propelled ships.)

CHAPTER 2 ELECTRICAL INSTALLATIONS IN SHIPS

Section 1 MAIN SOURCE OF ELECTRICAL POWER

2.1.2.1(3) the short circuit current of the generator and/or generator system is sufficient to trip the generator circuit breaker, taking into account the selectivity of the protective devices for the distribution system. Protection is to be arranged in order to safeguard the generator in case of a short circuit in the main bus-bar. The generator is to be suitable for further use after fault clearance;

Section 9 SAFETY SYSTEMS FOR SHIPS AND PERSONS ONBOARD

2.9.3.4 The ~~pre-discharge alarm and the release of the~~ fixed fire-extinguishing system for the protection of machinery spaces where main propulsion engine and main generator set are located is to be designed such that any action other than the release of fire extinguishing media are not to lead to automatic shutdown of ventilation fans and oil pumps in these machinery spaces, such as opening the release box (cabinet) door during fire drills.

Section 12 CABLES

2.12.3.4 Where cables for services, required to be operable under fire conditions, including their supply cables, pass through high fire risk areas①, and in addition for passenger ships, main vertical fire zones, other than those which they serve, they are to be so arranged that a fire in any of these areas or zones does not affect the operation of the service in any other area or zone. This may be achieved by either of the following:

Section 18 ADDITIONAL REQUIREMENTS FOR SHIPS CARRYING DANGEROUS GOODS

2.18.3.2 Cables required in 2.18.8.2 and the electrical equipment not inferior to that required as follows are permitted in the hazardous areas specified in 2.18.3.1 of this Section (unless otherwise specified in 2.18.5):
(1) general electrical equipment
— degree of protection IP55;
— maximum surface temperature 200℃; or
(2) certified explosion-proof electrical equipment
— degree of protection IP55;
— temperature class T3.

2.18.4.3 Cables required in 2.18.8.2 and the electrical equipment not inferior to that required in Table 2.18.4.3 are permitted in the hazardous areas specified in 2.18.4.1 and 2.18.4.2 of this Section (unless otherwise specified in 2.18.5).

2.18.5 Carriage of solid dangerous goods in bulk and MHB only

2.18.5.1 Where solid dangerous goods in bulk (solid dangerous goods capable of creating explosive gas atmosphere) and MHB are to be carried, electrical equipment installed in hazardous areas are to be in compliance with the minimum requirements of Table 2.18.5.1.

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① The "high fire risk areas" are defined as follows:
(1) machinery spaces as defined in SOLAS Reg. II-2/3.30, excluding spaces having little or no fire risk as defined in SOLAS Reg. II-2/9.2.2.3.2.2 (10) (including the interpretations for tables 9.3, 9.4, 9.5, 9.6, 9.7 and 9.8 given in MSC/Circ.1120 as amended by MSC.1/Circ.1436 and MSC.1/Circ.1510);
(2) spaces containing fuel treatment equipment or other highly flammable substances;
(3) galley and pantries containing cooking appliances;
(4) laundry containing drying equipment;
(5) spaces as defined in SOLAS Reg. II-2/9.2.2.3.2.2(8), (12), and (14) for ships carrying more than 36 passengers.

Characteristics of Electrical Equipment for Use in Hazardous Areas (Example)

Table 2.18.5.1

Dangerous goods	IMO class	Dominant risk①	Protection against explosive dust atmosphere	Protection against explosive gas atmosphere	
			Degree of protection	Explosion group	Temperature class
Aluminium ferrosilicon powder UN1395	4.3	H_2	—	IIC	T2
Aluminium silicon powder uncoated UN1398	4.3	H_2	—	IIC	T2
Aluminium smelting by-products or Aluminium remelting by-products UN3170	4.3	H_2	—	IIC	T2
Aluminium smelting/remelting by-products, processed	MHB(WF and/or WT and/or CR)	H_2	—	IIC	T1
Ammonium nitrate UN1942	5.1	Combustible	—	Intrinsically safe equipment	—
Ammonium nitrate based fertilizer UN2067	5.1	Combustible	—	Intrinsically safe equipment	—
Ammonium nitrate based fertilizer UN2071	9		—	Intrinsically safe equipment	—
Ammonium nitrate based fertilizer (non-hazardous)	-		—	Intrinsically safe equipment	—
Brown coal briquettes	MHB (CB and/or SH)	Dust, methane	IP55	IIA	T4
Coal	MHB (CB and/or SH and/or WF and/or CR)	Dust, methane	IP55	IIA	T4
Direct reduced iron (A)	MHB (SH and/or WF)	H_2	—	IIC	T2
Direct reduced iron (B)	MHB (SH and/or WF)	H_2	—	IIC	T2
Direct reduced iron (C)	MHB (SH and/or WF)	H_2	—	IIC	T2
Ferrophosphorus (including briquettes)	MHB (WF and/or WT)	H_2	—	IIC	T1
Ferrosilicon, with at least 25% but less than 30% silicon, or 90% or more silicon (including briquettes)	MHB (WF and/or WT)	H_2	—	IIC	T1
Ferrosilicon UN1408, with 30% or more but less than 90% silicon(including briquettes)	4.3	H_2	—	IIC	T1
Iron oxide, spent or sponge iron, spent UN1376	4.2	Dust	IP55	IIA	T2
Seed cake, containing vegetable oil UN1386	4.2	Hexane	—	IIA	T3
Seed cake UN2217	4.2	Hexane	—	IIA	T3
Seed cakes and other residues of processed oily vegetables	MHB (SH)	Dust	IP55	IIA	T3
Silicomanganese (low-carbon)	MHB(WF and/or WT and/or TX)	H_2	—	IIC	T1
Solidified fuels recycled from paper and plastics	MHB (SH)	Combustible	IP55	—	T3
Sugarcane biomass pellets	MHB(CB and/or WF	Combustible, dust	IP55	IIA	T3

Dangerous goods	IMO class	Dominant risk①	Protection against explosive dust atmosphere	Protection against explosive gas atmosphere	
			Degree of protection	Explosion group	Temperature class
	and/or WT and/or OH)				
Sulphur UN1350 (crushed lump and coarse grained)	4.1	Combustible, dust	IP55	—	T4
Zinc Ashes UN1435	4.3	H_2	—	IIC	T2
Wood torrefied	MHB(CB and/or SH and/or CR)	Combustible, dust	IP55	—	T3
Wood pellets, containing additives and/or binders	MHB(WF)	Dust	IP55	—	T3
Wood pellets, not containing any additives and/or binders	MHB(OH)	Dust	IP55	—	T3

Note: ① The term “risk” relates only to the risk of explosion due to dangerous goods and electrical appliances.

CHAPTER 3 CONSTRUCTION AND TESTING OF ELECTRICAL EQUIPMENT

Section 2 ROTATING MACHINES

3.2.3.2 Where the ambient air temperature for motor operation is more than 45°C, the permissible temperature rise is to be reduced by an amount equal to the difference between the actual air ambient temperature and 45°C, based on the specified value given in Table 3.2.3.1.
Where the ambient air temperature for motor operation is less than 45°C, the permissible temperature rise is to be increased by a value equal to the difference between the actual ambient air temperature and 45°C, based on the specified value given in Table 3.2.3.1, and the increased value is not to be more than 15 K.
For motors fitted with water-cooled heat exchanger, the temperature of cooling water at the inlet of the heat exchanger may be regarded as the ambient air temperature for motor operation.

Limits of Temperature Rise (K) of Air-Cooled Machines **Table 3.2.3.1**

Thermal classification		A			E			B			F			H		
Method of measurement③		Th	R	ETD	Th	R	ETD	Th	R	ETD	Th	R	ETD	Th	R	ETD
Item	Part of machine															
1a)	AC windings of machines having output of 5,000 kW (or kVA) or more	–	55	60	–	–	–	–	75	80	–	95	100	–	120	125
1b)	AC windings of machines having output above 200 kW (or kVA), but less than 5,000 kW (or kVA)	–	55	60	–	70	–	–	75	85	–	100	105	–	120	125
1c)	AC windings of machines having output of 200 kW (or kVA) or less, other than those of items 1d) or 1e)①	–	55	–	–	70	–	–	75	–	–	100	–	–	120	–
1d)	AC windings of machines having rated output of less than 600 W (or VA)①	–	60	–	–	70	–	–	80	–	–	105	–	–	125	–
1e)	AC windings and/or encapsulated windings of self-cooled machines without a fan (IC410)①		60	–	–	70	–	–	80	–	–	105	–	–	125	–
2	Windings of armatures having commutators	45	55	–	60	70	–	65	75	–	80	100	–	100	120	–
3	Field windings of AC and DC machines other than those of item 4	45	55	–	60	70	–	65	75	–	80	100	–	100	120	–
4a)	Field windings of synchronous machines with cylindrical rotors having DC excitation	–	–	–	–	–	–	–	85	–	–	105	–	–	130	–

Thermal classification		A			E			B			F			H		
Method of measurement③		Th	R	ETD	Th	R	ETD	Th	R	ETD	Th	R	ETD	Th	R	ETD
Item	Part of machine															
	windings embedded in slots, excluding synchronous induction motors															
4b)	Stationary field windings of DC machines having more than one layer	45	55	–	60	70	–	65	75	85	80	100	105	100	120	130
4c)	Single-layer low-resistance field windings of AC and DC machines and compensating windings of DC machines having more than one layer	55	55	–	70	70	–	75	75	–	95	95	–	120	120	–
4d)	Single-layer windings of AC and DC machines with exposed bare or varnished metal surfaces and single-layer compensating windings of DC machines②	60	60	–	75	75	–	85	85	–	105	105	–	130	130	–
5	Permanently short-circuited windings	The temperature rise or the temperature of any part is not to be detrimental to the insulation of that part or to any other part adjacent to it														
6	Commutators and slip rings and their brushes and brush gears	The temperature rise or the temperature of any part is not to be detrimental to the insulation of that part or any other part adjacent to it. In addition, the temperature rise or the temperature of a commutator or slip ring is not to exceed that at which the combination of brush grade and commutator or slip ring material can handle the current over the full operating range														
7	Structural components (other than bearings) and magnetic cores regardless of contact with insulation	The temperature rise or the temperature of any part is not to be detrimental to the insulation of that part or to any other part adjacent to it														

Thermal classification		B			F			H		
Method of measurement		Th	R	ETD	Th	R	ETD	Th	R	ETD
Item	Part of machine									
1a)	AC windings of machines having output of 5,000 kW (or kVA) or more	–	75	80	–	100	105	–	120	125
1b)	AC windings of machines having output above 200 kW (or kVA), but less than 5,000 kW (or kVA)	–	75	85	–	100	110	–	120	135
1c)	AC windings of machines having output of 200 kW (or kVA) or less, other than those of items 1d) or 1e)	–	75	–	–	100	–	–	120	–
1d)	AC windings of machines having rated output of less than 600 W (or VA)	–	80	–	–	105	–	–	125	–
1e)	AC windings and/or encapsulated windings of self-cooled machines	–	80	–	–	105	–	–	125	–

Thermal classification		B			F			H		
Method of measurement		Th	R	ETD	Th	R	ETD	Th	R	ETD
Item	Part of machine									
	without a fan (IC410)									
2	Windings of armatures having commutators	65	75	–	80	100	–	100	120	–
3	Field windings of AC and DC machines other than those of item 4	65	75	–	80	100	–	100	120	–
4a)	Field windings of synchronous machines with cylindrical rotors having DC excitation windings embedded in slots, excluding synchronous induction motors	–	85	–	–	110	–	–	130	–
4b)	Stationary field windings of DC machines having more than one layer	65	75	85	80	100	110	100	120	135
4c)	Single-layer low-resistance field windings of AC and DC machines and compensating windings of DC machines having more than one layer	75	75	–	95	100	–	120	120	–
4d)	Single-layer windings of AC and DC machines with exposed bare or varnished metal surfaces and single-layer compensating windings of DC machines	85	85	–	105	110	–	130	130	–

Notes:
1) The temperature rise or the temperature of any part of machine is not to be detrimental to the insulation of that part or to any other part adjacent to it.
2) With application of the superposition test method to windings of machines in items 1c), 1d) and 1e) with insulation classes B and F, the limits of temperature rise given for the resistance method may be exceeded by 5 K.
3) Multi-layer windings are to comply with the requirements of item 4d) where the under layers are all in contact with the circulating primary coolant.
4) Th – thermometer, R – resistance, and ETD – embedded temperature detector.

~~Notes:~~
~~① With application of the superposition test method to windings of machines rated 200 kW (or kVA) or less with insulation classes B and F, the limits of temperature rise given for the resistance method may be exceeded by 5 K.~~
~~② Multi-layer windings are also to be included where the under layers are all in contact with the circulating primary coolant.~~
~~③ Th – thermometer, R – resistance, and ETD – embedded temperature detector.~~

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PART SIX
FIRE PROTECTION, DETECTION AND EXTINCTION

CONTENTS

CHAPTER 1 GENERAL

Section 1 GENERAL PROVISIONS

1.1.1 General requirements

1.1.1.5 Where necessary, the ship's operator/owner is to pay attention to the standards of other industries and organizations in respect to fire safety of ships. However, such requirements are not conditions for classification with CCS.

CHAPTER 2 FIRE EXTINCTION SYSTEMS

Section 1 WATER FIRE EXTINCTION SYSTEMS

2.1.3 Internal diameter and pressure of fire main

2.1.3.2 In cargo ships of less than 1,000 gross tonnage, with the two pumps simultaneously delivering water through the specified nozzles ~~the quantity of water specified in 2.1.3.1 of this Section~~, through any adjacent hydrants, a minimum pressure of 0.25 N/mm^2 is to be maintained at all hydrants.

CHAPTER 4 INERT GAS SYSTEMS

Section 1 GENERAL PROVISIONS

4.1.2 Class notation

4.1.2.1 Inert gas systems complying with the requirements of this Chapter may be assigned the following class notation:

IGS ~~Inert Gas Systems (IGS)~~

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PART EIGHT
ADDITIONAL REQUIREMENTS

CONTENTS

CHAPTER 4 SHIP BRIDGE DESIGN AND EQUIPMENT ~~ADDITIONAL REQUIREMENTS FOR ONE MAN BRIDGE OPERATED (OMBO) SHIPS~~

Section 1 GENERAL PROVISIONS

4.1.1 General requirements

4.1.1.1 This Chapter applies to ~~all one man bridge operated~~ ships applying for the notations as specified in 4.1.2 of this Chapter.

4.1.1.2 ~~Ships complying with the requirements of this Chapter will be assigned the class notation OMBO.~~ The provisions of this Chapter are not to prevent the ship from complying with the relevant IMO conventions, codes and requirements of the Administration of the Flag State.

4.1.2 Notations

4.1.2.1 Ships of which bridge design and equipment installed complying with the following provisions may be assigned with the following notations upon application:

(1) BDE-1 is applicable to ships complying with the basic design requirements, working environment and the required equipment to be installed in Sections 1 to 5 of this Chapter;

(2) BDE-2 is applicable to ships complying with the requirements in Sections 1 to 6 of this Chapter;

(3) BDE-3 is applicable to ships of which the bridge is fitted with the Integrated Bridge System (IBS) complying with requirements in Sections 1 to 7 of this Chapter.

~~4.1.2~~ 4.1.3 Definitions

~~4.1.2.1~~ 4.1.3.1 For the purpose of this Chapter:

(1) Workstation means position at which one, or several tasks constituting a particular activity are carried out.

(2) Navigator means person navigating, operating bridge equipment and manoeuvring the ship.

(3) Back-up navigator means any individual, generally an officer, who has been designated by the ship's master to be on call if assistance is needed on the navigation bridge.

(4) Officer of the watch means person responsible for operating of bridge equipment and manoeuvring of the ship.

(5) Bridge means that area from which the navigation and control of the ship is exercised, including the wheelhouse and bridge wings.

(6) Wheelhouse means enclosed area of the bridge.

(7) Bridge wings are those parts of the bridge on both sides of the ship's wheelhouse which, in general, extend to the ship's side.

(8) Field of vision means angular size of a scene that can be observed from a position on the ship's bridge.

(9) Lookout means activity carried out by sight and hearing as well as by all available means appropriate in the prevailing circumstances and conditions so as to make a full appraisal of the

situation and of the risk of collision.

(10) Watch alarm means alarm that is transferred from the bridge to the master and the back-up navigator in case of any officer of the watch deficiency (absence, lack of alertness, no response to another alarm/warning, etc.).

(11) Workstation for navigation manoeuvring means a workstation with a commanding field of vision used by a navigator during course monitoring, traffic monitoring, course change and speed change, which can monitor the ship's safety condition.

(12) Workstation for monitoring means a workstation that facilitates the operation of equipment and observation of the ship's heading, speed, water and traffic with a commanding field of vision, including means necessary for route monitoring, to be used by the officer of the watch, backup navigator or pilot as needed for effective bridge team operation. The station may be considered as part of the workstation for navigation manoeuvring when paper charts or ECDIS are used for route monitoring.

(13) Workstation for manual steering means a workplace where the helmsman manually controls the ship's required ield of vision, indicators and equipment according to the instructions given by the navigator in charge of bridge operation.

(14) Workstation for docking means a workplace on the bridge wing that provides the field of vision and information required to control ship manoeuvring, tug operation and mooring operation along the berth.

(15) Workstation for plan development means a workplace used to plan the route of the entire voyage from place of departure to place of destination and to record the bridge operations during the voyage.

(16) Workstation for safe operation means a workplace dedicated to the organization and control of onboard emergency and distress operations with easy access to external and internal communications and information relevant to the safe status of the ship.

(17) Workstation for communication means a workplace for the operation and control of Global Maritime Distress and Safety System (GMDSS) equipment and on-board communications for ship operation under normal and emergency conditions.

(18) Commanding field of vision means the field of view within which there is no obstacle to the ability of the on-duty navigator and pilot to perform their main tasks, and it is at least to provide the field of vision required by the safe performance of collision avoidance function. It is required that the sea field of vision from the front of the bow to 10° of either side of the ship is not to be obscured by more than two ship’s lengths or 500 m, whichever is less, and that the horizontal view extends to a sector of at least 225°, that is, from dead ahead to either side of the ship is not less than 22.5° abaft the beam.

(19) Command position means a position located in the bridge, to monitor and guide the ship through the narrow water and buoy channel by visual observation, and provide the commanding field of vision, close field of vision of the sea surface and the information needed for maneuvering.

(20) Ship length means the length as defined in Reg.3.10, Chapter 1 of the International Regulation for Prevention Collision at Sea, 1972 , i.e. overall length of the ship.

~~4.1.3~~ 4.1.4 Plans and documents

~~4.1.3.1~~ 4.1.4.1 The following plans and documents are to be submitted for approval:

(1) Bridge visibility calculations, including scantlings of bridge, inclination and dimensions of windows and dimensions of consoles and so on;

(2) Arrangement of bridge, including positions of workstations, navigational equipment and consoles etc.;

(3) Arrangement of console panels;

(4) Diagram of power supply system for navigational equipment, internal communication equipment etc.;

(5) layout and power supply of cameras, where applicable.

~~4.1.3.2 Procedures for single-man watch-keeping and safety manual are to be kept onboard.~~

Section 2 BRIDGE LAYOUT

4.2.1 ~~Arrangement of bridge and wheelhouse~~ General requirements

4.2.1.1 The bridge configuration, the arrangement of consoles and equipment locations is to enable the officer of the watch to perform navigational duties and other functions allocated to the bridge as well as maintain a proper lookout from a convenient position on the bridge.

4.2.1.2 A workstation for navigation ~~and traffic surveillance/~~manoeuvring is to be arranged to enable efficient operation by one person under normal operating conditions. All relevant instrumentation and controls are to be easily visible, audible and accessible from related workstations.

4.2.1.3 The bridge layout and design of workstations are to enable the ship to be navigated and manoeuvred safely by two navigators in cooperation.

4.2.1.4 External sound signals and fog signals from outside the ship that are audible on the open deck, are also to be audible inside the wheelhouse; a transmitting device is to be provided to reproduce such signals inside the wheelhouse (recommended frequency range: 70 Hz to 700 Hz).

