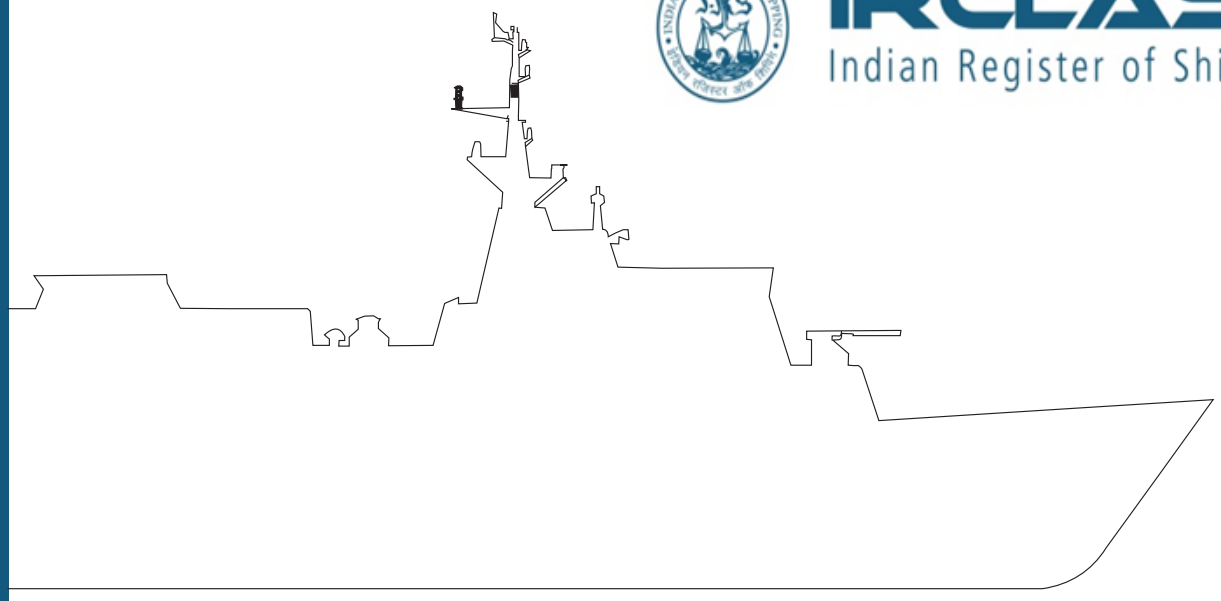
Rules & Regulations for the Construction & Classification of

Indian Coast Guard Ships

Rules Change Notice No. 1
September 2025

IRCLASS
Indian Register of Shipping



General Information

This Rules Change Notice gives amendments to the '*Rules and Regulations for the Construction and Classification of Indian Coast Guard Ships*'.

These amendments are to be read in conjunction with the requirements given in the 2015 edition of the Rules.

The Part / Chapters where amendments are made and their effective dates are indicated in **TABLE 1**. The actual requirements, arranged in the order of Part / Chapter / Section / Sub-section / Clause, have been given subsequently.

Corrigenda issued with this Rules Change Notice are given in **TABLE 2.**

For ease of reference, the newly added text has been highlighted by underlining and the deleted text by striking through.

RULES AND REGULATIONS FOR THE CONSTRUCTION AND CLASSIFICATION OF INDIAN COAST GUARD SHIPS– 2015

RULES CHANGE NOTICE No. 1 – September 2025

TABLE 1 – AMENDMENTS INCORPORATED IN THIS NOTICE

These amendments will come into force as indicated in the Table

Section/ Clause	Subject/ Amendments
Chapter 1: General	
1/ 1.1.1, 1.1.2, 1.1.3, 1.1.4,1.1.6, 1.1.7, 1.3.3, 1.4.1,1.4.2	Amendments made to reflect the current management structure of IRS
1/ 1.6.1&1.6.2	Amendments made to reflect IRS, its subsidiaries and associates in the liability clause.
1/ 1.9.1	Existing text deleted and reference made to Pt.1, Ch.1, 1.9 of IRS *Rules and Regulations for the Construction and Classification of Steel Ships*.
2/ 2.1.1 (new)	New clause added which describes the objective of Classification.
2/ 2.3.3 (new)	New clause describing the Classification process is added.
2/ IR2.6.19 (new)	It is clarified that the weight of mediums on board for the fixed fire-fighting systems is to be included in the lightweight and lightship calculations.
2/ 2.15.2 (deleted) 2.15.4 (new)	Clauses are amended/ added to provide better clarity on Owner's responsibilities.
Appendix 1	Class Notations **BD, BDS** and **DP (0)** are added to the list of notations.
Chapter 2: Materials of Construction *The amendments are applicable from 1 January 2026.*	
4/ Table 4.4.2	Amendments are made in this Chapter to update the referenced standards and provide tolerances for glass content (by weight) in laminates.
Chapter 6: General Hull Requirements for Fibre Composite and Sandwich Constructions *The amendments are applicable to* *a) Manufacturing Facilities, where requests for certification are received on or after 1 January 2026; or* *b) Raw materials, where requests for certification are received on or after 1 January 2026; or* *c) ships contracted for construction on or after 1 January 2026.*	
2/ 2.1.1, 2.1.4, 2.2.1 3/ 3.1.2, 3.2.5, 3.2.6	The term 'supplier' is replaced with 'manufacturer', as it is more appropriate
Chapter 8: Anchoring and Mooring Equipment *The amendments are applicable from 1 January 2026.*	
3/ Table 3.2.1	Editorial corrections are made in the Column pertaining to 'EN', to give better clarity on the applicable range.
Chapter 9: Fire Safety *The amendments are applicable from 1 January 2026.*	
5/ 5.2.2 g)	Clause amended to provide clarification on the requirements for pre-discharge alarm for fixed gas fire extinguishing systems.
The amendments are applicable to ships contracted for construction on or after 1 January 2026	
Section 7	Section 7 is revised to elaborate requirements for fire protection of helicopter facilities.

Chapter 10: Piping Design Requirements	
The amendments are applicable to ships contracted for construction on or after 1 January 2026.	
1/ Table 1.2.1	Note 2 is added to clarify that Class II pipes are not to be used for toxic media. Note 6 is added to clarify the requirements for Urea in SCR systems. Piping material standards for Urea in SCR systems are also specified.
The amendments are applicable from 1 January 2026.	
1/ 1.9.1, 1.9.2, Table 1.9.1	The conditions for acceptability of manufacturer's materials certificate for pipes, valves and fittings are better clarified.
The amendments are applicable to ships contracted for construction on or after 1 January 2026.	
2/ 2.5.1	The Clause is updated to specify that threaded sleeve joints are to conform with the requirements of a recognized standard such as ASME B31.1 and ASME B31.3.
2/ 2.5.2	Editorial changes are made for better clarity.
2/ 2.5.3 (new)	Requirements for threaded sleeve joints used for connecting small bore instrumentation equipment to piping systems are better clarified.
2/ Table 2.5.1 (Deleted)	Table 2.5.1 is deleted as it is superfluous.
2/ 2.7.3	Application of Table 2.7.1 and 2.7.2 is clarified. Requirements for dry-wet test conditions are added, in case of fire endurance test with exposure time more than 30 minutes.
2/ 2.7.5	The term "sea opening" is replaced with "ship's side below the bulkhead deck of passenger ships and freeboard deck of cargo ships".
2/ 2.7.8	It is clarified that slip-on joints may be permitted in pipelines in tanks that contain the same media.
2/ 2.7.9	It is clarified that use of slip type slip on joint as main means of pipe connection is not permitted except where compensation of axial pipe deformation is necessary.
2/ 2.7.11.6	It is clarified that pressure pulsation test is mandatory for mechanical joints in Class I and II piping systems. The test is also to be used in Class III systems where pressure pulsation other than water hammer is expected.
2/ Table 2.7.1	Table 2.7.1 is completely revised to provide more details on service conditions of pipe systems (dry, wet, dry/ wet) and appropriate fire endurance test requirements.
2/ Table 2.7.2	"Typical compression type" joint has been added in column for 'Types of joints'.
2/ Fig 2.7	Figure on examples of mechanical joints is amended.
5 / 5.1.2	Reference to IMO resolution for the test requirements are updated with latest amendments
8/ 8.2.1	Requirement for testing of gas fuel piping is deleted here to align with other requirements in this Chapter.
8/ 8.2.5 (new)	Pneumatic leak testing is specified as an alternative to hydrostatic pressure tests for water sensitive systems.
Chapter 12: Main and Auxiliary Machinery	
The amendments are applicable to ships contracted for construction on or after 1 January 2026.	
1/ Table 1.13.1	It is specified that switches and controls of emergency machinery and equipment are to remain in their last set position and no undesirable switching or operational changes are to occur.
1/ 1.13.2 (new)	The new sub-section details ship accelerations, motions and provides requirements to ensure that essential machinery operates effectively under the effects of ship accelerations and motions.
1/ 1.23.1	Cross-reference to Cl. 3.1.1.5 is provided.
1/ 1.24.7 (new)	Requirements for testing of the pitch control system of controllable pitch propellers are specified.

2/ 2.8.15.2	Cl. 2.8.15.2 is completely revised to align with Part 4, Chapter 4, Section 6.16 of the *Rules and Regulations for the Construction and Classification of Steel Ships*.
These new requirements are applicable to engines and gear boxes: *i) when an application for certification is dated on or after 1 January 2026;* *or* *ii) which are installed in new ships contracted for construction on or after 1 January 2026.*	
3/ 3.1.1.5.2 (new)	Approval philosophy for engines and gearboxes is clarified.
The amendments are applicable to ships contracted for construction on or after 1 January 2026	
3/ 3.1.2.6 (New)	Exemption for FRP vessels; from the requirement for reductant storage tanks to be of steel or other equivalent material with a melting point above 925 degree C, when these are built as integral tanks; is specified.
These new requirements are applicable to AC generating sets: *i) when an application for certification is dated on or after 1 January 2026;* *or* *ii) which are installed in new ships contracted for construction on or after 1 January 2026.*	
3/ 3.1.8(new)	New requirements added for the AC Generating sets (prime movers, alternators and couplings).
Chapter 15: Ships with Integrated Platform Management System *The amendments are applicable to ships contracted for construction on or after 1 January 2026.*	
2/ IR2.3.3.3.1 (new)	It is clarified that the term “bilge injection system” used in 2.3.3.3.1 means “Emergency bilge suction”.
2/ IR2.3.3.3.2 (new)	Sea inlet and discharge valves are to be located such that there is adequate time to reach them for operation in case of flooding. The conditions under which emergency bilge system valves may be exempted from this requirement are specified in 1), 2) and 3).
2/ 2.4.1 f) (new)	Added to clarify that the requirement for alarm system is to satisfy IRS Classification Notes *“Type Approval of Electrical Equipment used for Control, Monitoring, Alarm and Protection Systems for use in Ships”* and SOTRs for the specific vessel.
2/ 2.7.9	Amended to clarify the requirement for paralleling and load sharing of generators.
3/ 3.1.11	Amended to clarify that for monitoring requirements of transmitters, refer Note 7) of Table 3.1.1 and monitoring requirements for gears in Table 3.1.4.
3/ Table 3.1.1, Table 3.1.2, Table 3.1.5	Amendments are made to indicate monitoring of engine bearing temperature devices or equivalent devices as an alternative to oil mist detection arrangements, for protection of engine crankcases.
6/ 6.2.1	Title of the Classification Note corrected.
Chapter 16: Integrated Bridge System *The amendments are applicable to ships contracted for construction on or after 1 January 2026.*	
This Chapter is completely revised to elaborate and provide better clarity on requirements for Integrated Bridge System. Requirements for additional class notations **BD**, **BDS**, and **IBS** are also specified.	
Chapter 17: Dynamic Positioning Systems *The amendments are applicable to ships contracted for construction on or after 1 January 2026.*	
This Chapter is completely revised to elaborate and provide better clarity on requirements for Dynamic Positioning Systems. Additional class notation **DP(0)** is introduced. Requirements for additional class notations **DP(1)**, **DP(2)** and **DP(3)** are also amended.	

TABLE 2 – CORRIGENDA INCORPORATED IN THIS NOTICE

Section / Clause	Subject/ Corrigenda
Chapter 1: General	
2/ 2.7.3 & Appendix 1	Character “SU (-)” is corrected.
Appendix 1	Cross reference is added for IBS notation.
Chapter 4: Stability, Subdivision, Watertight and Weathertight Integrity	
4/ 4.5.1, 4.6.1, 4.7.1	Reference is corrected.

Chapter 1

General

Section 1

General Information

1.1 Indian Register of Shipping

1.1.1 Indian Register of Shipping (hereinafter referred to as "IRS") was incorporated in 1975 as a Public Limited Company under ~~Section 25 of~~ the Indian Companies Act, ~~1956~~ for the purpose of providing amongst other things a faithful and accurate classification of mercantile shipping classed with it, to approve designs of, to survey and to issue reports on mercantile and non mercantile ships, hovercrafts, hydrofoils etc; all within the scope of classification described in the Rules. This Section contains General Regulations which have been adopted by IRS for its governance.

1.1.2 The management of the affairs of IRS are carried out by the Managing Director (MD) and Jt. Managing Director (JMD) under the direction and control of the Board of Directors (hereinafter referred to as the 'Board'), in accordance with the provisions of its Memorandum and Articles of Association.

1.1.3 The Board of Directors shall consist of representative of the interests of various members of the Company and those concerned with shipping in general as under:

1 Jt. Managing Director, where so appointed, being full-time employee, appointed by the Board of Directors.

The composition of the Board as above is to be in accordance with the Articles of Association of IRS (as may be amended from time to time).

1.1.4 The Board shall consist of not less than six and not more than fifteen Directors. If the actual representation on the Board of Directors exceeds 15 Directors, the provisions of the Indian Companies Act would apply to approve the increase in the sanctioned strength of the Board beyond the limit specified in the Articles of Association of IRS. The Board of Directors shall elect one of its members to be Chairman of the Board of Directors. The reference to Chairman shall include Executive Chairman, where so appointed by the Board of Directors.

1.1.7 The employees of IRS are to be appointed by and be under the direction of the ~~Board.~~MD, except for Key Managerial Personnel (KMP), who would be appointed by the Board on the recommendation of the Nomination & Remuneration Committee.

1.3.3 The Technical Committee to be constituted as follows:

Number of Members	**Nominees/Representatives of**
1	Ex-Officio - Executive Chairman~~Managing Director~~ of IRS or his nominee

1.3.4 In addition to the foregoing, the Technical Committee may co-opt to the main body other members of high managerial positions in Shipping, Ship Building ~~and~~ , Marine Engineering, Naval Architecture, Marine Insurance, Steel Making, etc.

1.3.8 The terms of office of all members are to be not more than four years, one-fourth of all members (including those co-opted) to retire at the end of each calender year. The members so retiring being those who have been longest in office since their last nomination and such members to be eligible for re-nomination for a second term. Unless specially so authorised by the Board of Directors, no member

other than Chairman and/or Vice- Chairman, who has served for two periods of nomination, ~~is~~ to be eligible for re-nomination. In the event of any vacancy occurring before the expiration of the normal term of office, a representative to be nominated to fill the vacancy from the same group/body/institution and for such nominee the date of his nomination by the respective body is to be considered as date of his joining the Technical Committee for purposes of his retirement by rotation.

1.3.9 The meeting of the Technical Committee is to be convened as often and at such time and place as may appear necessary, but there shall be at least two meetings in each year.

1.4 Survey reports

1.4.1 All reports of survey are to be made by the Surveyors according to the form prescribed and submitted for consideration of the Board or the Sub-Committee of Classification, but the character assigned by the latter is to be reported to the Board. The Board may, in specified instances, vest in the Managing Director/Jt.Managing Director discretionary powers to act on its behalf, and all such actions being reported to the Board at its subsequent meeting.