4.2.1.5 A workstation for navigation manoeuvring is to be arranged on the starboard side near the center line, where applicable..

4.2.1.6 A workstation for monitoring is to be arranged on the port side near the center line, where applicable..

4.2.1.7 A Workstation for manual steering is to generally be located at the center line of the ship.

4.2.1.8 Sufficient manoeuvring positions are to be provided near the middle front window. If the view in the center line is obstructed by large masts, cranes, etc., two manoeuvring positions with a clear forward view are to be provided, one at the left side of the center line and the other at the right side, spaced not more than 5 m.

4.2.2 Field of vision

4.2.2.1 In order to obtain sufficient field of vision for safe navigation and manoeuvring of the ship, every effort is to be made to place the bridge above all other decked superstructures.

~~4.2.2.2 It is to be possible to observe all objects of interest for the navigation, such as other traffic and navigation marks, in any direction from inside the wheelhouse. Bearing this in mind, the observer is to obtain a 360º field of vision from inside the wheelhouse when moving within a certain range there.~~

~~4.2.2.3~~4.2.2.2 The view of the sea surface from the workstations for navigation~~/~~ manoeuvring is not to be obscured by more than two ship's lengths or 500 m, whichever is less, forward of the bow to 10º on either side, irrespective of the ship's draught, trim and deck cargo, as shown in Figure ~~4.2.2.3~~4.2.2.2.

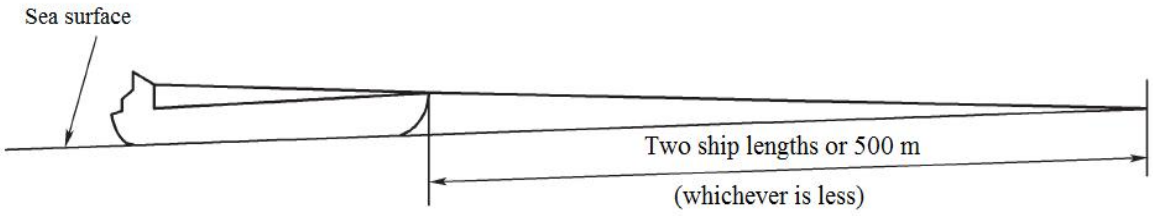

Figure ~~4.2.2.3~~4.2.2.2 Forward View

~~4.2.2.4~~4.2.2.3 No blind sector caused by cargo, cargo gear or other obstructions outside of the wheelhouse forward of the beam which obstructs the view of the sea surface as seen from the workstations for navigation~~/~~ manoeuvring is not to exceed 10º. The total arc of blind sectors is not to exceed 20º. The clear sectors between blind sectors are to be at least 5º. However, in the view described in ~~4.2.2.3~~4.2.2.2, each individual blind sector is not to exceed 5º.

~~4.2.2.5~~4.2.2.4 The horizontal field of vision from the workstations for navigation~~/~~ manoeuvring is to extend at least over an arc from 22.5º abaft the beam on one side, through forward, to 22.5º abaft the beam on the other side, as shown in Figure ~~4.2.2.5~~4.2.2.4.

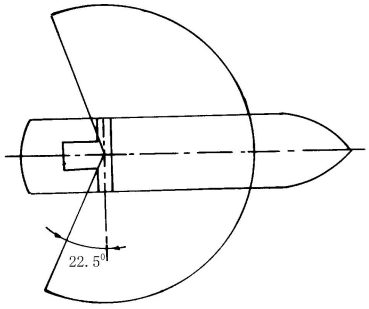

Figure ~~4.2.2.5~~4.2.2.4 Field of Vision from the Workstations for Navigation~~/~~ Manoeuvring

~~4.2.2.6~~4.2.2.5 The horizontal field of vision from the ~~main steering position~~ Workstation for manual steering is to extend over an arc from right ahead to at least 60º on each side of the ship, as shown in Figure ~~4.2.2.6~~4.2.2.5.

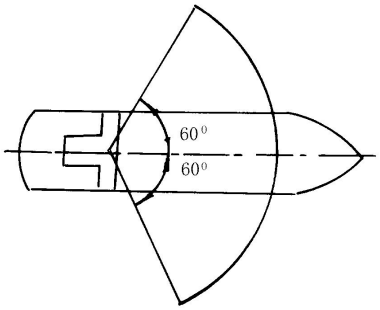

Figure ~~4.2.2.6~~4.2.2.5 Horizontal Field of Vision from the ~~Main Steering Position~~ Workstation for Manual Steering

~~4.2.2.7~~4.2.2.6 ~~From each bridge wing the~~ The horizontal field of vision from workstation for docking is to extend over an arc from 45º on the opposite bow through dead ahead and then aft to 180º from dead ahead, as shown in Figure ~~4.2.2.7~~4.2.2.6.

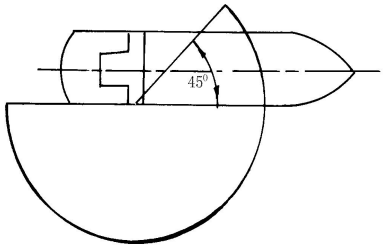

Figure ~~4.2.2.7~~4.2.2.6 Horizontal Field of Vision From ~~Each Bridge Wing~~ the Workstation for Docking

~~4.2.2.8~~4.2.2.7 At a workstation for ~~performance of functions other than navigation~~ monitoring, the field of vision is to enable the officer of the watch to maintain a proper lookout. The field of vision is to extend at least over an arc from 90º on port bow, through forward, to 22.5º abaft the beam on starboard, as shown in Figure ~~4.2.2.8~~4.2.2.7.

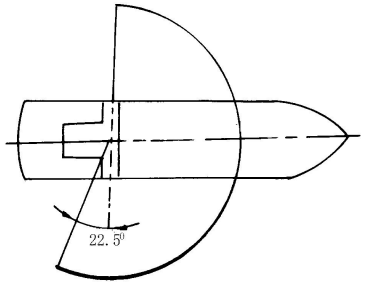

Figure ~~4.2.2.8~~4.2.2.7 Field of Vision form Workstations for ~~Docking Manoeuvres~~ Monitoring

~~4.2.2.9~~4.2.2.8 The ship's side is to be visible from the bridge wing.①

~~4.2.3 Working environment~~

~~4.2.3.1 The bridge area is to be free of physical hazards to bridge personnel. There are to be no sharp edges or protuberances which could cause injury to personnel. The wheelhouse, bridge, bridge wings and bridge deck are to be free of trip hazards and to have a non-slip surface whether it is wet or dry.~~

~~4.2.3.2 Sufficient hand-rails or equivalent thereto are to be fitted in the wheelhouse and around workstations to enable personnel to move or stand safely in bad weather.~~

~~4.2.3.3 For seating in the wheelhouse, means for securing are to be provided.~~

~~4.2.3.4 A glare-free coating is to be applied on the front surface of bulkheads, deckhead, consoles, chart table and other essential equipment. Means are to be provided to prevent dimming of the information shown by visual displays and instruments covered by transparent sheeting.~~

~~4.2.3.5 Doors to the bridge are to be capable of being secured from inside and manually operated. Doors to the bridge wings are not to be self-closing and means are to be made to keep them open.~~

~~4.2.3.6 According to climate, adequate air-conditioning or mechanical ventilation system and efficient heating system are to be provided to maintain the temperature in the wheelhouse within the range of 14℃~ 30℃. The controls of these systems are to be fitted in the wheelhouse.~~

~~4.2.3.7 The noise level on the bridge is not to interfere with verbal communication, mask audible alarms or be uncomfortable to bridge personnel. The noise level in the wheelhouse is not to exceed 65 dB(A) in good weather.~~

~~4.2.3.8 The vibration level on the bridge is not to be uncomfortable to the bridge personnel.~~

~~4.2.4 Lighting~~

~~4.2.4.1 An adequate level of lighting facilitating the performance of all bridge tasks at daytime and nighttime is to be provided. With illumination inside the equipment or the lighting system in the wheelhouse, controls, indicators, instruments, keyboard etc. are to be clearly visible.~~

① Refer to IMO MSC.1/Circ.1350/Rev.1.

~~4.2.4.2 All lighting of instruments, keyboards and controls are to be adjustable down to zero, except the lighting of alarm indicators and the control of dimmers, which are to remain readable.~~

~~4.2.4.3 The lighting on the bridge is to be supplied by two exclusive circuits, with one of which fed from an emergency source of electrical power, in such a way that failure of any one of the circuits does not leave the bridge in darkness.~~

~~4.2.4.4 The lighting on the bridge is to be designed so as not to impair the night vision of the officer on watch. Lighting used in areas and at items of equipment requiring illumination whilst the ship is navigating is to be such that night vision adaptation is not impaired, e.g. red lighting. Such lighting is to be arranged so that it cannot be mistaken for a navigation light by another ship. It is to be noted that red lighting is not to be fitted over the chart table so that possible confusion in colour discrimination is avoided.~~

~~4.2.5~~ 4.2.3 Windows

~~4.2.5.1~~4.2.3.1 All windows in the wheelhouse are to be of shatter-proof reinforced glass, the thickness of which is to comply with acceptable standards①. Polarized and stained glass windows are not to be installed.

~~4.2.5.2~~4.2.3.2 Windows are to be as wide as possible. Framing between windows is to be kept to a minimum and not installed immediately forward of any workstation.

~~4.2.5.3~~4.2.3.3 To help avoid reflections, the bridge front windows are to be inclined as possible from the vertical plane top out, at an angle of not less than 10º and not more than 25º. Alternative means are to be approved by CCS.

~~4.2.5.4~~4.2.3.4 The height of the lower edge of front windows is to allow a forward view above the ~~of~~ bow from the ~~navigation~~ workstation for navigation manoeuvring. To achieve this, the height of the lower edge above the deck is not to exceed 1 m as practicable.

~~4.2.5.5~~4.2.3.5 The upper edge of the navigation bridge front windows are to allow a forward view of the horizon, for a person with a height of eye of 1.8 m above the bridge deck at the conning position, when the ship is pitching in heavy seas. If deemed that a height of eye of 1.8 m is unreasonable and impractical, reduction of the height of eye may be allowed, but not to less than 1.6 m.

~~4.2.5.6~~4.2.3.6 At all times, regardless of weather conditions, at least two ~~the~~ windows in front of the workstations for navigation manoeuvring, monitoring and docking (where applicable) ~~conning position, navigation workstation and bridge wings~~ (if practical) are to provide a clear view.

~~4.2.5.7~~4.2.3.7 To ensure a clear view in bright sunshine, sunscreens of roller blind type with minimum colour distortion are to be affixed to windows that are within the required field of vision from the workstations. Such screens are to be readily removable and not to be permanently fixed.

~~4.2.5.8~~4.2.3.8 At least two windows in front of the workstations for navigation manoeuvring, monitoring and docking (where applicable) are to be provided with efficient ~~Efficient~~ cleaning, de-icing and de-misting systems ~~are to be installed~~ to ensure a clear view under all operating conditions.

~~4.2.5.9~~4.2.3.9 A safe external passageway or similar arrangement is to be provided under the bridge front window to enable cleaning in the event of failure of the systems specified in ~~4.2.5.8~~4.2.3.8 of this Section.

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① Refer to ISO 21005 Ships and marine technology − Thermally toughened safety glass panes for windows and sidescuttles.

4.2.4 Layout and dimensions

4.2.4.1 The design of the net height of the wheelhouse ceiling is to take into account the overhead mounted panels and equipment. There is to be at least 2.25 m between the wheelhouse deck and the ceiling beams. The lower edge of ceiling mounted equipment is to be at least 2.1 m above the deck of open areas, walkways and standing-type workstations.

4.2.4.2 Workstations are to be divided into two areas as far as possible:

(1) the vertical (tilted) part so that the display is in a position that is easy to read;

(2) the horizontal part (table top) so that the controller, switch and button are within easy reach of the working position.

4.2.4.3 The height of the console desktop of the workstation for navigation manoeuvring and the workstation for monitoring is to make it easy to use the equipment required for safe execution of the tasks performed from the standing and sitting positions.

4.2.4.4 The chart table is to be large enough to accommodate all nautical chart sizes in common use internationally, and appropriate lighting is to be provided.

4.2.4.5 Instruments and equipment operated by the navigator at the workstation for navigation manoeuvring are to be within reach of the manoeuvring.

4.2.4.6 Instruments, indicators and displays providing information considered essential for the safe and efficient performance of tasks at the workstation for navigation manoeuvring are to be easily readable from this workstation.

4.2.5 Passageways

4.2.5.1 A passageway through the wheelhouse from bridge wing to bridge wing is to be provided. The width of the passageway is to be at least 1200 mm, but if there are obstacles on the route of the passageway, the width of the passageway at the obstacle can be reduced to 700 mm without affecting the staggered passage of two wheelhouse personnel.

4.2.5.2 The distance between adjacent workstations is to be sufficient to allow the unimpeded passage of persons not working at the station. The passage space of the corridor between different workstation areas is to be at least 700 mm. The workstation operation area is to be a part of the workstation, not a passageway.

4.2.6 Doors

4.2.6.1 Doors to the bridge are to be capable of being secured from inside and manually operated. Doors to the bridge wings are not to be self-closing and means are to be made to keep them open.

Section 3 WORKING ENVIRONMENT

4.3.1 Lighting

4.3.1.1 An adequate level of lighting facilitating the performance of all bridge tasks at daytime and nighttime is to be provided. With illumination inside the equipment or the lighting system in the wheelhouse, controls, indicators, instruments, keyboard etc. are to be clearly visible.

4.3.1.2 All lighting of instruments, keyboards and controls are to be adjustable down to zero, except the lighting of alarm indicators and the control of dimmers, which are to remain readable.

4.3.1.3 The lighting on the bridge is to be supplied by two exclusive circuits, with one of which fed from an emergency source of electrical power, in such a way that failure of any one of the circuits does not leave the bridge in darkness.

4.3.1.4 The lighting on the bridge is to be designed so as not to impair the night vision of the officer on watch. Lighting used in areas and at items of equipment requiring illumination whilst the ship is navigating is to be such that night vision adaptation is not impaired, e.g. red lighting. Such lighting is to be arranged so that it cannot be mistaken for a navigation light by another ship. It is to be noted that red lighting is not to be fitted over the chart table so that possible confusion in colour discrimination is avoided.

4.3.1.5 High contrast between the brightness of the working area and the surrounding environment is to be avoided, that is, the brightness of the working area is not to be greater than 3 times the average brightness of the surrounding area.

4.3.1.6 Lighting sources are to be designed and positioned to avoid glare on working and display surfaces. The light sources are not to produce a detectable flicker.

4.3.2 Personnel safety precautions

4.3.2.1 The bridge area is to be free of physical hazards to bridge personnel. There are to be no sharp edges or protuberances which could cause injury to personnel. The wheelhouse, bridge wings and bridge deck are to be free of trip hazards and to have a non-slip surface whether it is wet or dry.

4.3.2.2 Sufficient hand-rails or equivalent thereto are to be fitted in the wheelhouse and around workstations to enable personnel to move or stand safely in bad weather. Special consideration is to be given to the protection of stairway openings.

4.3.2.3 For seating in the wheelhouse, means for securing are to be provided.

4.3.2.4 All safety equipment on the bridge is to be clearly identified and easily accessible and its storage location is to be clearly indicated.

4.3.3 Temperature and humidity

4.3.3.1 According to climate, adequate air-conditioning or mechanical ventilation system and efficient heating system are to be provided to maintain the temperature in the wheelhouse within the range of 14℃~ 30℃. The controls of these systems are to be fitted in the wheelhouse.

4.3.3.2 Air flow from air conditioning and heating systems to the workplace is to be avoided.

4.3.4 Noise

4.3.4.1 The noise level on the bridge is not to interfere with verbal communication, mask audible alarms or be uncomfortable to bridge personnel. The noise level in the wheelhouse is not to

exceed 65 dB(A) in good weather. However, the noise level in the communication workstation) is not to exceed 60dB(A).

4.3.5 Vibration

4.3.5.1 The vibration level on the bridge is not to be uncomfortable to the bridge personnel.

4.3.6 Glare-free

4.3.6.1 A glare-free coating is to be applied on the front surface of bulkheads, deckhead, consoles, chart table and other essential equipment. Means are to be provided to prevent dimming of the information shown by visual displays and instruments covered by transparent sheeting.

Section ~~3~~4 WORKSTATIONS

4.4.1 General requirements

4.4.1.1 According to its functions, the ship bridge can be divided into workstation for navigation manoeuvring, workstation for monitoring, workstation for manual steering, workstation for planning development, workstation for communication, workstation for docking and workstation for safe operation.

4.4.1.2 The workstation for navigation manoeuvring, workstation for monitoring and workstation for manual steering are functionally related and generally close to each other, so there is no need to re-equip these stations with relevant equipment.

~~4.3.1 Workstation for navigation~~4.4.2 Workstation for navigation manoeuvring

~~4.3.1.1 Sufficient manoeuvring positions are to be provided near the middle front window. If the view in the center line is obstructed by large masts, cranes, etc., two manoeuvring positions with a clear forward view are to be provided, one at the left side of the center line and the other at the right side, spaced not more than 5 m.~~

~~4.3.1.2~~4.4.2.1 The workstation for navigation manoeuvring is generally to be provided with the following equipment:

(1) radar / ARPA ~~(see 4.3.1.3)~~;

(2) display of positioning system ~~(see 4.3.1.4)~~;

(3) depth indicator;

(4) speed and distance indicator;

(5) display of gyro compass system ~~(see 4.3.1.7)~~;

(6) wind direction and speed indicator;

(7) indicator of steering gear and rudder angle;

(8) rate-of-turn indicator;

(9) course and track monitoring system ~~(see 4.3.1.5 and 4.3.1.6)~~;

(10) controls and indicators for main and athwartship propulsion;

(11) verification device and manually activating device used for bridge ~~safety~~ navigation watch alarm system (BNWAS);

(12) an internal communication system (see 4.5.5);

(13) VHF radiotelephone installation;

(14) clock;

(15) window wipe and wash control device;

(16) navigation light control;

(17) whistle control device;

(18) Morse lamp key;

(19) lighting control of wheelhouse and equipment;

(20) display for the Automatic Identification System (AIS);

(21) a device that stops sending Long-Range Identification and Tracking (LRIT) messages, if applicable;

(22) Electronic Chart Display and Information System (ECDIS);

(23) night vision equipment, if applicable.

~~4.3.1.3~~4.4.2.2 The ship is to be provided with two separate and independent radar systems. At

least one of the radars is to operate within the X-band. The radars are to be capable of detecting and clearly indicating any input signal loss (e.g. video or azimuth signal). The ship is also to be equipped with an ARPA system which may be independent or built into the radar equipment.

~~4.3.1.4~~4.4.2.3 At least two positioning systems capable of continuously displaying latitude and longitude are to be fitted, one of which is to be ~~global~~ electronic positioning system ~~(GPS) or equivalent~~ with global coverage and the other is to be ~~Decca or Loran-C or GPS~~ electronic positioning system with differential correction function.

~~4.3.1.5~~4.4.2.4 An off-course alarm independent of automatic steering system is to be provided. Where an automatic track-keeping system is provided, an off-course alarm may be initiated by the positioning system in case of deviation from the planned route to the set distance.

~~4.3.1.6~~4.4.2.5 Where an automatic track-keeping system is provided, a pre-warning is to be given at the approach of a way-point so that the back-up navigator will have sufficient time to reach the wheelhouse for acknowledging course alteration in case of any officer of the watch deficiency. The course is not to be automatically altered without prior confirmation.