1.4.2 The reports of the Surveyors shall, subject to the approval of the Managing Director/Jt.Managing Director, be open to inspection of the Owner and any other person authorised in writing by the Owner. Copies of the reports will, subject to the approval of the Managing Director/Jt.Managing Director, be supplied to Owners or their representatives.

1.5 Register of Ships

1.5.1 A Register of ships is available on-line on the IRCLASS website which contains the names of ships, character of class and notations assigned together with other relevant useful information for ships classed with IRS. This register also includes the names of crafts, the character of class notation assigned together with other relevant useful information for crafts classed with IRS.

1.6 Liability

1.6.1 Whilst Indian Register of Shipping, a Classification Society, along with its subsidiaries and associates (hereinafter referred to as ~~IRS~~the Society) and its Board/Committees use their best endeavours to ensure that the functions of the Society ~~IRS~~ are properly carried out, in providing services, information or advice, neither the Society ~~IRS~~ nor any of its servants or agents warrants the accuracy of any information or advice supplied. Except as set out herein, neither the Society ~~IRS~~ nor any of its servants or agents (on behalf of each of whom the Society ~~IRS~~ has agreed this clause) shall be liable for any loss damage or expense whatever sustained by any person due to any act or omission or error of whatsoever nature and howsoever caused of the Society~~IRS~~, its servants or agents or due to any inaccuracy of whatsoever nature and howsoever caused in any information or advice given in any way whatsoever by or on behalf of the Society~~IRS~~, even if held to amount to a breach of warranty. Nevertheless, if any person uses services of the Society~~IRS~~, or relies on any information or advice given by or on behalf of the Society ~~IRS~~ and suffers loss, damage or expenses thereby which is proved to have been due to any negligent act omission or error of the Society ~~IRS~~ its servants or agents or any negligent inaccuracy in information or advice given by or on behalf of the Society ~~IRS~~ then the Society ~~IRS~~ will pay compensation to such person for his proved loss up to but not exceeding the amount of the fee charged by the Society ~~IRS~~ for that particular service, information or advice.

1.6.2 Any notice of claim for loss, damage or expense as referred to in 1.6.1 shall be made in writing to ~~IRS~~ Head Office within six months of the date when the service, information or advice was first provided, failing which all the rights to any such claim shall be forfeited and the Society ~~IRS~~ shall be relieved and discharged from all liabilities.

1.9 Requirements for service suppliers

1.9.1 For requirements of approval of applicable service suppliers, refer to Part 1, Chapter 1, 1.9 of the IRS Rules and Regulations for the Construction and Classification of Steel Ships.

~~1.9.1 Firms providing following services on behalf of the Owner, the results of which are used by Surveyors in making decision affecting classification and/or affecting statutory certifications, are to be approved by IRS in accordance with the laid down procedures.~~

~~a) Class services~~

- ~~Firms engaged in thickness measurements on ships~~
- ~~Firms engaged in tightness testing of hatches with ultrasonic equipment~~
- ~~Firms carrying out in water survey of ships.~~
- ~~Firm engaged in the examination of bow, stern and inner doors~~

~~b) Statutory services~~

- ~~Firms engaged in surveys and maintenance of fire extinguishing equipment and systems~~
- ~~Firms engaged in service on inflatable liferafts, inflatable lifejackets, hydrostatic release units, etc.~~
- ~~Firms engaged in the servicing and testing of radio communication equipment~~
- ~~Firms engaged in inspection and testing of centralised gas welding and cutting equipment~~
- ~~Firms engaged in surveys and maintenance of self contained breathing apparatus.~~
- ~~Firm engaged in sound pressure level measurements of public address and general alarm system~~
- ~~Firms engaged in testing of coating systems in accordance with the requirements of IMO performance standards for protective coating.~~

Section 2

Application and Definitions

2.1General

2.1.1 The objective of Coast Guard ship classification is to verify the structural strength and integrity of essential parts of the ship's hull and its appendages; stability of the ship; the reliability and function of the propulsion and steering systems; power generation and those other features and auxiliary systems which have been built into the ship in order to maintain essential services on board.

--subsequent clauses renumbered--

2.3 Scope and process of Classification

2.3.1 These Rules and Regulations provide the requirements for classification of Indian Coast Guard Ships such as Offshore Patrol Vessels, Fast Patrol Vessel, Inshore Patrol Vessels, Interceptor Boats, Interceptor Craft etc.

2.3.2 Classification covers ship's hull, appendages, machinery including electrical systems and military aspects to the extent as specified in these Rules & Regulations.

2.3.3 The classification process consists of:

- A technical review of the design plans and related documents for a new ship to verify compliance with the applicable Rules;
- Attendance at the construction of the ship in the Shipyard by IRS Surveyor(s) to verify that the ship is constructed in accordance with the approved design plans and classification Rules;
- Attendance by IRS surveyor(s) at the relevant production facilities that provide key components such as the steel, engine, generators and castings to verify that the component conforms to the applicable Rule requirements;
- Attendance by IRS surveyor(s) at the sea trials and other trials relating to the ship and its equipment prior to delivery to verify conformance with the applicable Rule requirements;
- Upon satisfactory completion of the above, the builder's/ shipowner's request for the issuance of a class certificate will be considered by IRS and, if deemed satisfactory, the assignment of class may be approved and a certificate of classification issued;
- Once in service, the owner is to submit the ship to a clearly specified programme of periodical class surveys, carried out onboard the ship, to verify that the ship continues to meet the relevant Rule requirements for continuation of class. A classification survey is a visual examination that normally consists of an overall examination of the items identified in the Rules for survey, detailed check of selected parts on a sampling basis and witnessing tests, measurements and trials where applicable.
- When a Surveyor identifies corrosion, structural defects or damage to hull, machinery and/ or equipment which, based on the Rules and in the opinion of the Surveyor, affects the ship's class, remedial measures and/ or appropriate conditions of class are specified in order to retain class. Conditions of class are requirements to the effect that specific measures, repairs, surveys etc. are to be carried out within a specified time limit in order to retain class.

2.6 Definitions

2.6.19 **Lightweight** is the displacement of the ship[t] without cargo, fuel, lubricating oil, ballast water, fresh water and feed-water in tanks, consumable stores, passengers and crew and their effects.

IR2.6.19 The weight of mediums on board for the fixed fire-fighting systems (e.g. freshwater, CO_2, dry chemical powder, foam concentrate, etc.) is to be included in the lightweight and lightship condition.

2.7 Character of Classification

2.7.3 **Character SU (-)** assigned to sea-going vessels indicates that the ship and its machinery meet the Rule requirements and the equipment (i.e. anchors, chain cable and hawsers) of the ship is not supplied as per the relevant Rules in agreement with the owner, but is considered by IRS to be acceptable for particular service.

Appendix 1 **Table of characters of class and type notations, their expanded form and significance**		
Abbreviation	**Expanded Form**	**Significance**
Characters of Class		
SU (-)	SARVOUTAM	Denotes vessels which are classed with IRS when the anchoring and mooring equipment of the ship is not supplied as per the relevant Rules, in agreement with the Owner, but is considered by IRS to be acceptable for particular service
Class notations Machinery		
BD	BRIDGE DESIGN	The additional class notation 'BD' will be assigned to ships which comply with the requirements of ergonomic bridge design and layout in accordance with Chapter 16 of the Rules.
BDS	BRIDGE DESIGN AND SYSTEMS	The additional class notation 'BDS' will be assigned to ships which comply with the requirements of ergonomic bridge design and layout, navigation equipment and related systems in accordance with Chapter 16 of the Rules.
IBS	INTEGRATED BRIDGE SYSTEM	Denotes that the vessel is fitted with an integrated bridge system which allows simplified and centralized bridge operation and monitoring of the main functions of navigation, communication, manouvering and other functions as per the ~~applicable~~ requirements given in Chapter 16.
DP (0)	DYNAMIC POSITIONING (0)	Denotes that the ship is fitted with automatic controls for position keeping and/or heading without joystick system back-up as per Chapter 17 of the Rules

2.15 Certificates

~~2.15.2 Certificates of class maintenance in respect of completed periodical special surveys of hull and machinery will also be issued to Owners.~~

2.15.2~~3~~ The Surveyors are permitted to issue Interim Certificates to enable a ship, classed with IRS, to proceed on her voyage provided that, in their opinion, she is in a fit and efficient condition. Such Certificates will contain Surveyors' recommendations for continuance of Class, but in all cases are subject to confirmation by IRS.