~~4.3.1.7 Two gyrocompasses capable of continuously displaying heading information and providing navigation equipment with corresponding input information are to be installed. Installation of one gyrocompass and one transmitting magnetic compass capable of providing heading information to other instruments is acceptable as an option to two gyrocompasses.~~

~~4.3.1.8 Only one gyrocompass is to be used at any time for main display and control purposes. The navigating officer is to be able to switch between compasses at any time and the non-selected compass is to be used automatically as the independent heading source for the off-course warning.~~

~~4.3.1.9 It is to be possible to compare readings from each gyrocompass via the navigation workstation displays. Automatic comparison between the compasses is to be provided and an alarm given, should the difference between heading signals exceed a pre-set value.~~

~~4.3.1.10 Instruments and equipment operated by the navigator at the workstation for navigation are to be within reach of the manoeuvring.~~

~~4.3.1.11 Instruments, indicators and displays providing information considered essential for the safe and efficient performance of tasks at the workstation for navigation are to be easily readable from this workstation.~~

~~4.3.1.12 The ship is to be equipped with an Electronic Chart Display and Information System (ECDIS) which continuously displays the ship's position and the pre-planned route.~~

4.4.3 Workstation for monitoring

4.4.3.1 The workstation for monitoring is generally to be provided with the following equipment:

(1) radar /ARPA;

(2) the display of the depth sounder;

(3) speed and log display;

(4) compass display;

(5) steering gear and rudder angle indicator;

(6) rotation rate indicator;

(7) controllers and indicators for main propulsion and side push;

(8) BNWAS confirmation device and manual starting device;

(9) Internal communication system (see 4.5.5);

(10) VHF radio telephone;
(11) time indicator;
(12) window cleaning controller;
(13) air whistle controller.

4.4.4 Workstation for manual steering

4.4.4.1 The workstation for manual steering is generally to be provided with the following equipment:
(1) steering wheel/helmsman's handle;
(2) steering gear selection switch;
(3) compass display;
(4) steering gear and rudder angle indicator;
(5) rotation rate indicator.

~~4.3.2 Workstation for route planning~~4.4.5 Workstation for plan development

~~4.3.2.1~~4.4.5.1 The workstation for ~~route planning~~ plan development is to enable the following tasks to be performed:
(1) determining the ship’s position;
(2) planning the forthcoming voyage and estimating time of arrival at various way-points;
(3) indicating time.
~~4.3.2.2~~4.4.5.2 The time indication at the workstation for ~~route planning~~ plan development is to be derived from the same system as the workstation for navigation manoeuvring.
~~4.3.2.3 The chart table is to be large enough to accommodate all nautical chart sizes in common use internationally, and appropriate lighting is to be provided.~~

Section 45 EQUIPMENT AND SYSTEMS

~~4.4.1~~4.5.1 Basic requirements for equipment

~~4.4.1.1~~4.5.1.1 Navigation equipment is to be subject to type approval and the performance standards are not to be inferior to those of IMO in force.

~~4.4.1.2~~4.5.1.2 All instruments and panels are to be permanently mounted in consoles or at other appropriate places, taking into account both operational and environmental conditions.

~~4.4.1.3~~4.5.1.3 When siting equipment which is to be used in an exposed position, special care is to be taken to ensure that the siting does not impair the performance of the equipment.

~~4.4.1.4~~4.5.1.4 Antenna and sensor arrangements which are part of navigational instruments, are to be widely separated from radio communications systems.。

~~4.4.1.5~~4.5.1.5 Antenna units are to be sited so as not to constitute a hazard to personnel working in the vicinity.

~~4.4.1.6~~4.5.1.6 Satcom and radar antenna units are required to have a warning label, detailing safe distances, posted in the vicinity or on the equipment.

~~4.4.1.7~~4.5.1.7 Above-deck equipment is to be sited so as to prevent the installation from being affected by vibration.

~~4.4.1.8~~4.5.1.8 Instruments to be installed are to be located away from excessive heat sources, such as a heating vent or equipment heat exhaust.

~~4.4.1.9~~4.5.1.9 Instruments to be fitted into a bridge instrument console are to be protected from excessive heat by conduction or, if necessary, by forced air flow.

~~4.4.1.10~~4.5.1.10 Equipment not specifically designed for outdoor installation is not to be installed near a doorway, open window or hatch opening.

~~4.4.1.11~~4.5.1.11 When equipment is being installed, care is to be taken to ensure that the accuracy of the ship's magnetic compasses is adequately safeguarded.

~~4.4.2~~4.5.2 Computer-based systems and software

~~4.4.2.1~~4.5.2.1 Computer-based systems are subject to type approval, and are to comply with the applicable requirements of Section 6, Chapter 2, PART SEVEN of the Rules.

~~4.4.2.2~~4.5.2.2 Where failure in computer-based systems may affect safe navigation and manoeuvring of the ship, back-up systems are to be available for changeover.

~~4.4.2.3~~4.5.2.3 Adequate filtering of analogue and digital input signals is to be provided.。

~~4.4.2.4~~4.5.2.4 Software and data necessary to ensure satisfactory performance of the computer system are to be stored in a non-volatile memory, or a volatile memory with an uninterruptible power supply.

~~4.4.2.5~~4.5.2.5 Access to the computer's operating system is to be restricted, and any alteration of system software after final inspection and testing on board is to be subject to prior approval by CCS.。

~~4.4.2.6~~4.5.2.6 Necessary quality attributes for software are reliability, safeguard against error and misuse, fault detection and correction.

~~4.4.6.3~~4.5.2.7 Where computerized equipment are interconnected through a computer network, failure of the network is not to prevent individual equipment from performing their individual functions.

~~4.4.3~~4.5.3 Alarm system

~~4.4.3.1~~4.5.3.1 Alarms released by navigation equipment are to be both audible and visual and to be displayed as group alarm for easy identification.

~~4.4.3.2~~4.5.3.2 Alarms are to be set for the following as a minimum:

(1) the closest point of approach;

(2) insufficient depth of water;

(3) approach of a way-point;

(4) yaw;

(5) off-track;

(6) steering gear failure;

(7) navigation light failure;

(8) gyrocompass failure~~;~~

~~(9) bridge safety system failure~~.

~~4.4.4 Bridge safety system~~4.5.4 BNWAS

~~4.4.4.1 A bridge safety system is to be provided to indicate that an alert officer of the navigational watch is present on the bridge. The system is not to cause undue interference with the performance of bridge functions.~~4.5.4.1 The wheelhouse is to be provided with a BNWAS, the performance of which is to comply with the requirements of IMO resolution MSC.128(75).

~~4.4.4.2 The system is to be so designed and arranged that it could not be operated in an unauthorized manner, as far as practicable.~~

~~4.4.4.3 Any system used for periodic verification of the officer of the navigational watch's alertness is to be adjustable up to 12 min intervals and constructed, fitted and arranged so that only the ship's master has access to the component for setting the appropriate intervals.~~

~~4.4.4.4 The system is to provide for the acknowledgement by the officer of the navigational watch at the workstation for navigation and other appropriate locations in the bridge from where a proper lookout may be kept.~~

~~4.4.4.5 An alarm is to operate on the bridge in the event of a failure of the bridge safety system.~~

~~4.4.4.6 Any alarm/warning that requires bridge operator response is to be automatically transferred to the master, the selected back-up navigator and the public rooms, if not acknowledged on the bridge within 30 s. Such transfer is to be operated through a fixed installation. An alarm/warning may be initiated manually at any time from the bridge.~~

~~4.4.4.7 Response to alarms/warnings is to be operated only in the bridge.~~

~~4.4.4.8 The alarm transfer system is to be continuously powered and is to have an automatic changeover to a standby power supply in case of loss of normal power supply.~~

~~4.4.4.9 At all times, including during blackout, the officer of the watch is to have access to facilities enabling two-way speech communication with another qualified officer.~~

~~4.4.4.10 If the back-up navigator may attend locations not connected to the fixed installation(s) described in 4.4.4.6 of this Section, he is to be provided with a wireless portable device enabling both the alarm/warning transfer and two-way speech communication with the officer of the watch.~~

~~4.4.5~~4.5.5 Communication

~~4.4.5.1~~4.5.5.1 A telephone system is to be provided for two-way speech communication between the bridge and at least the following (the telephone system is to function properly in case of loss of

main power supply):

(1) engine control station;

(2) emergency steering position in steering gear room;

(3) cabins of captain and officers, offices, mess and public areas.

~~4.4.5.2~~4.5.5.2 The bridge is to have priority over the communication system.

~~4.4.5.3~~4.5.5.3 All extension numbers are to be shown at any telephone.

~~4.4.6~~4.5.6 Power supply

~~4.4.6.1~~4.5.6.1 Local distribution panels are to be arranged for all items of electrically operated navigational equipment~~, telephone system, bridge safety system~~ etc. These panels are to be supplied by two exclusive circuits, one fed from the main source of electrical power and the other fed from an emergency source of electrical power. Each item of navigational equipment is to be individually connected to its distribution panel. The power supplies to the distribution panels are to be arranged with automatic changeover facilities between the two sources. Failure of any power source is to initiate an audible and visual alarm.

~~4.4.3.1~~4.5.6.2 Following a loss of power which has lasted for ~~30s~~ 45s or less, all primary functions are to be readily reinstated. Following a loss of power which has lasted for more than ~~30s~~ 45s s, as many as practical primary functions are to be readily reinstated.

~~4.4.6.3 Where computerized equipment are interconnected through a computer network, failure of the network is not to prevent individual equipment from performing their individual functions.~~

~~4.4.7~~4.5.7 Man-machine interface

~~4.4.7.1~~4.5.7.1 All instruments are to be logically grouped according to their functions within each workstation. Their location and design are to give consideration to the physical capabilities of the human operator and comply with accepted ergonomic principles.

~~4.4.7.2~~4.5.7.2 The amount of information to be presented for conducting various tasks as well as the methods of displaying the information needed are to give consideration to the capabilities of the human operator to percept and process the information made available.

~~4.4.7.3~~4.5.7.3 Instruments or displays providing visual information to more than one person are to be located for easy viewing by all users concurrently. If this is not possible, the instruments or displays are to be duplicated.

~~4.4.7.4~~4.5.7.4 The method of presentation is to ensure that the instrument data is clearly visible to the observer at a practicable distance in the light conditions normally experienced on the bridge by day and by night.

~~4.4.7.5~~4.5.7.5 Means are to be provided for the manual adjustment of the brightness of each visual display unit.

~~4.4.7.6~~4.5.7.6 All information is to be presented on a background of high contrast, emitting as little light as possible by night.

~~4.4.7.7~~4.5.7.7 Paged displays are to be presented in a way which allows the operator to find quickly the information needed. An overview page is to be easily available to remind the operator of the paging system.

~~4.4.7.8~~4.5.7.8 Each page is to have a unique identifying label on the screen.

~~4.4.7.9~~4.5.7.9 The function and layout of control elements are to be logically coordinated~~ and comply with the acceptable standard, refer to IEC 447 Standard Direction of Movement for~~

~~Actuators Which Control the Operation of Electrical Apparatus~~.

~~4.4.7.10~~4.5.7.10 Maloperation of a computer-based bridge instrument is not to cause any loss of data, damage of programmes or malfunction of the system.

~~4.4.7.11~~4.5.7.11 Default values, where applicable, are to be indicated by the system when requesting operator input.

~~4.4.7.12~~4.5.7.12 If an input error is detected by the system, the operator is to be allowed to correct the error immediately.

~~4.4.7.13~~4.5.7.13 The system is to require confirmation from the operator for critical actions, e.g. they are not to rely on single keystrokes.

Section 5 OPERATIONAL PROCEDURES AND SAFETY MANUAL

4.5.1 Operational procedures

4.5.1.1 Operational procedures for single-man watch-keeping are to be established to ensure that the bridge is manned at all times, taking into account the following:

(1) when single-man watch-keeping is applied, another fully qualified officer is to be appointed as back-up officer;

(2) means are to be provided to ensure that the back-up officer is able to hear alarm and communication calls from the bridge;

(3) the total response time from sounding of alarm to the appearance of the back-up officer on the bridge is to be set in relation to the remaining time for reaching the danger of collision or grounding, taking into account all relevant factors necessary to allow proper and effective action to be taken;

(4) based on the actual time to reaching the danger, calculation of the response time is to take into account the time lapsed in acknowledging the alarm, proceeding to the bridge, evaluating the situation and taking proper and effective action in due time to avoid the danger;

(5) testing of the bridge safety system is to be carried out before transfer to single-man watch-keeping and at regular intervals during the voyage;

(6) operational requirements for navigation in narrow waterway.

4.5.2 Operational safety manual

4.5.2.1 A manual which presents and describes procedures, routines, duties and responsibilities of relevant personnel for normal and abnormal operating conditions is to be developed and implemented on board the ship.

4.5.2.2 The operational safety manual is to cover the following conditions and situations:

(1) normal conditions include daily operations and working conditions, as well as situations which, to some degree, require precautionary measures or actions for a continued operation;

(2) accident conditions are situations where threats against the ship or the personnel on board arise due to the environmental conditions;

(3) emergency conditions are situations where the ship and/or the personnel on board are threatened by a serious and imminent danger;

(4) miscellaneous conditions not covered by the above items.

Section 6 SUPPLEMENTARY REQUIREMENTS FOR THE NOTATION BDE-2

4.6.1 General requirements

4.6.1.1 Ships applying for the notation BDE-2 are to comply with the requirements of this Section in addition to the applicable requirements of other sections of this Chapter.

4.6.2 Field of vision

4.6.2.1 It is to be possible to observe all objects of interest for the navigation, such as other traffic and navigation marks, in any direction from inside the wheelhouse. Bearing this in mind, the observer is to obtain a 360º field of vision from inside the wheelhouse when moving within a certain range there. For rear view, other measures of the equivalent level of safety are acceptable, such as cameras with redundancy covering any obstructing view or blind area, if the 360° field of vision requirement around the ship cannot be met.

4.6.2.2 At the workstation for navigation manoeuvring, in the horizontal plane to vertical 5° above the line of sight, there is to be no obstruction; any structure/equipment or cargo obstructing the sea surface near the vessel in excess of 1000 m within a 180º sector in front of the lateral vessel in a line of sight from the horizontal plane to 5° below vertical is to be considered a blind area and the necessary calculations is to be carried out (eye height 1800 mm).

4.6.2.3 In all draft, trim and deck cargo conditions, the wheelhouse from the commanding position is to be able to observe all objects, shoreline and water at least 500 m from the hull within a sector of 10º to 90° on each side of the bow. If the vessel cannot meet the above requirements, measures of the equivalent level of safety are acceptable, such as cameras with redundancy covering any obstructing view or blind area.

4.6.2.4 In the process of ship manoeuvring, the navigator at the workstation for docking is to be able to observe the parallel ship side (eye height: 1600 mm). The total length of visibility on the ship's side is not to be less than 1/2 of the ship length.

4.6.3 Windows

4.6.3.1 To prevent reflection, the rear and side windows are to be tilted outwards at an angle of not less than 5° at the top of the vertical plane. The window in the bridge wing door may be exempted from this requirement.

4.6.4 Layout and dimensions

4.6.4.1 To provide accessibility from a standing position, the height of the console table top above the wheelhouse deck surface is to be not higher than 800 mm and not lower than 750 mm. For easy operation of the control device from the sitting position, it is to be possible to adjust the sitting height so that the elbow height is 50 mm higher than the console table.

4.6.4.2 The console in front of the work seat is to provide sufficient legroom to facilitate access to the equipment and control equipment to be used.

4.6.4.3 The shape of the console and the position of the display are to be designed to provide the user with the information required to perform the primary functions of the workstation within a viewing angle of 95° per side from the front.

4.6.4.4 If the seat is installed in the station used for standing and sitting operation, the seat is to be attached to the slide rail so that the seat can move back and forth to make it easy to operate the equipment while sitting, and there is enough space to stand in front of the console when the seat is pushed back, generally 700 mm. It is to be possible to adjust the height of the seat to accommodate users of different heights to obtain the best view and to achieve the best range of sight. Armrests (if provided) are to be of folding type and adjustable in height. Seats are to be equipped with adjustable trestles.

4.6.5 Passageways

4.6.5.1 The height of the entrance and door from the adjacent passageway to the wheelhouse is not to be less than 2.0 m.

4.6.5.2 At the workstation for docking, the distance between the bridge wing bulwarks, bulkheads and bridge wing consoles is to be as small as possible and the passageway is to be wide enough for one person to pass comfortably through the consoles. The width of the passageway is to be at least 600 mm.

4.6.6 Workstation for docking

4.6.6.1 The workstation for docking is to be capable of ship manoeuvring and is generally to be provided with the folloing equipment:

(1) compass display;

(2) wind speed and direction indicator;

(3) steering gear and rudder angle indicator;

(4) rotation rate indicator;

(5) controllers and indicators for main and side propulsion;

(6) BNWAS confirmation device and manual starting device;

(7) internal communication system.

Section 7 INTEGRATED BRIDGE SYSTEM (IBS)

4.7.1 General requirements

4.7.1.1 This Section applies to ships fitted with an IBS.

4.7.1.2 The layout of the IBS is to be such that the failure of one sub-system is immediately brought to the attention of the officer of the watch through auditory and visual alarms, and will not lead to the failure of any other sub-systems. If one part of an integrated navigation system (INS) fails, every other piece of equipment or every other part of the system is to be able to operate separately.

4.7.1.3 The performance criteria of the IBS is to comply with the requirements of IMO SN.1/Circ.288 Guidelines for Bridge Equipment and Systems, their Arrangement and Integration.

4.7.1.4 Ships applying for the notation BDE-3 are to comply with the requirements of this Section in addition to the applicable requirements of other sections of this Chapter.

4.7.2 Equipment

4.7.2.1 Two gyrocompasses capable of continuously displaying heading information and providing navigation equipment with corresponding input information are to be installed.

4.7.2.2 Only one gyrocompass is to be used at any time for main display and control purposes. The navigating officer is to be able to switch between compasses at any time and the non-selected compass is to be used automatically as the independent heading source for the off-course warning.

4.7.2.3 It is to be possible to compare readings from each gyrocompass via the navigation workstation displays. Automatic comparison between the compasses is to be provided and an alarm given, should the difference between heading signals exceed a pre-set value.

4.7.3 Alerts and management thereof

4.7.3.1 Navigation and operation workstations are to have a Bridge Alert Management (BAM) system that meets the requirements of IMO resolution MSC.302(87).

4.7.3.2 The BAM system is to provide the following alerts as a minimum:

(1) deviation from the route;

(2) close to the waypoint;

(3) incorrect or lost position;

(4) loss of heading input;

(5) equipment or sub-system failure;

(6) incompatibility of the compass.

4.7.3.3 Alerts are to be prioritized according to the type of emergency and response required by the navigation and operating workstations.

4.7.3.4 Within each priority, alerts will be arranged in groups to reduce the amount of information provided to the operator. However, the following alerts cannot be grouped:

(1) emergency alarm.

(2) a separate set of alarms related to a failure requiring reduction of speed or power or automatic shutdown of propulsion machinery.

(3) steering gear alarm.

(4) navigation light fault alarm.

4.7.3.5 The alerts are to be presented grouped in order of priority. Within the priorities the alerts are to be displayed in the order in which they occur (sequence). The visual display unit will provide an immediate display of new information, regardless of the currently selected information display.

4.7.3.6 Unacknowledged alerts can be distinguished by flashing text or by flashing markers adjacent to the text, not just by color changes. Acknowledged alerts can be distinguished by steady illuminated text or steady illuminated markers adjacent to the text.

CHAPTER 15 ADDITIONAL REQUIREMENTS FOR ELECTRICALLY PROPELLED SHIPS

Section 1 GENERAL PROVISIONS

15.1.1.1 The requirements of this Chapter apply to ~~electrically propelled~~ ships using electric motors as main propulsion.

15.1.1.3 Ships complying with the provisions of this Chapter are assigned with the following notation: Electrical Propulsion System.

15.1.2 Definitions

15.1.2.1 The definitions in this Chapter are as follows:

(1) propulsion motor means electrical motor intended to provide propulsion power.

(2) propulsion generator means generator mainly used for power supply of the propulsion system.

Section 2 ADDITIONAL REQUIREMENTS FOR ELECTRICAL PROPULSION INSTALLATIONS

15.2.1.5 ~~Machinery piping systems for the prime movers of generating sets for propulsion are to comply with all the requirements specified in Chapter 4 of PART THREE of the Rules applicable to main engines.~~ Under no circumstances should a single failure of the electrical or control system cause a permanent failure of the propulsion system.

15.2.1.6 ~~Where only one propulsion motor controlled via a semiconductor converter is fitted, a standby converter which it is easy to switch over to is to be provided. Double stator windings with one converter for each winding are considered as an alternative solution.~~ If electric propulsion is the sole means of propulsion for the ship, at least two independent propulsion motors and converters are generally to be provided. When any stator or propulsion motor fails, the remaining propulsion power is to be sufficient to maintain the efficient propulsion of the ship.

15.2.1.7 If the ship is provided with a single shaft-line propulsion system with one electric motor, an separate propulsion system is to be installed, providing power sufficient to maintain efficient propulsion of the vessel.

15.2.1.8 Propulsion systems having two or more generators, or two or more semiconductor converters, or two or more motors on one propeller shaft is to be so arranged that any unit may be taken out of service and disconnected electrically without affecting the operation of the remaining units.

15.2.1.~~7~~9 The common power plant is to meet the following requirements:

(1) The control system of the plant is to ensure a safe distribution of power between propulsion and ship services, with tripping of non-essential loads and/or reduction in the propulsion power if necessary.

(2) Where one generating set is out of action, the remaining sets are to be capable of providing all

essential and normal ship service loads while maintaining an effective level of propulsion power, i.e. ensuring a speed of not less than 7 knots or half of the design speed, whichever is the greater. Special consideration may be given in exceptional circumstances subject to agreement of CCS.

15.2.4.2 Machinery piping systems for the prime movers are to comply with all the requirements specified in Chapter 4 of PART THREE of the Rules applicable to main engines.

15.2.4.3 In the case of parallel operation of propulsion generators, the governing systems used are to permit stable operation to be maintained over the entire operational speed range of the prime movers.

15.2.4.~~3~~4 During manoeuvring of the ship, the regenerated power produced by the propulsion motor ~~machine~~ is not to cause tripping due to overspeed, neither to cause dangerous overload of the system. Where necessary, braking resistors are to be provided to absorb excess amounts of regenerated energy and to reduce the speed of rotation of the propulsion motor.

15.2.4.~~4~~5 The overspeed protective device is to be set to a speed in excess of the highest possible speed during the periods of power regeneration, and the generating set including prime mover is to be so designed that no damage will be raised from an overspeed equal to that at which the governor is set.

15.2.5 Propulsion ~~machines~~ generators and electric motors

15.2.5.1 Variable speed propulsion ~~machines~~ motors fitted with an integral fan are to be capable of operating at speeds below the rated speed with full-load torque, full-load current, full-load excitation or in similar conditions, and temperature rises are not to exceed the limits given in 3.2.3 of PART FOUR of the Rules.

15.2.5.2 The temperature of the cooling air of propulsion ~~machines~~ generators and propulsion motors provided with forced air ventilation is to be continuously monitored by means of direct reading thermometers which are readable from outside the machine and a remote audible alarm actuated by suitable temperature detectors.

15.2.5.3 For propulsion ~~machines~~ generators and propulsion motors fitted with heat exchangers in closed cooling circuits, the flow of primary and secondary coolants is to be monitored. Alternatively, monitoring of winding temperatures plus alarms may be accepted in lieu of the flow monitoring. In addition, consideration is to be given, where necessary, to the provision of devices for detecting leakage of cooling liquid in the machine enclosure and the operation of an associated alarm.

15.2.5.5 Effective means are to be provided for the propulsion ~~machines~~ motors to prevent condensation and accumulation of moisture when they are out of service. If steam is used for heating purpose, no joints of steam pipes are permitted within the motors.

15.2.5.6 ~~AC propulsion~~ Propulsion ~~machines~~ motors are to be capable of withstanding the effects of a sudden short circuit at their terminals under all ~~rated operating~~ conditions without suffering damage.

15.2.5.10 Propulsion generators and propulsion motors are to have a protection degree of at least IP 23. High voltage propulsion generators and propulsion motors are to have a protection degree of at least IP 44.

15.2.5.11 Propulsion generators and propulsion motors with semiconductor converters are to be designed for the expected harmonics of the system. A sufficient reserve is to be considered for the temperature rise due to total harmonic distortion.

15.2.6.1 The output current and voltage of exciters and their supply are to be suitable for the output required during manoeuvring and overcurrent conditions including short circuit as well as stalling condition. For this reason, attention is to be paid to the strength of shafts and couplings of rotating sets and to the power of their driving machines.

15.2.6.2 Any single fault in the propulsion ~~machines~~ generators and propulsion motors excitation system is not to result in a total loss of propulsion power.

15.2.6.6 If the protection device of the excitation system trips, the respective circuit breaker of the propulsion generator or motor is also to trip and is to be alarmed.

15.2.6.~~6~~7 Where fuses are used for excitation circuit protection, it is essential that they do not interrupt the field discharge resistor circuit upon rupturing.

15.2.7.1 ~~Control of the propulsion machines may be carried out from the bridge or deck.~~ ~~Local~~ Main and local controls are to be provided, independent of any remote or automatic system, to permit effective control of the propulsion equipment. Should the remote control system fail, local operation is to be possible within a reasonably short time and is to have the highest priority.

15.2.7.4 Levers for operating contactors, line switches, field switches and similar devices of ahead and astern circuits are to be interlocked to prevent their improper operation causing ahead and astern circuits being energized simultaneously. ~~These interlocks are to be of mechanical type as far as practicable.~~

15.2.7.7 Each control station is to have an emergency stop device which is independent of the control lever. The emergency stops are to be independent of the normal stop, and separate for each propulsion line. The emergency stop device is to be monitored against wire break and short circuit. The emergency stop device is to be protected against inadvertent action.

~~**15.2.9 Main circuits**~~

~~15.2.9.1 Propulsion systems having two or more generators, or two or more semiconductor converters, or two or more motors on one propeller shaft is to be so arranged that any unit may be taken out of service and disconnected electrically without affecting the operation of the remaining units.~~

15.2.~~10~~9 Protection

15.2.~~10~~9.1 Over-current protective devices, if fitted in the main circuits, are to be set sufficiently high so that there is no possibility of their action due to the over-current caused by manoeuvring or normal operation in heavy seas, or in floating pack ice.

15.2.~~10~~9.2 For DC systems in which overspeed of the propulsion motors may occur (due to light loads or loss of propeller, etc.), suitable overspeed protection is to be provided.

15.2.~~10~~9.3 Where separately driven DC generators are connected electrically in series, means is

to be provided to prevent rotation reversal of a generator upon failure of the driving power of its prime-mover.

15.2.~~10~~9.4 In excitation circuits, there is to be no overload protection causing the opening of the circuit, except for excitation circuits with semiconductor converters.

15.2.~~10~~9.5 Means are to be provided for discriminative tripping or rapid reduction of the magnetic fluxes of generators or motors to ensure that over-currents do not reach the value which may endanger the propulsion plant.

15.2.~~10~~9.6 Means for earth leakage detection is to be provided for the main propulsion circuit and be arranged to operate an alarm upon the occurrence of an earth fault. Where fault current flowing is liable to cause damage, arrangements for opening the main propulsion circuit are also to be provided. If the neutral is earthed, it is to be through an arrangement which will limit the current not to exceed approximately 20 A upon a fault to earth in the propulsion system.

15.2.~~10~~9.7 Means are to be provided for earth leakage detection in excitation circuits of propulsion machines, but may be omitted in circuits of brushless excitation systems and of motors rated up to 500 kW.

15.2.~~10~~9.8 Upon detection of a failure in the generators' excitation systems, an alarm is to be given on the navigation bridge and in the engine control room and actions to bring the system into a safe operational mode are to be automatically executed.

15.2.~~10~~9.9 In the design of DC machines and their protective systems, consideration is to be given to measures necessary to minimize any damage in the event of short circuit.

15.2.~~10~~9.10 Direct-current propulsion circuits are not to have fuses. Each circuit is to be protected by overload relays to open the field circuits or by remote-controlled main-circuit interrupting devices.

15.2.~~10~~9.11 If there is a possibility of blocking the propeller (e.g. during ice-breaking operation), a protection against damage to the propulsion plant is to be provided.

15.2.~~10~~9.12 Fuses may be provided for filter circuits. Visual and audible alarms are to be provided at the control station for tripping of the fuse.

15.2.~~10~~9.13 Differential protection or similar protection against internal short-circuit is to be provided for propulsion motors with an output of 1,500 kW or above.

15.2.~~10~~9.14 The following protection of semiconductor converters is to be provided:

(1) protection against overvoltage in the supply systems to which converters are connected;

(2) protection against over-currents in semiconductor elements during normal operation;

(3) short-circuit protection.

15.2.9.15 Each propulsion transformer is to be protected against primary and secondary side short-circuit. If the primary side of transformers is protected for short-circuit only, overcurrent protection is to be arranged on the secondary side.

15.2.~~11~~10 Monitoring instrumentation and alarms

15.2.~~11~~10.1 Alarms and displays associated with the electrical propulsion system are given in Table 15.2.~~11~~10.1. These alarms and displays are to be located in the centralized control station of the engine room (in the local station if without the centralized control station). Alarms and displays equivalent to those given in the Table may be accepted subject to agreement of CCS. Alarms for safety actions and group alarms for propulsion generators, motors and semiconductor converters are to be provided in the bridge.

Electric propulsion system monitoring, alarm and safety action item list **Table 15.2.~~11~~10.1**

System	Monitored parameter	Without class notations			BRC, MCC & AUT-0 notations			Remark
		Alarm	Display	Auto shut-down	Alarm	Display	Auto shut-down	
Propulsion generator (AC & DC)	Bearing lub. oil inlet pressure – low or bearing temperature – high	√	√	√	√	√	√	Prime mover automatic shutdown
	Voltage – off-limits (high/low)		√		√	√		To read all phases
	Frequency – off-limits (high/low)		√		√	√		For AC propulsion generators only
	Current		√			√		To read all phases
	Power		√			√		To indicate power consumed and power available for propulsion in bridge and centralized control station
	Stator windings temperature – high	√	√		√	√		To read all phases; for generators > 500 kW
	Main generator circuit breakers – open/close					√		
	Generator running		√			√		
	Failure of on-line generator				√			
	Transfer of standby generator				√			

System	Monitored parameter	Without class notations			BRC, MCC & AUT-0 notations			Remark
		Alarm	Display	Auto shut-down	Alarm	Display	Auto shut-down	
	Generator cooling medium temperature – high	√			√	√		If applicable
	Failure of generator cooling pump or fan motor				√			If applicable
	Field voltage and current		√			√		Not applicable to asynchronous generator
	Interpole windings temperature – high	√	√		√	√		For DC generators
Propulsion Motor (AC & DC)	Bearing lub. oil inlet pressure – low or bearing temperature – high	√	√	√	√	√	√	
	Voltage – off-limits (high/low)		√		√	√		To read all phases. For propulsion motor controlled by frequency converter, the monitoring of the ~~input~~ output voltage (single phase) of frequency converter may be taken as an alternative
	Field voltage					√		

System	Monitored parameter	Without class notations			BRC, MCC & AUT-0 notations			Remark
		Alarm	Display	Auto shut-down	Alarm	Display	Auto shut-down	
	Frequency – off-limits (high/low)				√	√		For AC propulsion motors only. For propulsion motor controlled by frequency converter, the monitoring of the ~~input~~ output of frequency converter may be taken as an alternative
	Armature current		√			√		To read all phases
	Field current		√			√		For synchronous motors
	Stator windings temperature – high	√			√	√		To read all phases; for AC motors > 500 kW only
	Motor circuit breakers – open/close					√		
	Motor running		√			√		
	Motor overspeed	√	√	√	√	√	√	For DC propulsion motors
	Failure of on-line motor				√			
	Transfer of standby motor				√			
	Motor cooling medium temperature – high	√			√	√		If applicable
	Failure of cooling pump or fan motor				√			If applicable
	Interpole current		√			√		For DC propulsion motors only

System	Monitored parameter	Without class notations			BRC, MCC & AUT-0 notations			Remark
		Alarm	Display	Auto shut-down	Alarm	Display	Auto shut-down	
	Differential protection or similar protection	√			√			For motors ≥ 1500 kW
Propulsion Semiconductor converter	Voltage (input)		√			√		
	Current (input)		√			√		
	Overload (high current)	√			√			Alarms before protective device is activated
	Open/close position for assignment switches					√		
	Converter cooling medium temperature – high	√	√		√	√		If applicable
	Failure of converter cooling pump or fan motor	√			√			If applicable
	Inter-phase reactor temperature – high				√	√		
	Tripping of filter circuit fuse	√			√			
Propulsion Transformer	Transformer windings temperature – high	√	√		√	√		
Others	Field circuit earth fault	√			√			May be omitted in circuits of brushless excitation systems and of motors rated up to 500 kW

System	Monitored parameter	Without class notations			BRC, MCC & AUT-0 notations			Remark
		Alarm	Display	Auto shut-down	Alarm	Display	Auto shut-down	
	Main propulsion circuit earth fault		√			√		

15.2.~~11~~10.2 Ships having machinery notation(s) are to comply with the automatic control and monitoring requirements applicable to diesel engines and gas turbines of propulsion generating sets as well as main boilers and auxiliary steam turbines, as specified in PART SEVEN of the Rules. Where two or more propulsion generating sets are provided and 100% design speed is still achieved upon the shutdown of any of them, only the automatic control and monitoring requirements of PART SEVEN of the Rules for auxiliary diesel engines, auxiliary gas turbines and auxiliary steam turbines are to be complied with.

15.2.~~12~~11 Special requirements for podded propulsion system

15.2.~~12~~11.1 Where a ship is fitted with one or more podded propulsion units, the unit used as steering manoeuvring system is to be supplied and controlled in compliance with the requirements of 13.1.8, PART THREE of the Rules.

15.2.~~12~~11.2 Where the electric motor is supplied by a slip ring, the following checks and tests on the ring are to be considered:

(1) check of the IP protection degree, in accordance with the location of the slip ring;

(2) check of clearances and creepage distances;

(3) check of contact resistance of the slip ring ~~insulation material according to the test procedure described in IEC Publication 60112~~;

(4) endurance test: After the contact pressure and rated current are set, the slip ring is subjected to a rotation test. The number of rotations is evaluated taking into consideration the ship operation and rotation speed control system. The possibility of turning the pod 180° to proceed astern and 360° to return to the original position is to be considered. The ring may be submitted to cycles comprising full or partial rotation in relation to the use of the pod as steering gear. The voltage drops and current are to be recorded. An overload test is to be carried out (minimum 150%, 15s);

(5) check of the behaviour of the slip ring when subjected to the vibration described in IEC Publication 60068-2-6;

(6) check of the behaviour of the slip ring, after damp heat test, as described in IEC Publication 60068-2-30;

(7) after the damp heat test, an insulation resistance test is to be carried out;

(8) dielectric strength test.

15.2.~~12~~11.3 All system failure alarms are to be displayed in the bridge. Alarms are to be arranged for the pod under the following circumstances:

(1) overload of propulsion motors;

(2) power failure of propulsion motors;

(3) low pressure of hydraulic oil system;
(4) low pressure of lubricating oil supply;
(5) high temperature of lubricating oil;
(6) low level of lubricating oil tank for motor bearings;
(7) high temperature of motor cooling air inlet;
(8) high temperature of motor cooling air outlet;
(9) abnormal operation of bilge pump;
(10) high level of pod bilge.

15.2.~~12~~11.4 Sensors for control, monitoring and alarm systems located within the pod are to be duplicated, one acting as a standby for the other.

15.2.~~12~~11.5 An effective cooling system is to be provided for the propulsion motor within the pod, and a standby cooling arrangement is to be provided and available for immediate use.

15.2.~~12~~11.6 Two independent means of automatic bilge drainage are to be provided for the pod. The number and location of bilge level detectors are to be such that accumulation of liquids will be detected at all design angles of heel and trim.

15.2.~~12~~11.7 The pod connecting bolts and slewing ring bearings are to comply with recognized standards, as applicable.。

15.2.~~13~~12 Cooling and ventilation

15.2.~~13~~12.1 Loss of ventilation to compartments with forced air cooling is not to cause loss of propulsion. To this end, two sets of ventilation fans are to be provided, one acting as a standby unit for the other.

15.2.~~13~~12.2 If semiconductor converters are separately cooled, the plant is to be capable of continuing operation at reduced power level if the cooling system fails. Means to contain any leakage of cooling liquid are to be provided so that the liquid does not cause a failure of the converter or any other electrical equipment located near the converter.

~~CHAPTER 17 ADDITIONAL REQUIREMENTS FOR PASSENGER SHIPS~~

~~Section 1 QUALITATIVE FAILURE ANALYSIS FOR PROPULSION AND STEERING ON PASSENGER SHIPS~~

~~17.1.1 Application~~

~~17.1.1.1 The detailed qualitative failure analysis for propulsion and steering is applicable for passenger ships engaged on international voyages, having a length of 120 m or more or having three or more main vertical zones, contracted for construction on or after 1 January 2010.~~

~~17.1.2 Note~~

~~17.1.2.1 This may be considered as the first step for demonstrating compliance with the revised Regulation 21 of SOLAS Chapter II-2 as amended by IMO resolutions up to MSC.421(98).~~

~~17.1.3 Objectives~~

~~17.1.3.1 For ships having at least two independent means of propulsion and steering to comply with SOLAS requirements for a safe return to port, items (1) and (2) below are applicable:~~

~~(1) provide knowledge of the effects of failure in all the equipment and systems due to fire in any space, or flooding of any watertight compartment that could affect the availability of the propulsion and steering;~~

~~(2) provide solutions to ensure the availability of propulsion and steering upon such failures in item (1).~~

~~17.1.3.2 Ships not required to satisfy the safe-return-to-port concept will require the analysis of failure in single equipment and fire in any space to provide knowledge and possible solutions for enhancing availability of propulsion and steering.~~

~~17.1.4 Systems to be considered~~

~~17.1.4.1 The qualitative failure analysis is to consider the propulsion and steering equipment and all its associated systems which might impair the availability of propulsion and steering.~~

~~17.1.4.2 The qualitative failure analysis is to include:~~

~~(1) Propulsion and electrical power prime movers, e.g.~~

~~① diesel engines;~~

~~② electric motors.~~

~~(2) Power transmission systems, e.g.~~

~~① shafting;~~

~~② bearings;~~

~~③ power converters;~~

~~④ transformers;~~

~~⑤ slip ring systems.~~

~~(3) Steering gear~~

① rudder actuator or equivalent for azimuthing propulsor;
② rudder stock with bearings and seals;
③ rudder;
④ power unit and control gear;
⑤ local control systems and indicators;
⑥ remote control systems and indicators;
⑦ communication equipment.
(4) Propulsors, e.g.
① propeller;
② azimuthing thruster;
③ water jet.
(5) Main power supply systems, e.g.
① electrical generators and distribution systems;
② cable runs;
③ hydraulic systems;
④ pneumatic systems.
(6) Essential auxiliary systems, e.g.
① compressed air;
② oil fuel;
③ lubricating oil;
④ cooling water;
⑤ ventilation;
⑥ fuel storage and supply systems.
(7) Control and monitoring systems, e.g.
① electrical auxiliary circuits;
② power supplies;
③ protective safety systems;
④ power management systems;
⑤ automation and control systems.
(8) Support systems, e.g.
① lighting;
② ventilation.
To consider the effects of fire or flooding in a single compartment, the analysis is to address the location and layout of equipment and systems.

17.1.5 Failure criteria

17.1.5.1 Failures are deviations from normal operating conditions such as loss or malfunction of a component or system such that it cannot perform an intended or required function.

17.1.5.2 The qualitative failure analysis is to be based on single failure criteria (not two independent failures occurring simultaneously).

17.1.5.3 Where a single failure cause results in failure of more than one component in a system (common cause failure), all the resulting failures are to be considered together.

17.1.5.4 Where the occurrence of a failure leads directly to further failures, all those failures are to be considered together.