2.15.3~~4~~ Individual Certificates can also be issued for propelling machinery, boilers, equipments and fittings which have been manufactured under IRS Survey and in accordance with these Regulations.

2.15.4 It is the responsibility of the owner to ensure that the validity of class and statutory certificates is maintained.

End of Chapter

Chapter 2

Materials of Construction

Section 4

Glass Reinforced Plastic Materials

4.4 Polyester resins

4.4.2 Properties

For each grade of resin to be approved, resin in liquid and cast conditions and the laminates prepared from it are to be tested in accordance with the Table 4.4.2 and are to comply with the requirements specified therein.

Table 4.4.2 : Properties for acceptance purposes : Polyester resins

Property	Required values		Recommended Test Method
	ISOPHTHALIC	ORTHOPHTHALIC	
(A) LIQUID RESIN			
Density (D)	MNV		ISO 1675
Viscosity (D)	MNV ± 20%		ISO 2555 OR ISO 2884
Acid value (D)	MNV ± 10%		ISO 2114
Monomer content (D)	MNV ± 10%		ISO 3251
Gel time (D)	MNV ± 20%		ISO 2535
~~Shrinkage during cure (D)~~	~~MNV~~		~~ISO 3521~~
(B) CAST RESIN			
Volume Shrinkage	MNV	MNV	ISO 3521
Density	MNV	MNV	
Hardness (Barcol)	35	35	ASTM D2583
Heat deflection temp.	75 (°C)	62 (°C)	ISO 75
Water absorption (mg) (28 days immersion)	80 (mg) max.	100 (mg) max.	Method 1~~A~~ ISO 62
Ultimate tensile strength	45 [N/mm^2]	45 [N/mm^2]	ISO 527-4
Tensile modulus	3000 [N/mm^2]	3000 [N/mm^2]	ISO 527-4
Elongation at fracture	2% (2.5% for gelcoat)	1.5%	
Ultimate bending strength	80 [N/mm^2]	80 [N/mm^2]	ISO 178
(C) LAMINATE			
Ultimate tensile strength	85 [N/mm^2]		ISO 527-4
Tensile modulus	6500 [N/mm^2]		ISO 527-4
Ultimate bending strength	152 [N/mm^2]		ISO 178
Bending modulus	5206 [N/mm^2]		ISO 178
Glass content (by weight)	0.3 (±3%)		ISO 1172
Notes: MNV : Manufacturer's Nominal Value (as given on the product specifications) D : To be tested for each delivery/batch			

End Of Chapter

Chapter 4

Stability, Subdivision, Watertight and Weathertight Integrity

Section 4

Subdivision and Arrangement

4.5 Testing of hull structure

4.5.1 In general the testing of tanks, watertight bulkheads, weathertight hatchcovers and closing appliances is to be carried out in accordance with the requirements given in Part 3, Chapter 17~~8~~, Section 3 of the IRS Rules and Regulations for the Construction and Classification of Steel Ships.

The references to 'freeboard deck' in the above rules are to be taken as references to 'Datum'.

4.6 Ventilation, Air Pipes and Discharges

4.6.1 The scantlings and arrangements for ventilation, air pipes and discharges are to be as per Part 3, Chapter 12~~3~~ of the IRS Rules and Regulations for the Construction and Classification of Steel Ships.

4.7 Bulwarks and Guard Rails

4.7.1 The arrangement of bulwarks and guard rails is to be as per Part 3, Chapter 7~~11~~, Section 9~~5~~ of the IRS Rules and Regulations for the Construction and Classification of Steel Ships.

End of Chapter

Chapter 6

General Hull Requirements for Fibre Composite and Sandwich Constructions

Section 2

Requirements for Manufacturing Facilities

2.1 Storage of raw materials

2.1.1 Storage premises are to be so equipped and arranged that the respective material ~~supplier's~~manufacturer's recommendations for correct storage and handling of the raw materials are complied with.

2.1.4 The resins are to be stored under dry, well-ventilated conditions, in accordance with the material ~~supplier's~~manufacturer's recommendations. Resins which are stored at temperatures lower than + 18ºC are to be pre-conditioned to the moulding shop temperature prior to use.

2.2 Manufacturing conditions

2.2.1 Manufacturing premises are to be so equipped and arranged that the material ~~supplier's~~manufacturer's directions for handling the materials, the laminating process and curing conditions can be followed.

Section 3

Production Procedures, Workmanship and Manufacturing Control

3.1 General

3.1.2 Raw materials for all structural members covered by the Rules are to be of approved type in accordance with Chapter 2. The ~~supplier's~~ material manufacturer's directions for application of the materials are to be followed.

3.2 Manual lamination

3.2.5 The time interval between applications of each layer of reinforcement is to be within the limits specified by the material ~~supplier~~manufacturer. For thicker laminates care is to be taken to ensure a time interval sufficiently large to avoid excessive heat generation.

3.2.6 Curing systems are to be selected with due regard to the reactivity of the polyester and in accordance with the ~~supplier's~~material manufacturer's directions. Heat development during curing is to be kept at a safe level. The quantity of curing agents is to be kept within the limits specified by the supplier.

End Of Chapter

Chapter 8

Anchoring and Mooring Equipment

Section 3

Equipment Specification

3.2 Equipment

Table 3.2.1 : Anchoring, Mooring and Towing Equipment

EN	HHP anchor	Stud-link chain cable				Towline (Recommendation)		Mooring lines		
	Mass [kg]	Length [m]	Diameter and Grade			Steel or fibre ropes				
			CC1 [mm]	CC2 [mm]	CC3 [mm]	Min. length [m]	Min. breaking strength [kN]	No	Length of each [m]	Min. breaking strength [kN]
≤ 5	10	55	See 5.1.1 for the required size			90	20	2	50	14
> 5 ≤ 10	14	55				90	24		50	17
> 10 ≤ 15	23	60				90	27		50	20
> 15 ≤ 20	32	65				90	34		50	24
> 20 ≤ 25	40	70				110	39		50	27
> 25 ≤ 30	48	75				110	44		50	27
> 30 ≤ 35	56	80				110	49		50	27
> 35 ≤ 40	64	85				135	54		50	29
> 40 ≤ 45	71	90				135	59		60	29
> 45 ≤ 50	79	95				135	64		60	29
> 50 ≤ 60	90	100	11	-	-	180	71		60	34
> 60 ≤ 70	105	105	12.5	11	-	180	71		80	34
> 70 ≤ 80	120	110	14	12.5	-	180	82		100	37
> 80 ≤ 90	135	110	14	12.5	-	180	82		100	37
> 90 ≤ 100	157	110	16	14	-	180	93		110	39
> 100 ≤ 110	180	110	16	14	-	180	93		110	44
> 110 ≤ 120	202	110	17.5	16	-	180	104		110	44
> 120 ≤ 130	225	137.5	17.5	16	-	180	104		110	49
> 130 ≤ 140	255	137.5	19	17.5	-	180	115		120	49
> 140 ≤ 150	292	137.5	20.5	17.5	-	180	115		120	49
> 150 ≤ 175	360	137.5	22	19	-	180	128		120	54
> 175 ≤ 205	427	137.5	24	20.5	-	180	143		120	59
> 205 ≤ 240	495	165	26	22	20.5	180	161		120	64
> 240 ≤ 280	585	165	28	24	22	180	182	3	120	69
> 280 ≤ 320	675	165	30	26	24	180	201		140	74
> 320 ≤ 360	765	192.5	32	28	24	180	226		140	78
> 360 ≤ 400	855	192.5	34	30	26	180	248		140	88
> 400 ≤ 450	1080	192.5	36	32	28	180	273		140	98
> 450 ≤ 500	967	192.5	38	34	30	180	301		140	108
> 500 ≤ 550	1192	220	40	34	30	180	329	4	160	123