17.1.6 Verification of solutions[③]

17.1.6.1 The shipyard is to submit a report to class societies that identifies how the objectives have been addressed. The report is to include the following information:

(1) identify the standards used for analysis of the design;

(2) identify the objectives of the analysis;

(3) identify any assumptions made in the analysis;

(4) identify the equipment, system or sub-system, mode of operation of the equipment;

(5) identify probable failure modes and acceptable deviations from the intended or required function;

(6) evaluate the local effects (e.g. fuel injection failure) and the effects on the system as a whole (e.g. loss of propulsion power) of each failure mode as applicable;

(7) identify trials and testing necessary to prove conclusions.

17.1.6.2 The report is to be submitted prior to approval of detail design plans. The report may be submitted in two parts:

(1) a preliminary analysis as soon as the initial arrangements of different compartments and propulsion plant are known which can form the basis of discussion. This is to include a structured assessment of all essential systems supporting the propulsion plant after a failure in equipment, fire or flooding in any compartment casualty;

(2) a final report detailing the final design with a detailed assessment of any critical system identified in the preliminary report.

17.1.6.3 Verification of the report findings are to be agreed between the class society and the shipyard.

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③ All stakeholders (e.g. class, owners, shipyards and manufacturers) are as far as possible to be involved in the development of the report.

CHAPTER 25 ADDITIONAL REQUIREMENTS FOR DIVING SUPPORT VESSELS

Section 5 FIRE-FIGHTING

~~**25.5.2 Fire-extinguishing systems**~~

~~25.5.2.1 Diving systems installed in enclosed spaces~~

~~(1) The fixed fire-extinguishing systems can be water spray fire-extinguishing systems or gas fire-extinguishing systems approved for machinery spaces of category A.~~

~~(2) Where fixed gas fire-extinguishing systems are used, the selection of the fire-extinguishing medium is to be such that when the medium is applied in its entirety in the enclosed spaces, the concentration of the toxic gas will not impair human body.~~

~~(3) For windows, view ports or other windows fitted on the manned pressure vessels in the enclosed spaces, means of cooling are to be provided.~~

~~(4) Portable fire extinguishers of sufficient number are to be provided in the enclosed spaces storing the diving system, one of which is to be placed near the access to the enclosed spaces. Spare charges are to be provided for 100% of the first ten extinguishers and 50% of the remaining fire extinguishers in the enclosed spaces.~~

~~(5) Enclosed spaces storing breathing gas cylinders or pressure vessels are to be provided with manually actuated water spray fire-extinguishing systems so as to cool the breathing gas cylinders or pressure vessels in case of fire. The application rate on the projected horizontal area is at least 10 l/m^2 per minute. Water mist fire-extinguishing systems may be provided in the enclosed spaces as an alternative, the application rate of which is at least 5 l/m^2 per minute.~~

~~25.5.2.2 Diving systems installed on the open deck~~

~~(1) Decks or similar hull structure areas storing diving systems are to be provided with appropriate fire-extinguishing systems.~~

~~(2) Fire hoses on the diving support vessel connecting to the fire mains are to be protected as appropriate.~~

~~(3) For windows, observation windows or other windows fitted on the manned pressure vessels in the enclosed spaces, means of cooling are to be provided.~~

25.5.2 Fire-extinguishing systems and means of cooling

25.5.2.1 Diving systems installed in enclosed spaces

(1) Fixed fire extinguishing systems installed in enclosed spaces are to be:

① fixed pressure water spray fire-extinguishing systems suitable for machinery spaces of category A according to the requirements of the FSS Code; or

② fixed gas fire-extinguishing systems suitable for machinery spaces of category A according to the requirements of the FSS Code; or

③ equivalent fire-extinguishing systems deemed by the Administration to provide an equivalent level of protection.

(2) Portable fire extinguishers of sufficient number are to be provided in the enclosed spaces

storing the diving system, one of which is to be placed near the access to the enclosed spaces. Spare charges are to be provided for 100% of the first ten extinguishers and 50% of the remaining fire extinguishers in the enclosed spaces.

(3) Where fixed gas fire-extinguishing systems are used, the selection of the fire-extinguishing medium is to be such that when the medium is applied in its entirety in the enclosed spaces, the concentration④ of the toxic gas will not impair human body.

25.5.2.2 Diving systems installed on the open deck

(1) Decks or similar hull structure areas storing diving systems are to be provided with appropriate fire-extinguishing systems.

(2) Fire hoses on the diving support vessel connecting to the fire mains are to be protected as appropriate.

25.5.2.3 Means of cooling

(1) For windows, observation windows or other windows fitted on the manned pressure vessels in the enclosed spaces, means of cooling are to be provided.

(2) Enclosed spaces storing breathing gas cylinders or pressure vessels are to be provided with manually- actuated water spray systems so as to cool the breathing gas cylinders or pressure vessels in case of fire. The application rate on the projected horizontal area is at least 10 l/m^2 per minute. Water mist fire-extinguishing systems may be provided in the enclosed spaces as an alternative, the application rate of which is at least 5 l/m^2 per minute.

④ The concentration of fire-extinguishing medium is to be lower than the No Observed Adverse Effect Level (NOAEL) as defined in amendments to MSC/Circ.848 (MSC.1/Circ.1267).

CHAPTER 27 BOW LOADING SYSTEM

Section 1 GENERAL PROVISIONS

27.1.2 Notation

27.1.2.1 Oil tankers complying with the provisions of Sections 1 to 8 of this Chapter may be assigned the notation: Bow Loading System.

27.1.2.2 Oil tankers complying with the provisions of Section 9 of this Chapter may be assigned the notation: Bow Loading System*.

Section 9 REQUIREMENTS FOR BOW LOADING SYSTEM*

27.9.1 General requirements

27.9.1.1 Oil tanks applying for Bow Loading System* may be exempted from the requirements of 27.5.2.3(4) of this Chapter, but are to comply with the provisions of this Section.

27.9.2 System requirements

27.9.2.1 Reliable control and safety signal transmission are to be achieved between the bow loading system control station and offshore terminal. The offshore terminal is responsible for safe control of cargo oil supply.

27.9.2.2 The communication system required by 27.5.3 of this Chapter is to be capable of sending emergency signal in case of communication failure during the operation and timely terminate the operation.

27.9.2.3 The emergency disconnection system required by 27.5.2.4 of this Chapter can disconnect the main crude oil transfer pumps of the offshore terminal by means of 27.5.3 and 27.9.2.2 of this Chapter.

CHINA CLASSIFICATION SOCIETY

RULES FOR CLASSIFICATION OF SEA-GOING STEEL SHIPS

AMENDMENTS

2023

PART NINE COMMON STRUCTURAL RULES FOR BULK CARRIERS AND OIL TANKERS

CONTENTS

PART 9-1 GENERAL HULL REQUIREMENTS

CHAPTER 1 RULE GENERAL PRINCIPLES

SECTION 1 APPLICATION

1 SCOPE OF APPLICATION

1.2 Scope of application for bulk carriers

1.2.1
These Rules apply to the hull structures of single side skin and double side skin bulk carriers having a freeboard length L_{LL} of 90 m or above.

Bulk carriers are ships which are constructed generally with single deck, double bottom, hopper side tanks and topside tanks and with single or double side skin construction in cargo hold region and intended primarily to carry dry cargoes in bulk. Typical arrangements of bulk carriers are shown in Figure 1.

Hybrid bulk carriers, where at least one cargo hold is constructed with hopper tank and topside tank, see typical arrangements in Figure 1, and other cargo holds are constructed without hopper tank and/or topside tanks, see examples of a transverse section in Figure 2, are to comply with the strength criteria defined in these Rules.

These Rules are not applicable to the following ship types:

- Ore carriers.
- Combination carrier.
- Woodchip carrier.
- Cement, fly ash and sugar carriers provided that loading and unloading is not carried out by grabs heavier than 10 tons, power shovels and other means which may damage cargo hold structure.
- Ships with inner bottom construction adapted for self-unloading.

1.3 Scope of application for oil tankers

1.3.1 Length and structural arrangement application
These Rules apply to the hull structures of double hull oil tankers having a freeboard length L_{LL} of 150 m or above. Oil tanker is defined as a ship which has to comply with Annex I of MARPOL73/78.
The typical arrangements of oil tankers covered by the rules are shown in Figure 3 and assume that the structural arrangements include:

- Double side structure with breadth in accordance with statutory requirements.
- Side longitudinal, centreline longitudinal or transverse bulkheads of plane, corrugated or double skin construction.
- Single deck structure.

The cross sections shown in Figure 3 are typical examples only and other variations of cross tie and web frame arrangements are also covered.

3 CLASS NOTATIONS

3.2 Class notation for bulk carriers

3.2.1 Additional service features BC-A, BC-B and BC-C
The following requirements apply to ships, as defined in [1.2.1], having a freeboard length L_{LL} of 150 m or

above. Bulk carriers are to be assigned one of the following additional service features:

a) BC-A: For bulk carriers designed to carry dry bulk cargoes of cargo density 1.0 t/m3 and above with specified holds empty at maximum draught in addition to BC-B conditions.

b) BC-B: For bulk carriers designed to carry dry bulk cargoes of cargo density of 1.0 t/m3 and above with all cargo holds loaded in addition to BC-C conditions.

c) BC-C: For bulk carriers designed to carry dry bulk cargoes of cargo density less than 1.0 t/m3.

The following additional service features are to be provided giving further detailed description of limitations to be observed during operation as a consequence of the design loading condition applied during the design in the following cases:

- {Maximum cargo density in t/m3} for additional service features BC-A and BC-B if the maximum cargo density is less than 3.0 t/m3, see also Ch 4, Sec 8, [4.1].
- {No MP} for all additional service features when the ship has not been designed for loading and unloading in multiple ports in accordance with the conditions specified in Ch 4, Sec 8, [4.2.2].
- {Holds a, b, … may be empty} for additional service feature BC-A, see also Ch 4, Sec 8, [4.1].
- {Block loading} for additional service feature BC-A, when the ship is intended to operate in alternate block load condition, see also Ch 4, Sec 8, [4.2.3] ,item d.

SECTION 2 RULE PRINCIPLES

3 DESIGN BASIS

3.1 General

3.1.3 Residual strength

Ships having a freeboard length L_{LL} of 150 m or above are to be designed to have sufficient reserve strength to withstand the loads in damaged conditions, e.g. collision, grounding or flooded scenarios. Residual strength calculations are to take into account the ultimate reserve capacity of the hull girder, considering permanent deformation and post-buckling behaviour as specified in Ch 5, Sec 3.

3.1.4 Finite element analysis

The scantling of the structural members within the cargo hold region of ships having a freeboard length L_{LL} of 150 m or above is to be assessed according to the requirements specified in Pt 1, Ch 7.

3.1.5 Fatigue life

Ships having a freeboard length L_{LL} of 150 m or above are to be assessed according to the design fatigue life for structural details specified in Pt 1, Ch 9.

SECTION 4 SYMBOLS AND DEFINITIONS

3 DEFINITIONS

3.8 Glossary

3.8.1 Definitions of terms

Table 7: Definition of terms

Terms	Definition
[Omitted]	[Omitted]
Stay	Bulwark and hatch coaming brackets.
Stem	The piece of bar or plating at which a ship's outside plating terminates at the forward end.
Stern	The after end of the vessel.
[Omitted]	[Omitted]

SECTION 5 LOADING MANUAL AND LOADING INSTRUMENTS

4 LOADING SPECIFIC TO BULK CARRIERS

4.1 Guidance for loading/unloading sequences

4.1.1 Scope of application

The requirements given in [4] are applicable to bulk carriers having a freeboard length L_{LL} of 150 m ~~in length and~~ or above.

CHAPTER 2 GENERAL ARRANGEMENT DESIGN

SECTION 2 SUBDIVISION ARRANGEMENT

1 WATERTIGHT BULKHEAD ARRANGEMENT

1.1 Number and disposition of watertight bulkheads

1.1.4
For bulk carriers with freeboard length L_{LL} less than 150 m ~~in length~~ not required to comply with subdivision requirements, bulkheads not less in number than indicated in Table 1 are to be fitted.

Table1: Number of bulkheads for bulk carriers with freeboard length L_{LL} less than 150 m ~~in length~~

~~Length~~ Freeboard length in m	Number of bulkheads for ships with aft machinery(1)
90≤ L_{LL} < 105	4
105 ≤ L_{LL} < 120	5
120 ≤ L_{LL} < 145	6
145 ≤ L_{LL} < 150	7
(1) Aft peak bulkhead and aft machinery bulkhead are the same.	

CHAPTER 3 STRUCTURE DESIGN PRINCIPLES

SECTION 3 CORROSION ADDITIONS

1 GENERAL

1.2 Corrosion addition determination

1.2.1

Table1: Corrosion addition for one side of a structural member

Compartment type	Structural member		t_{c1} or t_{c2}		
			Oil tankers	BC-A or BC-B ships with L_{LL}≥150 m	Other BC ships
Ballast water tank, bilge tank, drain storage tank, chain locker (1)	Face plate of PSM	Within 3m below top of tank (4)	2.0		
		Elsewhere	1.5		
	Other members (2) (3)	Within 3m below top of tank (4)	1.7		
		Elsewhere	1.2		
…	…	…	…		

SECTION 6 STRUCTURAL DETAIL PRINCIPLES

4 PRIMARY SUPPORTING MEMBERS (PSM)

4.3 Tripping bracket arrangement

4.3.4 Arm length

The arm length of tripping brackets is not to be less than the greater of the following values, in m:

$d = 0.38\ b$

$$d = 0.85b\sqrt{\frac{S_t}{t}}$$

where:

b : Height, in m, of tripping brackets, shown in Figure 4.
s_t : Spacing, in m, of tripping brackets.
t : Net thickness, in mm, of tripping brackets.

For tripping brackets in way of superstructures or deckhouses, only $d = 0.38\ b$ is to be applied.

SECTION 7 STRUCTURAL IDEALISATION

1 STRUCTURAL IDEALISATION OF STIFFENERS AND PRIMARY SUPPORTING MEMBERS

1.4 Geometrical properties of stiffeners and primary supporting members

1.4.9 Stiffener flange width

In case the stiffener flange thickness requirement in Ch 8, Sec 2, [3.1.1] b) is not fulfilled, the effective free flange outstand, used in strength assessment including the calculation of actual net section modulus, is to be taken as $b_{f\text{-}out\text{-}max}$ defined in Ch 8, Sec 2, [3.1.1].

CHAPTER 4 LOADS

SECTION 5 EXTERNAL LOADS

3. EXTERNAL IMPACT PRESSURES FOR THE BOW AREA

3.3 Bow impact pressure

3.3.1 Design pressures

The bow impact pressure P_{FB}, in kN/m^2, to be considered for the bow impact design load scenario is to be taken as:

$P_{FB}=1.025 f_{FB} c_{FB} V^2_{im} \sin\gamma_{wl}$

where:

f_{FB} : Longitudinal bow flare impact pressure distribution factor. To be taken as:

$f_{FB}=0.55$ for $x/L \leqslant 0.9$

$f_{FB}=4(x/L-0.9)+0.55$ for $0.9< x/L \leqslant 0.9875$

$f_{FB}=8(x/L-0.9875)+0.9$ for $0.9875< x/L \leqslant 1.0$

$f_{FB}=1.0$ for $x/L>1.0$

V_{im} : Impact speed, in knots, to be taken as:

$$V_{im} = 0.514 V_{ref} \sin\alpha_{wl} + \sqrt{L}$$

V_{ref} : Forward speed, in knots, to be taken as:

$V_{ref}=0.75V$, but not less than 10.

α_{wl} : Local waterline angle, in deg, at the considered position, but not less than 35 deg. See Figure 12.

γ_{wl} : Local bow impact angle, in deg, measured in a vertical plane containing the normal to the shell, from the horizontal to the tangent line at the considered position but not less than 50 deg, as shown in Figure 12. Where this value is not available, it may be taken as:

$$\gamma_{wl} = \tan^{-1}\left(\frac{\tan\beta_{pl}}{\cos\alpha_{wl}}\right)$$

For ships with bow impact angle less than 50 deg, the impact pressure is to be individually considered by the Society. The resulting scantling individually considered by the Society is in no case to be less than the scantling calculated in accordance with [3.3.1] for local bow impact angle equal to 50 deg.

β_{pl} : Local body plan angle, in deg, at the considered position from the horizontal to the tangent line, but not less than 35 deg.

c_{FB} : Coefficient to be taken as:

$c_{FB}=1.0$ for positions between draughts T_{BAL} and T_{SC}

$$c_{FB} = \sqrt{1.0 + \cos^2\left[90\frac{(h_{fb}-2h_0)}{h_{fb}}\right]}$$ for positions above draughts T_{SC}

h_{fb} : Vertical distance, in m, from the waterline at the draught T_{SC} to the highest deck at side. See Figure12.

h_0 :Vertical distance, in m, from the waterline at the draught T_{SC} to the considered position. See Figure 12.

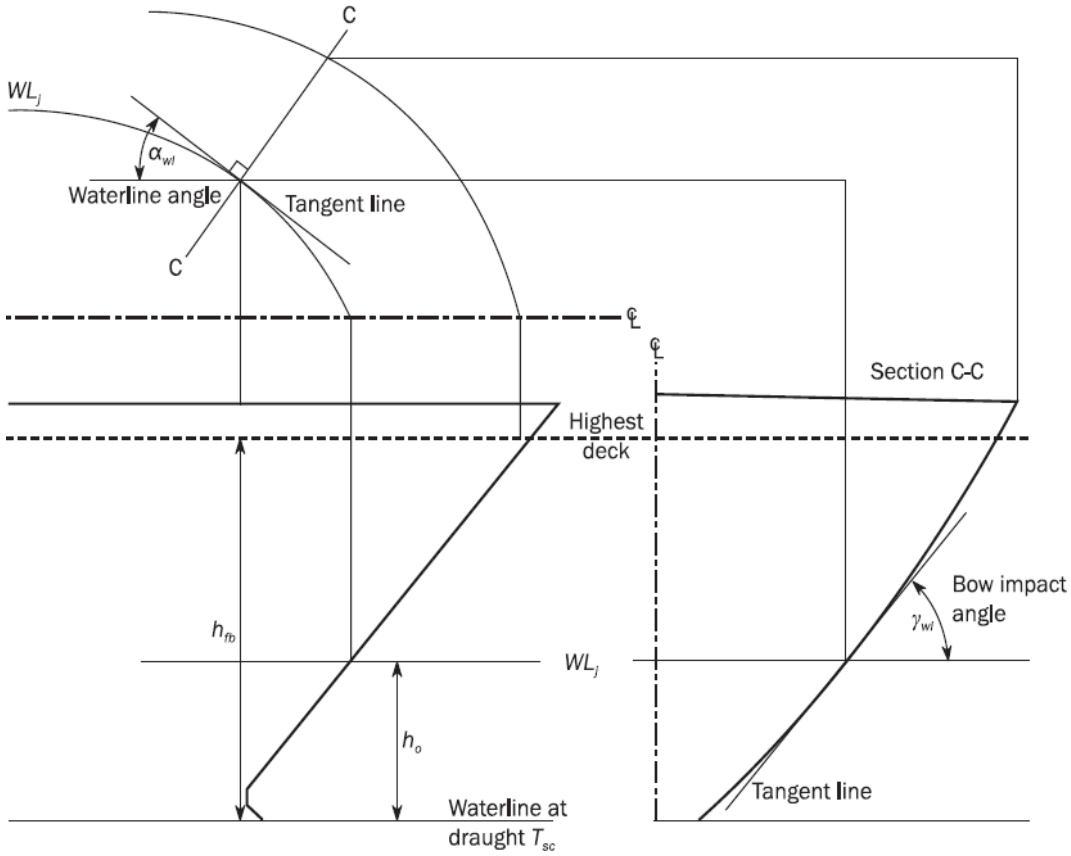


Figure 12 Definition of bow geometry

CCS 3.3.1a For ships with impact angle, γ_{wl} less than 50 deg, in addition to [3.3.1], the requirements given in Ch 6, Sec 7, [3.3] of CCS Rules for Structures of Container Ships are to be complied also.