> 550 ≤ 600	1305	220	42	36	32	180	356		160	132
> 600 ≤ 660	1440	220	44	38	34	180	387		160	147
> 660 ≤ 720	1575	220	46	40	36	180	420		160	157

End Of Chapter

Chapter 9

Fire Safety

Section 5

Fire Detection and Extinguishing Systems

5.2 Fixed fire extinguishing systems

5.2.2 General Requirements of Fixed Fire Extinguishing Systems

f) Means are to be provided to close all openings which may admit air to, or allow gas to escape from, a protected space from a position outside the protected space. (For closing of openings for ventilation fans and stopping of ventilation fans, refer Section 4).

g) Means are to be provided for automatically giving audible warning of the release of fire-extinguishing medium into any space in which personnel normally work or to which they have access. The alarm is to operate for a suitable period before the medium is released, but not less than 20 [sec]. Visible alarms are to be arranged in addition to the audible alarm. The pre-discharge alarms may be pneumatically (by the extinguishing medium or by air) or electrically operated, with requirements as follows:

- If electrically operated, the alarms are to be supplied with power from the main and an emergency source of power.
- If pneumatically operated by air, the air supplied is to be dry and clean and the supply reservoir is to be fitted with a low-pressure alarm. The air supply may be taken from the starting air receivers. Any stop valve fitted in the air supply line is to be locked or sealed in the open position. Any electrical components associated with the pneumatic system are to be powered from the main and an emergency source of electrical power.

h) The volume of starting air receivers, converted to free air volume are to be added to the gross volume of the machinery space when calculating the necessary quantity of extinguishing medium. Alternatively, a discharge pipe connected to a safety valve may be fitted provided it leads directly to the open air.

Section 7

Fire Protection of Helicopter Facilities

7.1 Purpose

The purpose of this section is to provide additional measures in order to address the fire safety objectives of this part for ships fitted with special facilities for helicopters. For this purpose, the following functional requirements are to be met:

7.1.1 Helideck structure is to be adequate to protect the ship from the fire hazards associated with helicopter operations;

7.1.2 Firefighting appliances are to be provided to adequately protect the ship from the fire hazards associated with helicopter operations;

7.1.3 Refueling and hangar facilities and operations are to provide the necessary measures to protect the ship from the fire hazards associated with helicopter operations; and

7.1.4 Operation manuals and training are to be provided.

7.2 Structure

7.2.1 Construction of steel or other equivalent material

7.2.1.1 In general, the construction of the helidecks is to be of steel or other equivalent materials. If the helideck forms the deckhead of a deckhouse or superstructure, it is to be insulated to "A-60" class standard. ~~the helicopter landing deck and the boundaries of helicopter handling and fuelling areas shall be constructed of steel or equivalent material and insulated to 60 [min] fire protection time standard.~~

7.3.2 Construction of aluminium or other low melting point metals

7.3.2.1 If helideck platform of such construction located above the ship's deckhouse or similar structure:

- The deckhouse top and bulkheads under the platform are to have no openings; and
- Windows under the platform are to be provided with steel shutters.

7.3.2.2 After each fire on the platform or in close proximity its suitability for further use will be specially considered in each case.

7.4 Means of escape

7.4.1~~2~~ Heli decks are to be provided with both main and emergency means of escape/evacuation and access for ~~-~~fire fighting and rescue personnel. These ~~shall~~ are to be located as far from each other as practicable and preferably on opposite sides of the helideck~~possible~~.

7.5 Fire-fighting appliances

7.5.1~~3~~ In close proximity to the heli-deck and near the access, the following fire fighting appliances are to~~shall~~ be provided:

.1 at least two dry powder extinguishers having total capacity of not less than 45 [kg];

.2 carbon di-oxide~~-~~ extinguishers of total capacity of not less than 18 [kg];

.3 a suitable foam application system consisting of monitors or foam-making branch pipes capable of delivering foam to all parts of the helicopter facilities in all weather conditions in which helicopters can operate. The system ~~shall~~ is to be capable of delivering a ~~-~~discharge rate as required in Table 7.5.1 for at least five minutes; ~~5 [min] of 250 [litres/min] for helicopters upto 15 [m] length, 500 [litres/min] for helicopters of length 15 upto 24 [m], 800 [litres / min] for helicopters of length 24 upto 35 [m]. The foam compound should be of approved type and compatible for usage with sea water.~~

Table 7.5.1 : Foam discharge rates

Category	Helicopter overall length	Discharge rate foam solution [l/min.]
H1	up to but not including 15 [m]	250
H2	from 15 [m] up to but not including 24 [m]	500
H3	from 24 [m] up to but not including 35 [m]	800

.4 the principal agent is to be suitable for use with salt water and conform to performance standards;

.5 at least two ~~dual purpose~~ nozzles of an approved dual-purpose type (jet/spray) and hoses sufficient to reach any part of the helideck~~copter service areas~~;

.6 two additional sets of ~~fireman's~~ fire-fighter's out~~-~~fits;

.7 at least the following equipment~~s, protected from the weather~~ are to be stored in a manner that provides for immediate use and protection from the ~~:~~elements:

- adjustable wrench;
- fire resistant blanket;
- bolt cutter, 60 [mm];
- grab or ~~slaving~~ salving hook;
- heavy duty hack saw complete with 6 spare blades;
- ladder;
- ~~life~~ lift line of 5 [mm] ~~-~~diameter and 15 [m] length;
- side cutting pliers;
- set of assorted screw drivers;
- harness knife with sheath;

7.6 Drainage facilities

7.6.1~~4~~ Drainage facilities in way of~~at~~ heli~~-~~decks are to be constructed of steel and are to~~shall~~ lead directly over board independent of any other system and is to be designed so that drainage does not fall onto any part of the ship.

7.7 Helicopter refueling and hangar facilities

~~7.5~~ Where the ship has helicopter refueling and hangar facilities, the following requirements are to be complied with:

7.7.1 a designated area is to be provided for the storage of fuel tanks which is to be:

- as remote as is practicable from accommodation spaces, escape routes and embarkation stations; and

- isolated from areas containing a source of vapour ignition;

7.7.2 the fuel storage area is to be provided with arrangements whereby fuel spillage may be collected and drained to a safe location;

7.7.3 tanks and associated equipment are to be protected against physical damage and from a fire in an adjacent space or area;

7.7.4 where portable fuel storage tanks are used, special attention is to be given to:

- design of the tank for its intended purpose;

- mounting and securing arrangements;

- electric bonding;

- inspection procedures.

7.7.5 storage tank fuel pumps are to be provided with means which permit shutdown from a safe remote location in the event of a fire. Where a gravity fuelling system is installed, equivalent closing arrangements are to be provided to isolate the fuel source;

7.7.6 the fuel pumping unit is to be connected to one tank at a time. The piping between the tank and the pumping unit is to be of steel or equivalent material, as short as possible, and protected against damage;

7.7.7 electrical fuel pumping units and associated control equipment is to be of a type suitable for the location and potential hazards;

7.7.8 fuel pumping units are to incorporate a device which will prevent over-pressurization of the delivery or filling hose;

7.7.9 equipment used in refuelling operations is to be electrically bonded;

7.7.10 “NO SMOKING” signs are to be displayed at appropriate locations;

7.7.11 hangar, refuelling and maintenance facilities are to be treated as category ‘A’ machinery spaces with regard to structural fire protection, fixed fire-extinguishing and detection system requirements;

7.7.12 enclosed hangar facilities or enclosed spaces containing refuelling installations are to be provided with mechanical ventilation, as required by 6.7 for closed ro-ro spaces of cargo ships. Ventilation fans are to be of non-sparking type; and

7.7.13 electric equipment and wiring in enclosed hangar or enclosed spaces containing refuelling installations are to comply with 6.7.4 and 6.7.5.

~~Helicopter fuel tanks shall be located at a designated area, as far removed from other areas of major fire risk as possible and away from main escape routes. Arrangements are to be provided to drain any spillage to safe locations. Tanks and associated fittings are to be protected from physical damages and from fire in adjacent spaces by suitably insulated boundaries or coffer dams.~~

~~7.6 All piping for helicopter fuel handling are to be of steel or equivalent material. Only approved flexible pipes are to be used for fuelling the helicopters. Suitable devices are to be provided to prevent over pressurisation of the piping.~~

~~7.7 All electrical equipments in the vicinity of helicopter fuelling arrangements are to be intrinsically safe and explosion proof as per applicable international standards. All electrical cabling and wiring shall be as per 6.7 of the requirements for Ro-Ro spaces as applicable.~~

7.8 Operations manual and fire-fighting service

7.8.1 Each helicopter facility is to have an operation manual, including a description and a checklist of safety precautions, procedures and equipment requirements. This manual may be part of the ship’s emergency response procedures.

7.8.2 The procedures and precautions to be followed during refueling operations are to be in accordance with recognized safe practices and contained in the operations manual.

7.8.3 Fire-fighting personnel consisting of at least two persons trained for rescue and fire-fighting duties and fire-fighting equipment are to be immediately available at all times when helicopter operations are expected.

7.8.4 Fire-fighting personnel are to be present during refueling operations. However, the fire-fighting personnel are not to be involved with refueling activities.

7.8.5 On-board refresher training is to be carried out and additional supplies of fire-fighting media is to be provided for training and testing of the equipment.

End of Chapter

Chapter 10

Piping Design Requirements

Section 1

General

1.2 Classes of pipes

1.2.1 For the purpose of testing, type of joints to be adopted, heat treatment and welding procedure, piping systems are divided into three classes, as given in Table 1.2.1.

Table 1.2.1 : Classes of piping systems [3,4]

Piping system	Class I	Class II	Class III
Toxic or corrosive media	Without special safeguards	~~Not to be used~~With special safeguards[1, 2]	Not to be used
a) Flammable media heated above flash point[2] b) Flammable media having flash point below 60°C[2] ~~c) Liquefied gas~~	Without special safeguards	With special safeguards[1]	Not to be used
Steam	P > 16 or T > 300	16 ≥ P > 7 and 300 ≥ T > 170	P ≤ 7 and T ≤ 170
Thermal Oil	P > 16 or T > 300	16 ≥ P > 7 and 300 ≥ T > 150	P ≤ 7 and T ≤ 150
Fuel oil + Lubricating oil + Flammable hydraulic oil	P > 16 or T > 150	16 ≥ P > 7 and 150 ≥ T > 60	P ≤ 7 and T ≤ 60
Other media[5,6] ~~including water, air, gases, non-flammable hydraulic oil~~	P > 40 or T > 300	40 ≥ P > 16 and 300 ≥ T > 200	P ≤ 16 and T ≤ 200

Notes:

1 Safeguards for reducing leakage possibility and limiting its consequences will be specially considered e.g. leading pipes in positions where leakage of internal fluids will not cause a potential hazard or damage to surrounding areas or by the usage of pipe ducts, shielding, screening etc.

2 Class II pipes are not to be used for toxic media.

~~2~~3 Cargo oil pipes belong to Class III piping systems.

~~3~~4 P = Design pressure in bar as defined in 1.3

~~4~~5 T = Design temperature in °C as defined in 1.4.

6 Including water, air, gases, non-flammable hydraulic oil, Urea for SCR systems*

~~5~~7 For open ended pipes (drains, overflow, vents, exhaust gas lines, boiler escape lines, etc.) irrespective of the temperature, Class III pipes may be used.

* When piping materials selected according to ISO 18611-3:2014 for Urea in SCR systems.

1.9 Materials

1.9.1 Materials for ~~ferrous~~metallic castings and forgings of Class I and Class II piping systems are to be produced at Works approved by IRS and are in general to be tested in accordance with the requirements of ~~Pt.2~~Part 2 of the Rules.

1.9.2 The manufacturer's ~~test~~ materials certificate ~~for materials of valves and fittings~~ will be accepted in lieu of the IRS materials certificate for Class III piping systems and for all other classes of piping and associated components where ~~provided~~ the maximum design conditions are less than the values given in Table 1.9.1.

1.9.3 Pipes and bodies of valves, intended to be fitted on ship's side and bottom or on collision bulkhead, are to comply with the requirements of Class II piping systems.

1.9.4 Materials for Class III piping systems may be manufactured and tested in accordance with the requirements of an acceptable national/ international standard.

Table 1.9.1 : Maximum conditions for pipes valves and fittings for which manufacturer's test certificate is acceptable

Material	Working temp.°C	DN = Nominal Diameter [mm] P_w = Working Pressure in ~~bar~~MPa
Carbon and low alloy steel Spheroidal or nodular cast iron	< 300	DN < 50 or P_w x DN < 250~~0~~
Copper alloy	< 200	DN < 50 or P_w x DN < 150~~0~~

Section 2

Carbon and Low Alloy Steel Pipes and Fittings

2.5 Slip-on ~~T~~threaded ~~sleeve~~ joints

2.5.1 Slip-on ~~T~~threaded ~~sleeve~~ joints having pipe threads where ~~requiring~~ pressure-tight joints~~,~~ are made on the threads ~~having~~ parallel or tapered threads are to comply with the requirements of ~~in accordance with~~ a recognized national or other established standards (such as ASME B3.1.1 and ASME B3.1.3)~~, may be used with carbon steel pipes within the limits given in Table 2.5.1 and~~

2.5.2 Slip-on threaded joints may be used for outside diameters as stated in 2.5.5 except for ~~services other than~~ piping~~e~~ systems conveying ~~combustible~~ flammable or toxic ~~fluids~~ media or services where fatigue, severe erosion or crevice corrosion is expected to occur.

2.5.3 Slip-on threaded joints may be used for connecting small bore instrumentation equipment (e.g., pressure/temperature sensors) to piping systems conveying flammable media if such connections comply with a recognized national and/or international standard (such as ASME B3.1.1 and ASME B3.1.3). The use of such threaded joints is to be limited to outside diameters of maximum 25mm.

2.5.4 Threaded joints in CO_2 systems ~~shall~~ are to be allowed only inside protected spaces and in CO_2 cylinder rooms.

2.5.5 Threaded joints for direct connections of pipe lengths with tapered threads are to be allowed for

a) Class I piping having outside diameter not more than 33.7 [mm].

b) Class II and Class III piping having outside diameter not more than 60.3 [mm].

Threaded joints with parallel threads are to be allowed for Class III piping having outside diameter not more than 60.3 [mm].

In particular cases, sizes in excess of those mentioned above may be accepted by IRS if in compliance with a recognized national and/or international standard.

~~Table 2.5.1 : Limiting design conditions for threaded sleeve joints~~		
~~Nominal bore [mm]~~	~~Maximum pressure in bar~~	~~Maximum temp.°C~~
~~≤ 25~~	~~12~~	~~260~~
~~> 25 ≤ 40~~	~~10~~	~~260~~
~~> 40 ≤ 80~~	~~8.5~~	~~260~~
~~> 80 ≤ 100~~	~~7~~	~~260~~

2.7 Mechanical joints

2.7.1 Mechanical joints means devices intended for direct connection of pipe lengths other than by flanges, threaded joints or welding as described in 2.4, 2.5 and 2.6.

2.7.2 The requirements given here are applicable to pipe unions, compression couplings, slip-on joints as shown in Fig.2.7. Similar joints complying with these requirements may be acceptable.