SECTION 6 INTERNAL LOADS

SYMBOLS

…

K_C : Coefficient taken equal to:

$K_C = cos^2\alpha + (1 - \sin\Psi)sin^2\alpha$ ~~for inner bottom, hopper tank, transverse and longitudinal bulkhead, lower stool, vertical upper stool, inner side and side shell.~~ for $\alpha \leq 90°$

~~$K_C = 0$~~ ~~for topside tank, main deck and sloped upper stool.~~

$K_C = (1 - \sin\Psi)sin^2\alpha$ for $90° < \alpha \leq 120°$

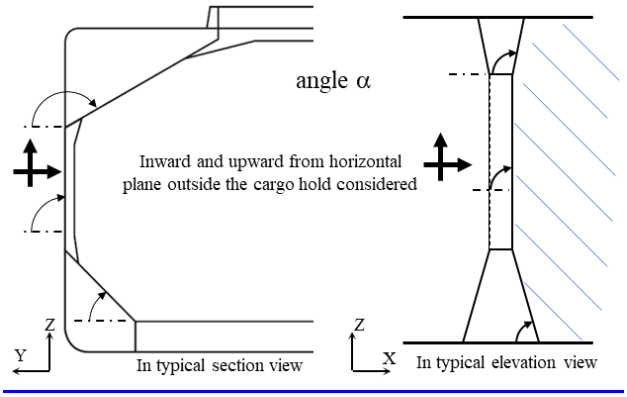
$K_C = 0.75(1 - \sin\Psi)[1 - (\alpha - 120)/(60 - \Psi)]$ for $\alpha > 120°$ and $\alpha + \Psi < 180°$

$K_C = 0$ when $\alpha + \Psi \geq 180°$

…

α : Angle, in deg, between panel considered and the horizontal plane. The angle is to be measured inward and upward from horizontal plane outside cargo hold, between 0 and 180 deg, as shown in Figure 1a.

Figure 1a: Measurement of angle



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SECTION 7 DESIGN LOAD SCENARIOS

2 DESIGN LOAD SCENARIOS FOR STRENGTH ASSESSMENT

2.1 Principal design load scenarios

2.1.1

The principal design load scenarios are given in Table 1.

Table1: Principal design load scenarios

Design load scenario			Harbour and sheltered water and testing	Seagoing conditions With extreme sea loads	Ballast water exchange (4)	Accidental flooded conditions (4)	
Load components			Static (S)	Static + Dynamic (S+D)	Static + Dynamic (S+D)	Static (S)	Static + Dynamic (A : S+D)
Hull Girder	*VBM*		M_{sw-p}	$M_{sw} + M_{wv-LC}$	$M_{sw} + M_{wv-LC}$	M_{sw-f} (2)	$M_{sw-f} + M_{wv-LC}$ (3)
	HBM		-	M_{wh-LC}	M_{wh-LC}	-	M_{wh-LC} (3)
	VSF		Q_{sw-p}	$Q_{sw} + Q_{wv-LC}$	$Q_{sw} + Q_{wv-LC}$	-	$Q_{sw-f} + Q_{wv-LC}$ (3)
	TM		-	M_{wt-LC}	M_{wt-LC}	-	-
Local Loads	P_{ex}	External deck for green sea	-	P_D	-	-	-
		Hull envelope	P_S	$P_S + P_W$	$P_S + P_W$	-	-
	P_{in}	Ballast tanks (1)	$Max(P_{ls}, P_{ST})$	$P_{ls} + P_{ld}$	$P_{ls} + P_{ld}$	-	-
		Liquid cargo tanks			-	-	
		Other tanks			-	-	
		Watertight boundaries	-	-	-	P_{fs}	$P_{fs} + P_{fd}$
		Cargo holds	P_{bs}	$P_{bs} + P_{bd}$	-		
	P_{dk}	Internal decks for dry spaces	P_{dl-s}	$P_{dl-s} + P_{dl-d}$	-	-	-

		External deck for distributed loads	$P_{dl\text{-}s}$	$P_{dl\text{-}s} + P_{dl\text{-}d}$	-	-	-
		External deck for heavy units	$F_{U\text{-}s}$	$F_{U\text{-}s} + F_{U\text{-}d}$	-	-	-

(1) WB cargo hold is considered as ballast tank except for design load scenario 'ballast water exchange'.
(2) M_{swf} used for hull local scantling of watertight bulkhead
(3) Hull girder strength check is performed according to Ch 5, Sec 1 for bulk carriers having a freeboard length L_{LL} of 150 m or above
(4) Applicable to prescriptive assessment only

SECTION 8 LOADING CONDITIONS

1 APPLICATION

1.1 Ships having a freeboard length L_{LL} of 150m or above

1.1.1
The requirements in [2] to [5] are applicable to ships having a freeboard length L_{LL} of 150 m or above.

1.2 Bulk carriers having a freeboard length L_{LL} less than 150 m

1.2.1
The severest loading condition from the loading manual, midship section drawing or otherwise specified by the Designer are to be considered for the longitudinal strength given in Ch5 and for local strength check of plating, ordinary stiffeners and primary supporting members given in Ch6 and Pt 2, Ch1, Sec 3 and Pt 2, Ch1, Sec 4.

The requirements in [2] are applicable to ships having a freeboard length L_{LL} less than 150 m.

2 COMMON DESIGN LOADING CONDITIONS

2.1 Definitions

2.1.2 Departure conditions

The departure conditions are to be based on bunker tanks not taken less than 95% full and other consumables taken at 100% capacity. In case of liquefied gas fuel tank, the filling level is to be based on the definition in International Code of Safety for Ships Using Gases or other Low-Flashpoint Fuels (IGF code) 6.8.

2.2 Partially filled ballast tanks

2.2.1 Partially filled ballast tanks in ballast loading conditions

Ballast loading conditions involving partially filled peak and/or other ballast tanks in any departure, arrival or intermediate condition are not permitted to be used as design loading conditions unless:

- Longitudinal strength of hull girder given in Ch 5, Sec 1 and Ch 8, Sec 3 is to comply with loading conditions with the considered tanks full, empty and partially filled at intended level in any departure, arrival or intermediate condition.

- For bulk carriers having a freeboard length L_{LL} of 150 m or above, longitudinal strength of hull girder in flooded condition given in Ch 5, Sec 1 is to comply with loading conditions with the considered tanks full, empty and partially filled at intended level in any departure, arrival or intermediate condition.

The corresponding full, empty and partially filled tank conditions are to be considered as design conditions for calculation of the still water bending moment and shear force, but these do not need to comply with propeller immersion and trim requirements as specified in [2.3.1], [3.1.1] or [4.1.1].

Where multiple tanks are intended to be partially filled, all combinations of empty, full and partially filled at intended levels for those tanks are to be investigated. These requirements are not applicable to ballast water exchange using the sequential method.

APPENDIX 1 HOLD MASS CURVES

1 GENERAL

1.1 Application

1.1.1
The requirements of this appendix apply to bulk carriers having a freeboard length L_{LL} of 150 m ~~in length L and~~ or above.

CHAPTER 5 HULL GIRDER STRENGTH

SECTION 1 Hull Girder Yielding Strength

2 HULL GIRDER BENDING ASSESSMENT

2.2 Normal stresses

2.2.1

Table 1: Permissible hull girder bending stress

Operation	Design load	Permissible hull girder bending stress, σ_{perm}				
		$\frac{x}{L} \le 0.1$	$0.1 < \frac{x}{L} < 0.3$	$0.3 < \frac{x}{L} < 0.7$	$0.7 < \frac{x}{L} < 0.9$	$\frac{x}{L} \ge 0.9$
Seagoing	(S+D)	140/*k*	Linear interpolation	190/*k*	Linear interpolation	140/*k*
Harbour/ sheltered water	(S)	105/*k*	Linear interpolation	143/*k*	Linear interpolation	105/*k*
Flooded condition at sea for bulk carriers having a freeboard length L_{LL} of 150 m or above	(A:S+D)	140/*k*	Linear interpolation	190/*k*	Linear interpolation	140/*k*

2.2.2

Table 2: Normal stress, σL

Operation	Normal stress, σ_L		
	At any point located below Z_{VD}	At bottom (1)	At deck (1)
Seagoing	$\sigma_L = \frac{M_{sw} + f_\beta M_{wv}}{Z_{A-n50}} 10^{-3}$	$\sigma_L = \frac{M_{sw} + f_\beta M_{wv}}{Z_{B-n50}} 10^{-3}$	$\sigma_L = \frac{M_{sw} + f_\beta M_{wv}}{Z_{D-n50}} 10^{-3}$
Harbour/sheltered water	$\sigma_L = \frac{M_{sw-p}}{Z_{A-n50}} 10^{-3}$	$\sigma_L = \frac{M_{sw-p}}{Z_{B-n50}} 10^{-3}$	$\sigma_L = \frac{M_{sw-p}}{Z_{D-n50}} 10^{-3}$
Flooded condition at sea for bulk carriers having a freeboard length L_{LL} of 150 m or above	$\sigma_L = \frac{M_{sw-f} + M_{wv}}{Z_{A-n50}} 10^{-3}$	$\sigma_L = \frac{M_{sw-f} + M_{wv}}{Z_{B-n50}} 10^{-3}$	$\sigma_L = \frac{M_{sw-f} + M_{wv}}{Z_{D-n50}} 10^{-3}$
(1) The σ_L values at bottom and deck, correspond to the application of formula given for any point, calculated at equivalent deck line and at baseline.			

2.4 Extent of high tensile steel

2.4.1 Vertical extent

Table 3: Hull girder stresses at baseline and moulded deck line

Operation	At baseline	At moulded deck line
Seagoing	$\sigma_{bl} = \frac{\lvert M_{sw} + f_\beta M_{wv} \rvert}{I_{y-n50}} z_n 10^{-3}$	$\sigma_{dk} = \frac{\lvert M_{sw} + f_\beta M_{wv} \rvert}{I_{y-n50}} (z_{dk-s} - z_n) 10^{-3}$
Harbour/sheltered water	$\sigma_{bl} = \frac{\lvert M_{sw-p} \rvert}{I_{y-n50}} z_n 10^{-3}$	$\sigma_{dk} = \frac{\lvert M_{sw-p} \rvert}{I_{y-n50}} (z_{dk-s} - z_n) 10^{-3}$
Flooded condition at sea for bulk carriers having a freeboard length L_{LL} of 150 m or above	$\sigma_{bl} = \frac{\lvert M_{sw-f} + M_{wv} \rvert}{I_{y-n50}} z_n 10^{-3}$	$\sigma_{dk} = \frac{\lvert M_{sw-f} + M_{wv} \rvert}{I_{y-n50}} (z_{dk-s} - z_n) 10^{-3}$
z_{dk-s}: Distance from baseline to moulded deck line at side, in m.		

3 HULL GIRDER SHEAR STRENGTH ASSESSMENT

3.2 Hull girder shear capacity

3.2.1

Table 4: Permissible hull girder shear stress

Operation	Design load	Permissible hull girder shear, $\tau_{i\text{-}perm}$
Seagoing	(S+D)	120/k
Harbour/sheltered water	(S)	105/k
Flooded condition at sea of bulk carriers having a freeboard length L_{LL} of 150 m or above	(A:S+D)	120/k

3.3 Acceptance criteria

3.3.1 Permissible vertical shear force

The positive and negative permissible vertical shear forces are to comply with the following criteria:

- For seagoing operation:

$$\lvert Q_{sw} \rvert \le Q_R - \lvert f_\beta Q_{wv} \rvert$$

- For harbour/sheltered water operation:

$$\lvert Q_{sw-p} \rvert \le Q_R$$

- For flooded condition at sea of bulk carriers having a freeboard length L_{LL} of 150 m or above:

$$\lvert Q_{sw-f} \rvert \le Q_R - \lvert Q_{wv} \rvert$$

where:

Q_R : Total vertical hull girder shear capacity, in kN, as defined in [3.2.1].

The shear force Q_{wv}, used in 2 above criteria is to be taken with the same sign as the considered shear forces Q_{sw}, and $Q_{sw\text{-}f}$ respectively.

3.3.2 Vertical still water shear force

The vertical still water shear forces, in kN, for all loading conditions are to comply with the following criteria:

- For seagoing operation:

$$\lvert Q_{sw-Lcd} - \Delta Q_{mdf} \rvert \le \lvert Q_{sw} \rvert$$

- For harbour/sheltered water operation:

$$\left|Q_{sw-Lcd-p} - \Delta Q_{mdf}\right| \le \left|Q_{sw-p}\right|$$

• For flooded condition at sea of bulk carriers having a freeboard length L_{LL} of 150 m or above:

$$\left|Q_{sw-Lcd-f} - \Delta Q_{mdf}\right| \le \left|Q_{sw-f}\right|$$

where:

ΔQ_{mdf} : Shear force correction at the transverse section considered, in kN, taken as:

• For bulk carriers, the value defined in [3.6.1].

• For oil tankers, $\Delta Q_{mdf} = 0$.

The permissible shear forces Q_{sw}, Q_{sw-p} and Q_{sw-f} are to be taken with the same sign as the considered shear forces Q_{sw-Lcd}, $Q_{sw-Lcd-p}$ and $Q_{sw-Lcd-f}$ respectively.

3.4 Effective net thickness for longitudinal bulkheads between cargo tanks of oil tankers

3.4.1

For longitudinal bulkheads between cargo tanks, the effective net thickness of the plating above the inner bottom, $t_{sfi-n50}$ for plate i, in mm, is given by:

$$t_{sfi-n50} = t_{i-n50} - t_{\Delta i}$$

where:

$t_{\Delta i}$: Thickness deduction for plate i, in mm, as defined in [3.4.2].

3.5 Effective net thickness for longitudinal bulkheads between cargo tanks of oil tankers - Correction due to loads from transverse bulkhead stringers

3.5.1

In way of transverse bulkhead stringer connections, within areas as specified in Figure 8, the equivalent net thickness of plate, $t_{sti-k-n50}$ in mm, where the index k refers to the identification number of the stringer, is not to be taken greater than:

$$t_{sti-k-n50} = t_{sfi-n50}\left(1 - \frac{\tau_{sti-k}}{\tau_{i-perm}}\right)$$

where:

τ_{sti-k} : Shear stress in plate i, in N/mm^2, in the longitudinal bulkhead due to the stringer force in way of stringer k, taken as:

~~$\tau_{sti-k} = \dfrac{Q_{st-k}}{l_{st-k} t_{sfi-n50}}$~~

$$\tau_{sti-k} = \frac{Q_{st-k}}{l_{st-k} t_{sfi-k-n50}}$$

~~$t_{sfi-n50}$~~ $t_{sfi-k-n50}$: Effective net plating thickness as defined in [3.4.1], in mm, calculated at the transverse bulkhead for the height corresponding to the level of the stringer.

$t_{sfi-n50}$: Effective net plating thickness as defined in [3.4.1], calculated at the lower edge of plate i connecting to the stringer.

SECTION 2 HULL GIRDER ULTIMATE STRENGTH

1 APPLICATION

1.1 General

1.1.1
The requirements of this section apply to ships with freeboard length L_{LL} equal to or greater than 150 m ~~in length L~~.

SECTION 3 HULL GIRDER RESIDUAL STRENGTH

1 APPLICATION

1.1 General

1.1.1
The requirements of this section apply to ships with freeboard length L_{LL} equal to or greater than 150 m ~~in length L~~.

CHAPTER 6 HULL LOCAL SCANTLING

SECTION 2 LOAD APPLICATION

2 DESIGN LOAD SETS

2.1 Application of load components

2.1.3 Design load sets for plating, stiffeners and PSM

Design load sets for plating, stiffeners and primary supporting members are given in Table 1.

In addition, the design load sets for primary supporting members of bulk carriers with freeboard length L_{LL} less than 150 m and of oil tankers within the cargo hold region are given respectively in Pt 2, Ch 1, Sec 4, [4.2] and in Pt 2, Ch 2, Sec 3, [1.2].

SECTION 6 PRIMARY SUPPORTING MEMBERS AND PILLARS

2 PRIMARY SUPPORTING MEMBERS WITHIN CARGO HOLD REGION

2.2 Bulk carriers

2.2.1 Bulk carriers having a freeboard length L_{LL} of 150m and above

The scantlings of primary supporting members within the cargo hold region are to be verified by FE structural analysis as defined in Ch 7.

2.2.2 Bulk carriers having a freeboard length L_{LL} less than 150m

The scantlings of primary supporting members within the cargo hold region are to comply with the requirements given in Pt 2, Ch 1, Sec 4, [4]. Alternatively, the scantlings of such members may be verified by direct strength assessment as deemed appropriate by the Society.

CHAPTER 7 DIRECT STRENGTH ANALYSIS

SECTION 1 STRENGTH ASSESSMENT

1 GENERAL

1.1 Application

1.1.1
This chapter provides requirements applicable to ships having a freeboard length L_{LL} of 150 m or above to assess the scantlings of the hull structure using finite element analysis.

CHAPTER 8 BUCKLING

SECTION 2 SLENDERNESS REQUIREMENTS

1 STRUCTURAL ELEMENTS

1.1 General

1.1.1
All structural elements are to comply with the applicable slenderness and proportion requirements given in [2] to ~~[4]~~[6], except for the ones listed below:~~.~~

- Bilge plates within the cylindrical part of the ship and radius gunwale;
- Corrugation;
- Structure members in superstructures and deck houses, if the structural members do not contribute to the longitudinal strength.

Pillars in superstructures and deckhouses are to comply with the applicable slenderness and proportion requirements given in [6.1].

2 PLATES

2.1 Net thickness of plate panels

2.1.1

The net thickness of plate panels is to satisfy the following criteria:
[…]
~~This requirement does not apply to the bilge plates within the cylindrical part of the ship and radius gunwale.~~

3 STIFFENERS

3.1 Proportions of stiffeners

3.1.1 Net thickness of all stiffener types
The net thickness of stiffeners is to satisfy the following criteria:

a) Stiffener web plate:

$$t_w \geq \frac{h_w}{C_w}\sqrt{\frac{R_{eH}}{235}}$$

b) Flange:

$$t_f \geq \frac{b_{f-out}}{C_f}\sqrt{\frac{R_{eH}}{235}}$$

where:
C_w, C_f : Slenderness coefficients given in Table 1.

If requirement b) is not fulfilled, the effective free flange outstand, in mm, used in strength assessment including the calculation of actual net section modulus, is to be taken as:

$$b_{f-out-\max} = C_f t_f \sqrt{\frac{235}{R_{eH}}}$$

Table 1 : Slenderness coefficients

Type of stiffener	C_w	C_f
Angle and L2	75	12
T-bars	75	12
Bulb bars	45	-
Flat bars	22	-

For built-up profile where the relevant yielding strength defined in Ch 6 and Ch 7 for the web of built-up profile without the edge stiffener is acceptable, as an alternative the web can be assessed according to the web requirements of Angle and L2 in Ch 8, Sec 2, Table 1 and the edge stiffener can be assessed as a flat bar stiffener according to [3.1.1]. The requirement to flange in [3.1.2] shall still apply.

4 PRIMARY SUPPORTING MEMBERS

4.1 Proportions and stiffness

4.1.1 Proportions of web plate and flange

The net thicknesses of the web plates and flanges of primary supporting members are to satisfy the following criteria:

a) Web plate:

$$t_w \geq \frac{s_w}{C_w}\sqrt{\frac{R_{eH}}{235}}$$

b) Flange:

$$t_f \geq \frac{b_{f-out}}{C_f}\sqrt{\frac{R_{eH}}{235}}$$

where:

s_w : Plate breadth, in mm, taken as the spacing of the web stiffeners.