2.7.3 Mechanical joints including pipe unions, compression couplings, slip-on joints and similar joints are to be of approved type for the pressure ratings, service conditions and the intended application. The construction and type are to conform to the examples shown in Fig.2.7. ~~and are to be in accordance with Table 2.7.1 and Table 2.7.2 for their classification and application.~~ Application of mechanical joints and their acceptable use for each service is indicated in Table 2.7.1. In case exposure time (t_T) for fire endurance test is greater than 30 minutes, the dry-wet test conditions are 8 minutes dry and, accordingly, the wet period t_T-8 minutes. Application of mechanical joints depending upon the class of piping and pipe dimensions is indicated in Table 2.7.2. (For approval refer Classification Notes "Type Approval of Mechanical Joints used in Piping").

2.7.4 Where the application of mechanical joints results in reduction in pipe wall thickness due to the use of bite type rings or other structural elements, this is to be taken into account in determining the minimum wall thickness of the pipe to withstand the design pressure.

The materials used in construction of mechanical joints is to be compatible with the piping material and internal and external media. ~~In general~~Where appropriate, the mechanical joints are to be of fire resistant type as required by Table 2.7.1.

~~2.7.5 The pressure pulsation, piping vibration, temperature variation and any other similar adverse effects occurring during operation on board is not to result in failure of joint integrity or its tightness.~~

2.7.~~6~~5 Mechanical joints, which in the event of damage could cause fire or flooding, are not to be used in piping sections directly connected to the ~~sea openings~~ ship's side below the bulkhead deck of passenger ships and freeboard deck of cargo ships or tanks containing flammable fluids.
~~2.7.7 The mechanical joints are to be designed to withstand internal and external pressure as applicable and where used in suction lines are to be capable of operating under vacuum.~~

2.7.~~8~~6 The number of mechanical joints in ~~oil~~flammable fluid systems is to be kept to a minimum. In general, flanged joints conforming to recognised standards are to be used.

2.7.~~9~~7 Piping in which a mechanical joint is fitted is to be adequately adjusted, aligned and supported Supports or hangers are not to be used to force alignment of piping at the point of connection.

2.7.~~10~~8 Slip-on joints are normally not to be used in pipelines in cargo holds, tanks and other spaces which are not easily accessible (refer to MSC/ Circ. 734), ~~unless approved in each case~~except that these joints may be permitted in tanks that contain the same media.

~~2.7.11 Application of mechanical joints inside tanks may be permitted only for the same media that is in the tanks.~~2.7.~~12~~9 ~~Unrestrained slip-on joints are to be used only in cases where compensation of lateral pipe deformation is necessary~~. Usage of slip type slip-on ~~these~~ joints as the main means of pipe connection is not permitted except for cases where compensation of axial pipe deformation is necessary.

2.7.~~13~~10 In particular cases, sizes in excess of those mentioned in Table 2.7.2 may be accepted if in compliance with a recognised national and/or international standard.

2.7.~~14~~11 Mechanical joints are to be subjected to the following tests:

.1 leakage test
.2 vacuum test
.3 vibration (fatigue) test
.4 fire endurance test
.5 burst pressure test at 4 times the design pressure (for design pressures above 200 bar, the burst pressure will be specially considered by IRS)
.6 pressure pulsation test (mandatory for all Class I and II systems and for use in Class III systems where pressure pulsation other than water hammer is expected.)
.7 assembly test
.8 pull out test.

NOTE : For details of tests refer classification notes, “Type Approval of Mechanical Joints used in Piping”.

2.7.~~15~~12 The installation of mechanical joints is to be in accordance with the manufacturer’s assembly instructions and using special tools and gauges as required.

~~**Table 2.7.1 : Application of mechanical joints**~~

~~Systems~~		~~Kind of connections~~		
		~~Pipe unions~~	~~Compression couplings 6)~~	~~Slip-on joints~~
~~Flammable Fluids (Flash point ≤ 60°)~~				
~~1~~	~~Cargo oil lines~~	~~+~~	~~+~~	~~+5)~~
~~2~~	~~Crude oil washing lines~~	~~+~~	~~+~~	~~+5)~~
~~3~~	~~Vent lines~~	~~+~~	~~+~~	~~+3)~~
~~Inert Gas~~				
~~4~~	~~Water seal effluent lines~~	~~+~~	~~+~~	~~+~~
~~5~~	~~Scrubber effluent lines~~	~~+~~	~~+~~	~~+~~
~~6~~	~~Main lines~~	~~+~~	~~+~~	~~+2) 5)~~
~~7~~	~~Distributions lines~~	~~+~~	~~+~~	~~+5)~~
~~Flammable Fluids (Flash point > 60°)~~				
~~8~~	~~Cargo oil lines~~	~~+~~	~~+~~	~~+5)~~
~~9~~	~~Fuel oil lines~~	~~+~~	~~+~~	~~+3) 2)~~
~~10~~	~~Lubricating oil lines~~	~~+~~	~~+~~	~~+2) 3)~~
~~11~~	~~Hydraulic oil~~	~~+~~	~~+~~	~~+2) 3)~~
~~12~~	~~Thermal oil~~	~~+~~	~~+~~	~~+2) 3)~~
~~Sea Water~~				
~~13~~	~~Bilge lines~~	~~+~~	~~+~~	~~+1)~~
~~14~~	~~Fire main and water spray~~	~~+~~	~~+~~	~~+3)~~
~~15~~	~~Foam system~~	~~+~~	~~+~~	~~+3)~~
~~16~~	~~Sprinkler system~~	~~+~~	~~+~~	~~+3)~~
~~17~~	~~Ballast system~~	~~+~~	~~+~~	~~+1)~~
~~Sea Water (contd.)~~				
~~18~~	~~Cooling water system~~	~~+~~	~~+~~	~~+1)~~
~~19~~	~~Tank cleaning services~~	~~+~~	~~+~~	~~+~~
~~20~~	~~Non-essential systems~~	~~+~~	~~+~~	~~+~~
~~Fresh Water~~				
~~21~~	~~Cooling water system~~	~~+~~	~~+~~	~~+1)~~
~~22~~	~~Condensate return~~	~~+~~	~~+~~	~~+1)~~
~~23~~	~~Non-essential system~~	~~+~~	~~+~~	~~+~~

Table 2.7.1 (Contd.)

Systems		Kind of connections		
		Pipe unions	Compression couplings 6)	Slip-on joints
Sounding / Vent				
Sanitary / Drains / Scuppers				
24	Deck Drains (Internal)	+	+	+4)
25	Sanitary Drains	+	+	+
26	Scuppers and Discharge (Overboard)	+	+	-
27	Water tanks / Dry spaces	+	+	+
28	Oil tanks (f.p > 60°C)	+	+	+2) 3)
Miscellaneous				
29	Starting / Control air 1)	+	+	-
30	Service air (non-essential)	+	+	+
31	Brine	+	+	+
32	CO_2 system 1)	+	+	-
33	Steam	+	+	-

Abbreviations

\+ Application is allowed
\- Application is not allowed

Footnotes:

1) Inside machinery spaces of category A – only approved fire resistant types.
2) Not inside machinery spaces of category A or accommodation spaces. May be accepted in other machinery spaces provided the joints are located in easily visible and accessible positions.
3) Approved fire resistant types
4) Above free board deck only.
5) pump rooms and open decks – only approved fire resistant types.
6) If compression couplings include any components which readily deteriorate in case of fire, they are to be of approved fire resistant type as required for slip-on joints.
7) –