C_w : Slenderness coefficient for the web plate taken as:

$C_w = 100$

C_f : Slenderness coefficient for the flange taken as:

$C_f = 12$

If requirement b) is not fulfilled, the effective free flange outstand, in mm, used in strength assessment including the calculation of actual net section modulus, is to be taken as:

$$b_{f-out-\max} = C_f t_f \sqrt{\frac{235}{R_{eH}}}$$

SECTION 3 PRESCRIPTIVE BUCKLING REQUIREMENTS

2 HULL GIRDER STRESS

2.1 General

2.1.2

The hull girder shear stresses, τ_{hg}, in N/mm^2, in the plate *i* are determined as follows:

$$\tau_{hg} = \frac{Q_{Tot}(x)q_{vi}}{t_{i-n50}}10^3$$

where:

$Q_{Tot}(x)$: Total vertical shear force, in kN, at the ship longitudinal location x, taken as follows:

- For the design load combination S+D
  - For seagoing operations:

$$Q_{Tot}(x) = \left|Q_{sw} + Q_{wv-LC}\right|$$

  - For flooded conditions at sea for bulk carriers having a freeboard length L_{LL} of 150 m or above:

$$Q_{Tot}(x) = \left|Q_{sw-f} + Q_{wv-LC}\right|$$

……

SECTION 5 BUCKLING CAPACITY

2 BUCKLING CAPACITY OF PLATES AND STIFFENERS

2.1 Overall stiffened panel capacity

2.1.2

The stress multiplier factor $\gamma_{GEB,bi}$ for the stiffened panel subjected to biaxial loads is taken as:

$$\gamma_{GEB,bi} = \frac{\pi^2}{L_{B1}^2 L_{B2}^2} \frac{[D_{11}L_{B2}^4 + 2(D_{12}+D_{33})n^2 L_{B1}^2 L_{B2}^2 + n^4 D_{22} L_{B1}^4]}{L_{B2}^2 N_x + n^2 L_{B1}^2 ~~K_{tran}~~ N_y}$$

…

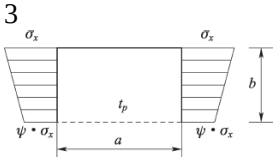
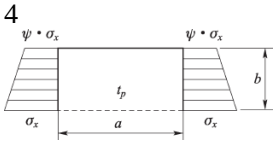
~~K_{tran} : Coefficient taken as 0.9~~

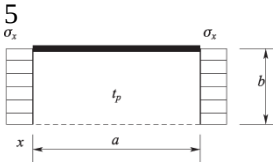
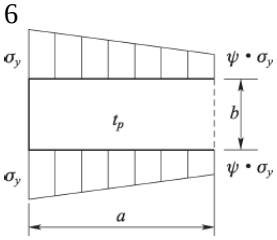
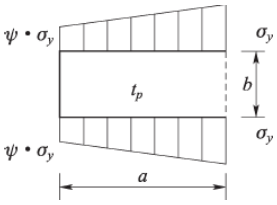
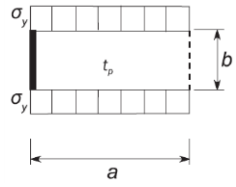
…

2.2 Plate capacity

2.2.1 Plate limit state

Table3: Buckling factor and reduction factor for plane plate panels

Case	Stress Ratio ψ	Aspect Ratio α	Buckling factor K	Reduction factor C
3 	$1 \geq \psi \geq 0$	$K_x = \frac{4(0.425+1/\alpha^2)}{3\psi+1}$		For UP-A: $C_x = 1$ for $\lambda \leq 0.75$ $C_x = \frac{0.75}{\lambda}$ for $\lambda > 0.75$ For UP-B: $C_x = 1$ for $\lambda \leq 0.7$ $C_x = \frac{1}{\lambda^2 + 0.51}$ for $\lambda > 0.7$
	$0 > \psi > -1$		$K_x = 4(0.425+1/\alpha^2)(1+\psi) - 5\psi(1-3.42\psi)$	
4 	$1 \geq \psi \geq -1$		$K_x = \left(0.425 + \frac{1}{\alpha^2}\right)\frac{3-\psi}{2}$	

Case	Stress Ratio ψ	Aspect Ratio α	Buckling factor K	Reduction factor C
5 	—	$\alpha \geq 1.64$	$K_x=1.28$	
		$\alpha < 1.64$	$K_x = \frac{1}{\alpha^2}+0.56+0.13\alpha^2$	
6 	$1 \geq \psi \geq 0$	$K_y = \frac{4(0.425+\alpha^2)}{(3\psi+1)\alpha^2}$		For UP-A: $C_y = 1$ for $\lambda \leq 0.75$ $C_y = \frac{0.75}{\lambda}$ for $\lambda > 0.75$ For UP-B: $C_y = 1$ for $\lambda \leq 0.7$ $C_y = \frac{1}{\lambda^2+0.51}$ for $\lambda > 0.7$
	$0 > \psi \geq -1$	$K_y = 4(0.425+\alpha^2)(1+\psi)\frac{1}{\alpha^2}-5\psi(1-3.42\psi)\frac{1}{\alpha^2}$		
7 	$1 \geq \psi \geq -1$	$K_y = (0.425+\alpha^2)\frac{(3-\psi)}{2\alpha^2}$		
8 	—	$K_y = 1+\frac{0.56}{\alpha^2}+\frac{0.13}{\alpha^4}$		

2.3 Stiffeners

2.3.4 Ultimate buckling capacity

σ_b : Bending stress in the stiffener, in N/mm^2:

~~$\sigma_b = \frac{M_0+M_1}{1000Z}$~~

$\sigma_b = \frac{M_0+M_1+M_2}{1000Z}$

…

M_2 : Bending moment, in Nmm, due to eccentricity of sniped stiffeners, to be taken as

$M_2=0$ for continuous stiffeners

$M_2=C_{snip}w_{na}\gamma\sigma_x(A_p+A_s)$ for stiffeners sniped at one or both ends.

C_{snip} : Coefficient to account for the end effect of the stiffener sniped at one or both ends, to be taken as

C_{snip}= -1.2 for stiffener induced failure (*SI*)

C_{snip}= 1.2 for plate induced failure (*PI*).

w_{na} : Distance from the mid-point of attached plating to the neutral axis of the stiffener calculated with the effective width of the attached plating according to [2.3.5].

M_0 : Bending moment, in Nmm, due to the lateral deformation of stiffener:

~~$M_0 = F_E \frac{\gamma}{\gamma_{GEB} - \gamma} w_0$~~ $M_0 = F_E C_{sl} \frac{\gamma}{\gamma_{GEB} - \gamma} w_0$ with precondition $\gamma_{GEB} - \gamma > 0$

where γ_{GEB} is the stress multiplier factor of global elastic buckling capacity as defined in [2.1].

C_{sl} : Deformation reduction factor to account for global slenderness, to be taken as:

$C_{sl} = 1 - \frac{1}{12}\lambda_G^4$ for $\lambda \leq 1.56$

$C_{sl} = 3/\lambda_G^4$ for $\lambda > 1.56$

λ_G : The reference degree of global slenderness of the stiffened panel, to be taken as

$\lambda_G = \sqrt{\frac{\gamma_{ReH}}{\gamma_{GEB}}}$ and $\gamma_{ReH} = \frac{\min(R_{eH\_P}, R_{eH\_S})}{\sqrt{\sigma_{x,av}^2 + \sigma_y^2 - \sigma_{x,av}\sigma_y + 3\tau_{xy}^2}}$

w_0 : Assumed imperfection, in mm, to be taken as:

$w_0 = l/1000$ ~~in general.~~

~~$w_0 = w_{na}$ for stiffeners sniped at one or both ends considering stiffener induced failure (*SI*).~~

~~$w_0 = w_{na}$ for stiffeners sniped at one or both ends considering plate induced failure (*PI*).~~

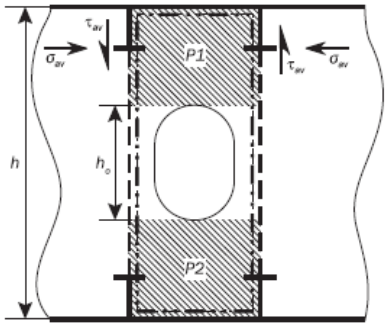
…

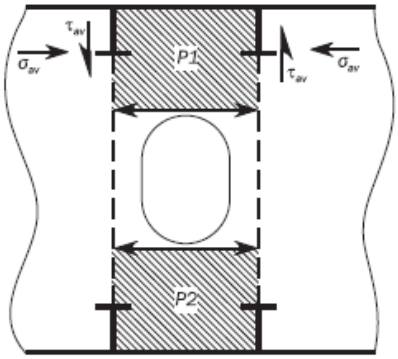
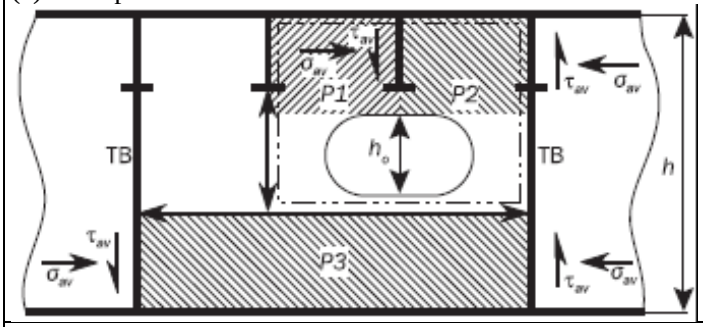
2.4 Primary supporting members

2.4.2 Reduction factors of web plate in way of openings

The reduction factors, C_x or C_y in combination with, C_τ of the plate panel(s) of the web adjacent to the opening is to be taken as shown in Table 6.

Table 6: Reduction factors

Configuration[1]	C_x, C_y	C_τ	
		Opening modelled in PSM	Opening not modelled in PSM
(a) Without edge reinforcements:[2] 	Separate reduction factors are to be applied to areas *P*1 and *P*2 using case 3 or case 6 in Table 3, with edge stress ratio: Ψ=1.0	Separate reduction factors are to be applied to areas *P*1 and *P*2 using case 18 or case 19 in Table 3	When case 17 of Table 3 is applicable: A common reduction factor is to be applied to areas *P1* and *P2* using case 17 in Table 3 with: $\tau_{av} = \tau_{av}$(web)
			When case 17 of Table 3 is not applicable: Separate reduction factors are to be applied to areas *P1* and *P2* using case 18 or case 19 in

Configuration[(1)]	C_x, C_y	C_τ	
		Opening modelled in PSM	Opening not modelled in PSM
			Table 3 with: $\tau_{av} = \tau_{av}(web)\ h/(h-h_0)$
(b) With edge reinforcements: 	Separate reduction factors are to be applied for areas $P1$ and $P2$ using C_x for case 1 or C_y for case 2 in Table 3 with stress ratio: Ψ=1.0	Separate reduction factors are to be applied for areas $P1$ and $P2$ using case 15 in Table 3.	Separate reduction factors are to be applied to areas $P1$ and $P2$ using case 15 in Table 3 with: $\tau_{av} = \tau_{av}(web)\ h/(h-h_0)$
(c) Example of hole in web: 	Panels $P1$ and $P2$ are to be evaluated in accordance with (a). Panel $P3$ is to be evaluated in accordance with (b).		

Where:

h : Height, in m, of the web of the primary supporting member in way of the opening.

h_0 : Height in m, of the opening measured in the depth of the web.

$\tau_{av}(web)$: Weighted average shear stress, in N/mm^2, over the web height h of the primary supporting member.

Note (1) : Web panels to be considered for buckling in way of openings are shown shaded and numbered $P1$, $P2$, etc.

Note (2) : For a PSM web panel with opening and without edge reinforcements as shown in configuration (a), the applicable buckling assessment method depends on its specific boundary conditions. If one of the long edges along the face plate or along the attached plating is not subject to "inline support", i.e. the edge is free to pull in, Method B should be applied. In other cases, typically such as when the short plate edge is attached to the plate flanges, Method A is applicable.

CHAPTER 9 FATIGUE

SECTION 1 GENERAL CONSIDERATIONS

1 RULE APPLICATION FOR FATIGUE REQUIREMENTS

1.1 Scope

1.1.1 General

This chapter provides requirements applicable to ships having a freeboard length L_{LL} between 150 m and 500 m to evaluate fatigue strength of the ship's structural details considering an operation time in North Atlantic environment equal to the design fatigue life, T_{DF}.

CHAPTER 10 OTHER STRUCTURES

SECTION 1 FORE PART

4 ADDITIONAL SCANTLING REQUIREMENTS

4.1 Plate stem

4.1.1
The net thickness, t_{stm} in mm, ~~is not to~~ from keel line above to T_{SC} + 0.6 m is not to be less than:

$t_{stm} = (0.6 + 0.4S_B)(0.08\,L + 2.7)\sqrt{k}$ but need not be greater than $22\sqrt{k} - 1$

Where:

S_B : Spacing, in m, between horizontal stringers (partial or not), breasthooks, or equivalent horizontal stiffening members.

Starting from 0.6 m above T_{SC} to T_{SC} + C_w, the net thickness may gradually be reduced to 0.8 t_{stm}.

CHAPTER 11 SUPERSTRUCTURE, DECKHOUSES AND HULL OUTFITTING

SECTION 1 SUPERSTRUCTURES, AND DECKHOUSES AND COMPANIONWAYS

SYMBOLS

For symbols not defined in this section, refer to Ch 1, Sec 4.

P : Pressure applied on the considered superstructure side or deck, in kN/m^2

$P = P_D$ for external exposed decks,

$P = P_{dl}$ for unexposed deck,

$P = P_{SI}$ for superstructure side.

P_D : Lateral pressure for exposed decks, in kN/m^2, as defined in Ch 4, Sec 5, [2] and in Ch 4, Sec 5, [4.2].

P_{dl} : Lateral pressure for unexposed decks, in kN/m^2, as defined in Ch 4, Sec 6, [5].

P_{SI} : Lateral pressure for superstructure side, in kN/m^2, as defined in Ch 4, Sec 5, [4.3].

P_{FB} : Lateral pressure for side shell plating, in kN/m^2, affected by bow impact requirements according to Ch 4, Sec 5, [3.3.1].

P_A : External pressure for end bulkheads of superstructure and deckhouse walls, in kN/m^2 according to Ch 4, Sec 5, [4.4.1].

l_{bdg} : Effective bending span, in m, as defined in Ch 3, Sec 7.

l_{shr} : Effective shear span, in m, as defined in Ch 3, Sec 7.

c : Coefficient taken as:

c = 0.75 for beams, girders and transverses which are simply supported in one or both ends.

c = 0.55 in other cases.

m_a : Coefficient taken as:

$$m_a = 0.204 \frac{s}{1000\, l_{bdg}} \left[4 - \left(\frac{s}{1000\, l_{bdg}}\right)^2\right] \quad \text{with} \quad \frac{s}{1000\, l_{bdg}} \leq 1$$

1 GENERAL

1.1 Application

1.1.1

The requirements of this section are applicable to superstructures, and deckhouses and companionways, made of steel.

The scantling requirements are listed in Table 1.

The requirements of Pt 1, Ch 6 apply in addition to those of this section for exposed decks of superstructure and the side of superstructure or deckhouse when this side is part of the side shell.

Table 1: Applicable requirements

Item	Superstructure	Deckhouse
Exposed decks	[3.1.1]	[3.2]
Unexposed decks	[3.2.2] to [3.2.5]	[3.2]
Side walls	[3.1.1]	[3.3]
End bulkheads (fore and aft)	[3.3]	[3.3]

1.2 Gross scantlings

1.2.1

With reference to Ch 3, Sec 2, [1.1.3], all scantlings and dimensions referred to in [3] are gross, unless otherwise specified.

2 STRUCTURAL ARRANGEMENT

2.1 Structural continuity

2.1.1 Bulkheads and sides of deckhouses

The aft, front and side bulkheads are to be effectively supported by under deck structures such as bulkheads, girders and pillars.

Sides and main longitudinal and transverse bulkheads are to be in line in the various tiers of deckhouses. Where such arrangement in line is not possible, other effective support is to be provided.

Arrangements are to be made to ~~minimise~~ minimize the effect of discontinuities in erections. All openings cut in the sides are to be framed and have well-rounded corners. Continuous coamings or girders are to be fitted below and above doors and similar openings.

2.2 End connections

2.2.1 Deck stiffeners

Transverse beams are to be connected to side frames by brackets according to Ch 3, Sec 6, [3.2.1], [3.2.2] and [3.2.3]. Beams crossing longitudinal walls and girders may be attached to the stiffeners of longitudinal walls and the webs of girders respectively by welding without brackets.

3 SCANTLINGS

3.1 Superstructures sides and decks

3.1.1 Exposed sides and exposed decks ~~plating~~

When the side of superstructure is part of the side shell, the net scantlings of ~~E~~exposed sides and exposed decks plating, stiffeners and primary supporting members ~~inclusive their supporting structure~~ are to comply with the applicable requirements ~~given in [3.2.1] to [3.2.5] and bow impact requirements in Ch 10, Sec 1, [3.3], if applicable~~of Ch 6, Sec 3, Ch 6, Sec 4, Ch 6, Sec 5 and Ch 6, Sec 6, respectively, with the pressure P_D, P_{dl} and P_{SI} defined in this Section. The net scantling approach defined in Ch 3, Sec 2 and the corrosion additions defined in Ch 3, Sec 3, are to be considered.

When the side of superstructure is not part of the side shell, the exposed sides and exposed deck plating inclusive their supporting structure are to comply with the requirements given in [3.3], [3.2.1] and [3.2.3] to [3.2.5], respectively.

~~3.1.2 Deck plating of unexposed decks~~

~~The deck plating and supporting structures of unexposed decks of superstructures are to comply with requirements given in [3.2.2] to [3.2.5].~~

3.2 Deckhouses decks

3.2.1 Exposed deck ~~P~~plating

The gross thickness of the deckhouses exposed deck plating, $t_{gr\text{-}exp}$, in mm, is not to be less than

$t_{gr-exp} = 7.5\sqrt{\frac{k\,s}{s_{std}}}$, on first tier.

$t_{gr-exp} = 7.0\sqrt{\frac{k\,s}{s_{std}}}$, on second tier.

$t_{gr-exp} = 6.5\sqrt{\frac{k\,s}{s_{std}}}$, on third tier and above.

where:
s_{std} : Standard reference spacing of stiffeners or beams, in mm, taken as:

$s_{std} = 470 + 1.67\ L_1$

Where deck is protected by sheathing, the gross thickness of the deck plating may be reduced by 1.5 mm, without being less than 5 mm.
Where sheathing other than wood is used, attention is to be paid that the sheathing does not affect the steel. The sheathing is to be effectively fitted to the deck.

3.2.2 Unexposed ~~D~~deck plating ~~of unexposed decks~~

The gross thickness of the deckhouses unexposed deck plating, $t_{gr-unexp}$, in mm, is not to be less than the greater value of:

$t_{gr-unexp} = 0.9\ t_{gr-exp}$ at the tier considered, and

$t_{gr-unexp} = (5.8\frac{s}{1000} + 1)\sqrt{k}$ but not less than 5.5 mm.

3.2.3 Beams and stiffeners

The gross section modulus Z_{gr}, in cm^3, and the gross shear area A_{gr-sh}, in cm^2, of deckhouses deck transverse beams and of stiffeners are not to be less than:

$$Z_{gr} = c\ k\ P\ \frac{s}{1000}\ {l_{bdg}}^2$$

$$A_{gr-sh} = 0.05\ (1 - 0.817\ m_a)\ k\ P\ \frac{s}{1000}\ l_{shr}$$

3.2.4 Girders and transverses

The gross section modulus Z_{gr}, in cm^3, and the gross shear area A_{gr-sh}, in cm^2, of deckhouses deck girders and transverses are not to be less than:

$Z_{gr} = c\ k\ P\ S\ {l_{bdg}}^2$

$A_{gr-sh} = 0.05\ k\ P\ S\ l_{shr}$

The girder depth is not to be less than l/25. The web depth of girders scalloped for continuous deck beams is to be at least 1.5 times the depth of the deck beams.

3.3 Deckhouses walls and end bulkheads of superstructures

~~3.4 Companionways~~

~~3.4.1~~

~~The scantlings of companionways are to be determined in accordance with [3.2] and [3.3].~~

CHAPTER 12 CONSTRUCTION

SECTION 3 DESIGN OF WELD JOINTS

2 TEE OR CROSS JOINT

2.5 Weld Size Criteria

2.5.2

The leg length, l_{leg} in mm, of continuous, lapped or intermittent fillet welds is not to be taken less than the greater of the following values:

$l_{leg} = f_1 f_2 t_{as-built}$

$l_{leg} = f_{yd} f_{weld} f_2 f_3 t_{as-built} + t_{gap}$

l_{leg} as given in Table 1.

where:

f1 : Coefficient depending on welding type:

f1 = 0.30 for double continuous welding.

f1= 0.38 for intermittent welding.

f2 : Coefficient depending on the edge preparation:

f2 = 1.0 for welds without bevelling.

f2 = 0.70 for welds with one/both side bevelling and *f* = *tas-built* /3.

fyd : Coefficient not to be taken less than the following:

$$f_{yd} = \left(\frac{1}{k}\right)^{0.5} \left(\frac{235}{R_{eH\_weld}}\right)^{0.75}$$

fyd = 0.71.

ReH_weld : Specified minimum yield stress for the weld deposit in N/mm2, not to be less than:

: *ReH_weld* = 305 N/mm^2 for welding of normal strength steel with *ReH* = 235N/mm^2.

: *ReH_weld* = 375 N/mm^2 for welding of higher strength steels with *ReH* from 265 to 355 N/mm^2.

: *ReH_weld* = 400 N/mm^2 for welding of higher strength steel with *ReH* = 390N/mm^2.

fweld : Weld factor dependent on the type of the structural member, see Table 2, Table 3 and Table 4.

k : Material factor of the abutting member.

f3 : Correction factor for the type of weld:

f3 = 1.0 for double continuous weld.

f3 = *sctr* /l_{weld} for intermittent or chain welding.

sctr : Distance between successive fillet welds, in mm.

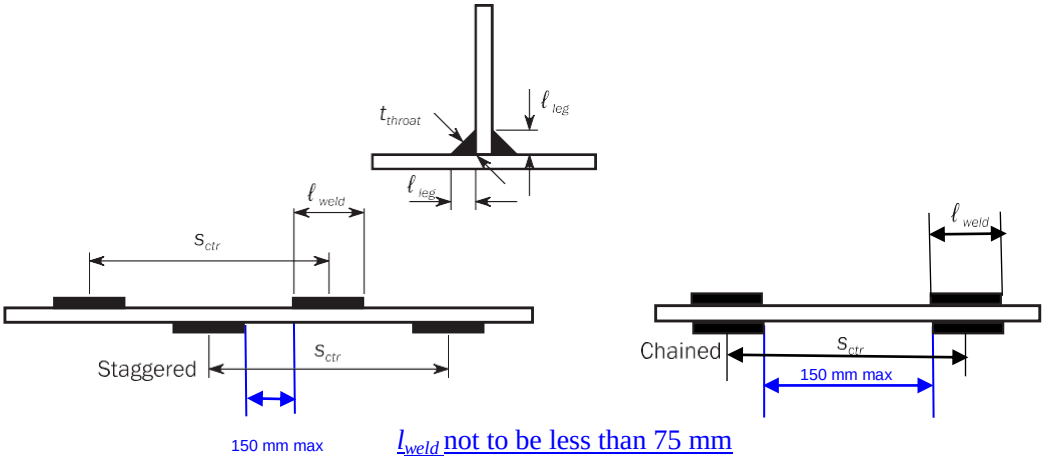
Leg length for intermittent welding is not to exceed the greater of 6.5mm or 0.62*$t_{as-built}$

2.5.3

The throat size t_{throat}, in mm, as shown in Figure 4, is not to be less than:

$$t_{throat} = \frac{l_{leg}}{\sqrt{2}}$$

Figure 4 : Weld scantlings definitions



l_{weld} not to be less than 75 mm

PART 9-2 SHIP TYPES

CHAPTER 1 BULK CARRIERS

SECTION 2 STRUCTURAL DESIGN PRINCIPLES

3 STRUCTURAL DETAIL PRINCIPLES

3.1 Double bottom structure

3.1.1 Application

In addition to the requirements provided in Pt 1, Ch 2, Sec 3, [2], the requirements of this sub-article are applicable to the following ships:

- All bulk carriers ~~of~~ with freeboard length L_{LL} less than 150 m ~~in length~~,
- Bulk carriers ~~with~~ having a freeboard length L_{LL} of 150 m or above, with one or more cargo holds arranged for carriage of water ballast.

3.3 Deck structures

3.3.1 Web frame spacing in topside tanks

For bulk carriers with freeboard length L_{LL} less than 150 m ~~in length~~, the spacing of web frames in topside tanks is generally not to be greater than 6 frame spaces.

3.3.4 Openings in strength deck - Corner of hatchways

a) Within the cargo hold region

For cargo hatchways located within the cargo hold region, insert plates, the thicknesses of which are to be determined according to the formula given after, are to be fitted in way of corners where the plating cut-out has a circular profile.

The radius of circular corners is not to be less than 5% of the hatch width, where a continuous longitudinal deck girder is fitted below the hatch coaming.

Corner radius, in the case of the arrangement of two or more hatchways athwartship, is considered by the Society on a case-by-case basis.

For hatchways located within the cargo hold region, insert plates are, in general, not required in way of corners where the plating cut-out has an elliptical or parabolic profile and the half axes of elliptical openings, or the half lengths of the parabolic arch, are not less than:

- 1/20 of the hatchway width or 600 mm, whichever is the lesser, in the transverse direction.
- Twice the transverse dimension, in the fore and aft direction.

Where insert plates are required, their net thickness is to be obtained, in mm, from the following formula:

$t_{INS} = (0.8+0.4l/b)t_{off}$

without being taken less than t_{off} or greater than 1.6 t_{off}.

where:

l : Width, in m, in way of the corner considered, of the cross deck strip between two consecutive hatchways, measured in the longitudinal direction, see Pt 1, Ch 3, Sec 6, Figure 15.

b: Width, in m, of the hatchway considered, measured in the transverse direction, see Pt 1, Ch 3, Sec 6, Figure 15.

t_{off} : Offered net thickness, in mm, of the deck at the side of the hatchways.

For the extreme corners of end hatchways, insert plates are required. The net thickness of these insert plates is to be 60% greater than the net offered thickness of the adjacent deck plating. A lower thickness may be accepted by the Society on the basis of calculations showing that stresses at hatch corners are lower than permissible values.

Where insert plates are required, the arrangement is shown in Pt 1, Ch 9, Sec 6, Table 15, in which d_1, d_2, d_3 and d_4 are to be greater than the stiffener spacing.

For ships having a freeboard length L_{LL} of 150 m or above, the corner radius, the thickness and the extent of insert plate may be determined by the results of a direct strength assessment according to Pt 1, Ch 7, including buckling check and fatigue strength assessment of hatch corners according to Pt 1, Ch 8 and Pt 1, Ch 9 respectively. For such type of ships it is recommended to arrange circular hatch corners.

SECTION 4 HULL LOCAL SCANTLINGS FOR BULK CARRIERS LLL<150M

1 GENERAL

1.1 Application

1.1.1

Unless otherwise defined, the requirements of this section define the strength criteria applicable to bulk carriers ~~of~~ with freeboard length L_{LL} less than 150 m ~~in length~~.

4 PRIMARY SUPPORTING MEMBERS

4.1 Application

4.1.1
The requirements of this section apply to the strength check of primary supporting members in cargo hold structures, subjected to lateral pressure for ships having a freeboard length L_{LL} less than 150 m.

4.2 Design load sets

4.2.1 Application
Design load sets as given in Table 3 are to be considered for primary supporting members on cargo hold boundaries of bulk carriers with freeboard length L_{LL} less than 150 m ~~in length~~.

SECTION 5 CARGO HATCH COVERS

1 GENERAL

1.2 Materials
1.2.1 Steel
The formulae for scantlings given in [5] are applicable to steel hatch covers.
Materials used for the construction of steel hatch covers are to comply with the applicable requirements of the Society.

CCS 1.2.1a Materials used for the construction of top plating, bottom plating and primary supporting members of steel hatch covers are to comply with the material grade requirements for class I as specified in Table 7 of 2.3 in Section 1, Chapter 3 of PART 9-1.

5 STRENGTH CHECK

5.1 General
5.1.1 Application
The strength check is applicable to rectangular hatch covers subjected to lateral pressure and/or concentrated loads, designed with primary supporting members arranged in one direction or as a grillage of longitudinal and transverse primary supporting members.
It is also applicable for hatch covers fitted with U-type stiffeners as shown in Figure 1. The stresses in all structural members are to be determined by a finite element analysis with the modelling requirements as described in [5.6.1].
It is to be checked that stresses of all structural members comply with the yield strength assessment requirement in [5.6.2], and the buckling strength assessment requirements as described in [5.2.3], [5.3.4], [5.4.6], [5.6.3] and [5.6.4].

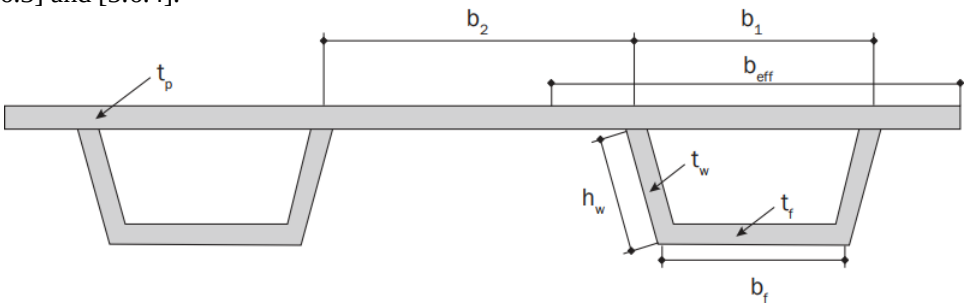


Figure 2 Example of hatch cover fitted with U type stiffener

CCS 5.1.1a When the hatch cover is arranged as a grillage of longitudinal and transverse primary supporting members, it is to be modeled as follows:

(1) *The cover geometry is to be idealized as realistically as possible. Element size is to be appropriate to account for effective breadth. In way of force transfer points and cut-outs the mesh has to be refined where applicable. The ratio of element length to width is not to exceed 4.*
The element height of webs of primary supporting members is not to exceed one third of the web height. Stiffeners and supporting plates against pressure loads have to be included in the idealization. Buckling stiffeners may be disregarded for the stress calculation.

(2) *A right-hand coordinate system is to be used with:*
the x-axis measured in the longitudinal direction, positive forward;
the y-axis measured in the transverse direction, positive to port from the centerline;
the z-axis measured in the vertical direction, positive upwards.

(3) *Scantlings are to be based on net thicknesses for FE analysis.*

(4) *The extent of the FE model is to be determined as follows:*

① *For symmetry of the hatch cover girders, ~~or~~ loads and boundary supporting conditions about only the x-axis or y-axis, it may be limited to a half of the hatch cover for check.*

② *For non-symmetry of hatch cover girders, ~~or~~ loads or boundary supporting conditions about any of the axes, the whole hatch cover is to be taken for strength evaluation, see Figure CCS 5.1.1a (1).*

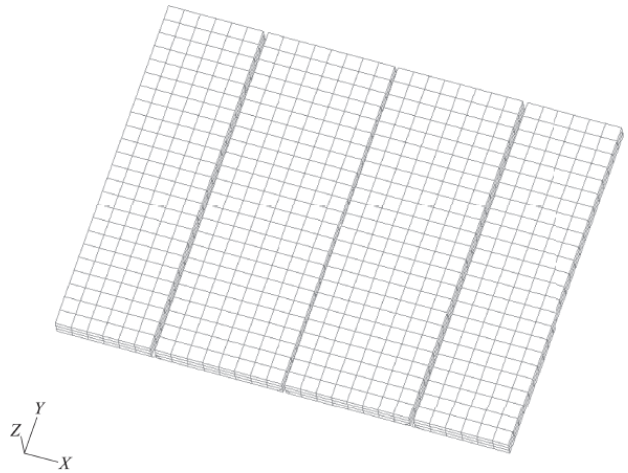


Figure CCS 5.1.1a(1) Finite Element Hatch Cover Model

(5) *The model element is to comply with the following requirements:*

① *All plating, including girders and stiffeners, is to be represented by the finite element model.*

② *All plating, such as top plates, bottom plates, brackets, and girder webs, face plates of primary supporting members is to modeled using plate elements, triangular elements are to be avoided where possible.*

③ *All stiffeners are to be modeled using beam, rod or plate elements.*

(6) *The element mesh size is to be controlled as follows:*

① *The mesh size is not to be greater than the spacing of stiffeners.*

② *The girders are to be represented by at least 3 elements in the depth.*

③ *Triangular and distorted quadrilateral elements with corner angles less than 60 degrees and greater than 120 degrees are to be avoided.*

(7) *Boundary conditions are to be determined as follows:*

① *For symmetry of the hatch cover girders and loads about the x-axis, the longitudinal displacement of nodes in the symmetric plane and the rotations about the y-and z-axes are to be taken as 0, respectively, i.e. $\delta_x = \theta_y = \theta_z = 0$, as shown in Figure CCS 5.1.1a(2).*

② *For symmetry of the hatch cover girders and loads about the y-axis, the transverse displacement of nodes in the symmetric plane and rotation about the x-and z-axes are to be taken as 0 respectively i.e. $\delta_y = \theta_x = \theta_z = 0$, as shown in Figure CCS 5.1.1a.*

③ *Boundary nodes in way of bearing pads on the hatch coamings are to be fixed against displacement in the z direction in general, i.e. $\delta_y = 0$.*

④ *Lifting stoppers are to be fixed against displacements in the direction determined by the stoppers.*

⑤ *Hinges in folding type hatch covers are to be represented as rigid links which tie together*

displacements in the z direction.

CHINA CLASSIFICATION SOCIETY

RULES FOR CLASSIFICATION OF SEA-GOING STEEL SHIPS

AMENDMENTS

2023

PART TEN
SHIPS IN RESTRICTED SERVICE

CONTENTS

CHAPTER 0 GENERAL

Section 1 GENERAL PROVISIONS

0.1.1 Scope of application

0.1.1.1 The provisions of this PART apply to ships navigating and/or operating in restricted service, including ships engaged on international and non-international (domestic or regional) voyages and/or operation.

0.1.1.2 Where not covered by this PART, the relevant provisions of PART ONE to PART EIGHT of the Rules are to be complied with.

0.1.1.3 Where relevant provisions for ships engaged on non-international voyages in this PART are not consistent with the requirements of the Administration of the flag State, the requirements of the Administration of the flag State are to be satisfied and relevant requirements of this PART may not be satisfied.

0.1.2 Definitions

0.1.2.1 Restricted service is a generic term of the service categories 1, 2 and 3. For limitation for navigation of each service category, see Table 2.1.3.1, Section 1, Chapter 2, PART ONE of the Rules.

0.1.3 Class notations

0.1.3.1 Ships complying with this PART, except for the provisions for ships engaged on non-international voyages in restricted service, ~~and to which the provisions of 0.1.1.3 are not applicable~~ will be assigned one of the following notations:

(1) Service category 1: R1;

(2) Service category 2: R2;

(3) Service category 3: R3.

~~0.1.3.2 Ships engaged in non-international voyages complying with this PART and to which the provisions of 0.1.1.3 are applicable will be assigned one of the following notations:~~

~~(1) Service category 1: R1(D);~~

~~(2) Service category 2: R2(D);~~

~~(3) Service category 3: R3(D).~~

0.1.3.2 Ships complying with the provisions for ships engaged on non-international voyages in restricted service of this PART will be suffixed D after the corresponding service category notations: R1(D), R2(D), R3(D).

0.1.3.3 For ships assigned with notations R1, R2, R3, the survey after construction is to comply with the relevant requirements of PART ONE of the Rules; for ships assigned with notations R1(D), R2(D), R3(D), the survey after construction is to comply with the relevant requirements of Chapter 1 of this PART.

0.1.3.4 For engineering ships whose operation areas are different from transiting areas, the areas applicable for transiting and operation may be identified separately, e.g.: R2 for Transiting and R3 for Operation.

0.1.3.~~2~~5 Other service restriction or limitation notations are given in Table ~~B~~C, Appendix 1,

Chapter 2, PART ONE of the Rules.

CHAPTER 1 SURVEYS AFTER CONSTRUCTION OF SHIPS ENGAGED ON NON-INTERNATIONAL VOYAGES

Section 2 HULL AND EQUIPMENT SURVEYS

1.2.4 Special surveys

Minimum Requirements for Thickness Measurements at Hull Special Surveys of Bulk Carriers (including double skin bulk carriers)

Table 1.2.4.5(5)①

Age ≤ 10	10 < Age ≤ 15	Age > 15
1 Suspect areas throughout the ship	1 Suspect areas throughout the ship	1 Suspect areas throughout the ship
	2 Within the cargo length: a. Each deck plate outside line of cargo hatch openings. b. Two transverse sections, one in the amidship area, outside line of cargo hatch opening. c. All wind and water strakes	2 Within the cargo length: a. Each deck plate outside line of cargo hatch openings. b. Three transverse sections, one in the amidship area, outside line of cargo hatch opening. c. Each bottom plate
	3 Selected wind and water strakes outside the cargo length area	3 All hatch covers and hatch coamings (plate and stiffener) of all cargo holds
		4 Internals in forepeak and afterpeak ballast tanks
		5 All exposed main deck full length
		6 Representative exposed superstructure deck (poop, bridge, and forecastle deck)
		7 Lowest strake and centre strake~~s~~ in way of ~~'tween decks of~~ all transverse bulkheads in cargo spaces together with internals in way
		8 All wind- and water strakes, port and starboard, full length
		9 All keel plates full length. Also, additional bottom plates in way of cofferdams, machinery space, and aft end of tanks
		10 Plating of sea chests. Shell plating in way of overboard discharges as considered necessary by the attending Surveyor

Minimum Requirements for Thickness Measurements at Special Surveys of Chemical Tankers

Table 1.2.4.6(4) ①

Age ⩽ 10	10 < Age ⩽ 15	Age > 15
1 Suspect areas throughout the ship	1 Suspect areas throughout the ship	1 Suspect areas throughout the ship
	2 Within the cargo area: a) each deck plate; b) two transverse sections; c) all wind and water strakes	2 Within the cargo area: a) each deck plate; b) three transverse sections; c) each bottom plate
	3 Selected wind and water strakes outside the cargo area	3 Internals in forepeak and afterpeak ballast tanks
		4 All exposed main deck full length
		5 Representative exposed superstructure deck (poop, bridge, and forecastle deck)
		6 Lowest strake ~~and strakes in way of 'tween decks~~ of all transverse bulkheads in cargo spaces together with internals in way
		7 All wind- and water strakes, port and starboard, full length
		8 All keel plates full length. Also, additional bottom plates in way of cofferdams, machinery space, and aft end of tanks
		9 Plating of sea chests. Shell plating in way of overboard discharges as considered necessary by the attending Surveyor

CHAPTER 2 HULL

Section 1 GENERAL PROVISIONS

2.1.2 Longitudinal strength

2.1.2.1 The values of the minimum midship section modulus W_0 for the calculation of longitudinal strength in accordance with the requirements of Section 2, Chapter 2, PART TWO of the Rules may be reduced by:

(1) 5% for ships intended for service category 1;

(2) 10% for ships intended for service category 2;

(3) 15% for ships intended for service category 3.

2.1.2.2 For the check of longitudinal strength of ships in accordance with the requirements of Section 2, Chapter 2 or Sections 2 and 10, Chapter 7 of PART TWO of the Rules, the wave bending moment and wave shear force may be reduced by:

(1) 10% for ships intended for service category 1;

(2) 15% for ships intended for service category 2;

(3) 20% for ships intended for service category 3.

2.1.2.3 For engineering ships assigned with different notations for transiting and operation, the wave bending moment and wave shear force reduction requirements of the corresponding area are to be used in different conditions to check longitudinal strength of ships.