Table 2.7.1 : Application of mechanical joints

Systems		Kind of connections			Classification of pipe system	Fire endurance test condition[7]
		Pipe unions	Compression couplings	Slip-on joints		
Flammable Fluids (Flash point ≤ 60°C)						
1	Cargo oil lines[1]	+	+	+	dry	30 min dry (*)
2	Crude oil washing lines[1]	+	+	+	dry	
3	Vent lines[3]	+	+	+	dry	
Inert Gas						
4	Water seal effluent lines	+	+	+	wet	30 min wet (*)
5	Scrubber effluent lines	+	+	+	wet	30 min wet (*)
6	Main lines[1&2]	+	+	+	dry	30 min dry (*)
7	Distributions lines[1]	+	+	+	dry	30 min dry (*)
Flammable Fluids (Flash point > 60°C)						
8	Cargo oil lines[1]	+	+	+	dry	30 min dry (*)
9	Fuel oil lines[2&3]	+	+	+	wet	30 min wet (*)
10	Lubricating oil lines[2&3]	+	+	+	wet	
11	Hydraulic oil[2&3]	+	+	+	wet	
12	Thermal oil[2&3]	+	+	+	wet	
Sea Water						
13	Bilge lines[4]	+	+	+	dry/ wet	8 min dry +22 min wet (*)
14	Permanent water filled fire extinguishing systems, e.g. sprinkler systems[3]	+	+	+	wet	30 min wet (*)
15	Non-permanent water filled fire extinguishing systems, e.g. foam, drencher systems and fire main[3]	+	+	+	dry/ wet	8 min dry + 22 min wet (*) For foam systems, Part 6 Chapter 8. Section 6 is to be complied with.
16	Ballast System[4]	+	+	+	wet	30 min wet (*)
17	Cooling water system[4]	+	+	+	wet	30 min wet (*)
18	Tank cleaning services	+	+	+	dry	Fire endurance test not required
19	Non-essential systems	+	+	+	dry dry/ wet wet	Fire endurance test not required
Fresh Water						
20	Cooling water system[4]	+	+	+	wet	30 min wet (*)
21	Condensate return[4]	+	+	+	wet	30 min wet (*)
22	Non-essential system	+	+	+	dry dry/ wet wet	Fire endurance test not required

Table 2.7.1 (Contd.)

Systems		Kind of connections			Classification of pipe system	Fire endurance test condition[7]
		Pipe unions	Compression couplings	Slip-on joints		
Sanitary/ Drains/ Scuppers						
23	Deck drains (internal)[5]	+	+	+	dry	Fire endurance test not required
24	Sanitary drains	+	+	+	dry	
25	Scuppers and discharge (overboard)	+	+	-	dry	
Sounding/ Vent						
26	Water tanks/ Dry spaces	+	+	+	dry, wet	Fire endurance test not required
27	Oil tanks (f.p.>60°C)[2&3]	+	+	+	dry	
Miscellaneous						
28	Starting/ Control air[4]	+	+	+	dry	30 min dry (*)
29	Service air (non-essential)	+	+	+	dry	Fire endurance test not required
30	Brine	+	+	+	wet	
31	CO_2 system (outside protected space)	+	+	+	dry	30 min dry (*)
32	CO_2 system (inside protected space)	+	+	+	dry	Mechanical joints are to be constructed of materials with melting point above 925°C. Ref. to Part 6, Chapter 8, Section 5 of the *Rules and Regulations for the Construction and Classification of Steel Ships.*
33	Steam	+	+	+[6]	wet	Fire endurance test not required

Abbreviations

\+ Application is allowed
\- Application is not allowed
* Fire endurance test as specified in IRS Classification Note: *Type Approval of Mechanical Joints used in Piping.*

Footnotes: - Fire resistance capability

If mechanical joints include any components which readily deteriorate in case of fire, the following footnotes are to be observed:

1) Fire endurance test is to be applied when mechanical joints are installed in pump rooms and open decks.
2) Slip-on joints are not acceptable inside machinery spaces of category A or accommodation spaces. May be accepted in other machinery spaces provided the joints are located in easily visible and accessible positions (Refer to MSC/Circ. 734).
3) Approved fire-resistant types except in cases where such mechanical joints are installed on open decks, as defined in Pt. 6, Ch. 3, Cl. 3.2.3.3.2.2(10) of the *Rules and Regulations for the Construction and Classification of Steel Ships* and not used for fuel lines.

4) Fire endurance test is to be applied when mechanical joints are installed inside machinery spaces of category A.

Footnotes – General (Table 2.7.1)

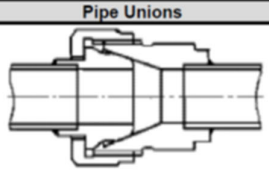
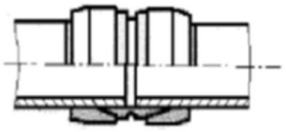
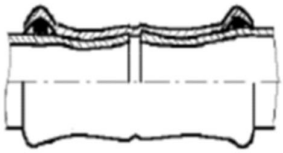
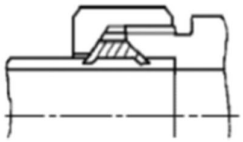
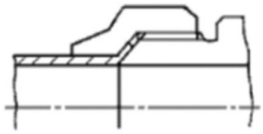
5) Only above bulkhead deck of passenger ships and freeboard deck of cargo ships.
6) Slip type slip-on joints as shown in Fig. 2.7 may be used for pipes on deck with a design pressure of 10 bar or less.
7) If a connection has passed the "30 min dry" test, it is considered suitable also for applications for which the "8 min dry+22 min wet" and/or "30 min wet " tests are required. If a connection has passed the "8 min dry+22 min wet" test, it is considered suitable also for applications for which the "30 min wet" test is required.

Table 2.7.2 : Application of mechanical joints depending upon the class of piping

Types of joints	Classes of piping systems		
	Class I	Class II	Class III
Pipe Unions			
Welded and brazed type	+ (OD ≤ 60.3 mm)	+ (OD ≤ 60.3 mm)	+
Compression Couplings			
Swage type	+	+	+
Bite type ~~Flared type~~	+ ~~(OD ≤ 60.3 mm)~~ ~~+ (OD ≤ 60.3 mm)~~	+ ~~(OD ≤ 60.3 mm)~~ ~~+ (OD ≤ 60.3 mm)~~	+ ~~+~~
Typical compression type	+	+	+
Flared type	+	+	+
Press type	-	-	+
Slip-on joints			
Machine grooved type	+	+	+
Grip type	-	+	+
Slip type	-	+	+

Abbreviations:

\+ Application is allowed
\- Application is not allowed

Pipe Unions	
Welded and Brazed Types	
Compression Couplings	
Swage Type	
Press Type	
Bite Type	
Flared Type	

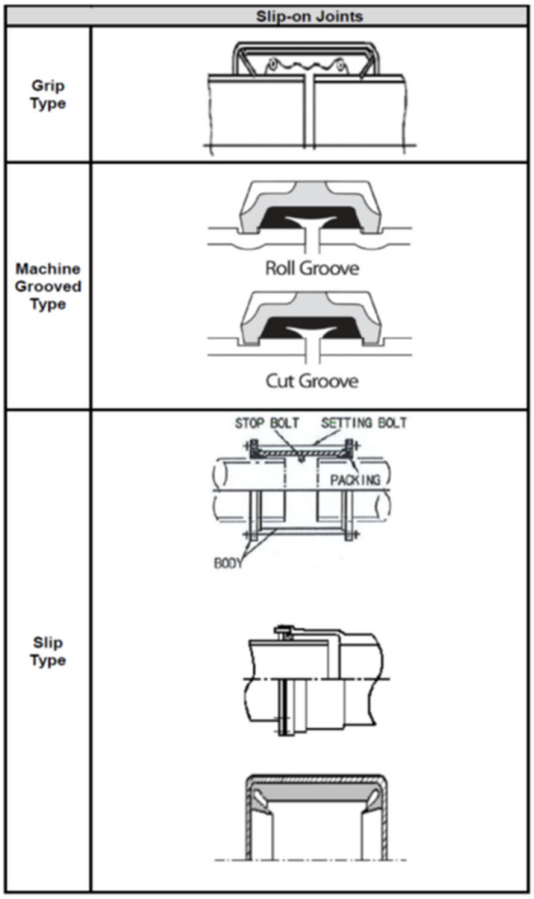
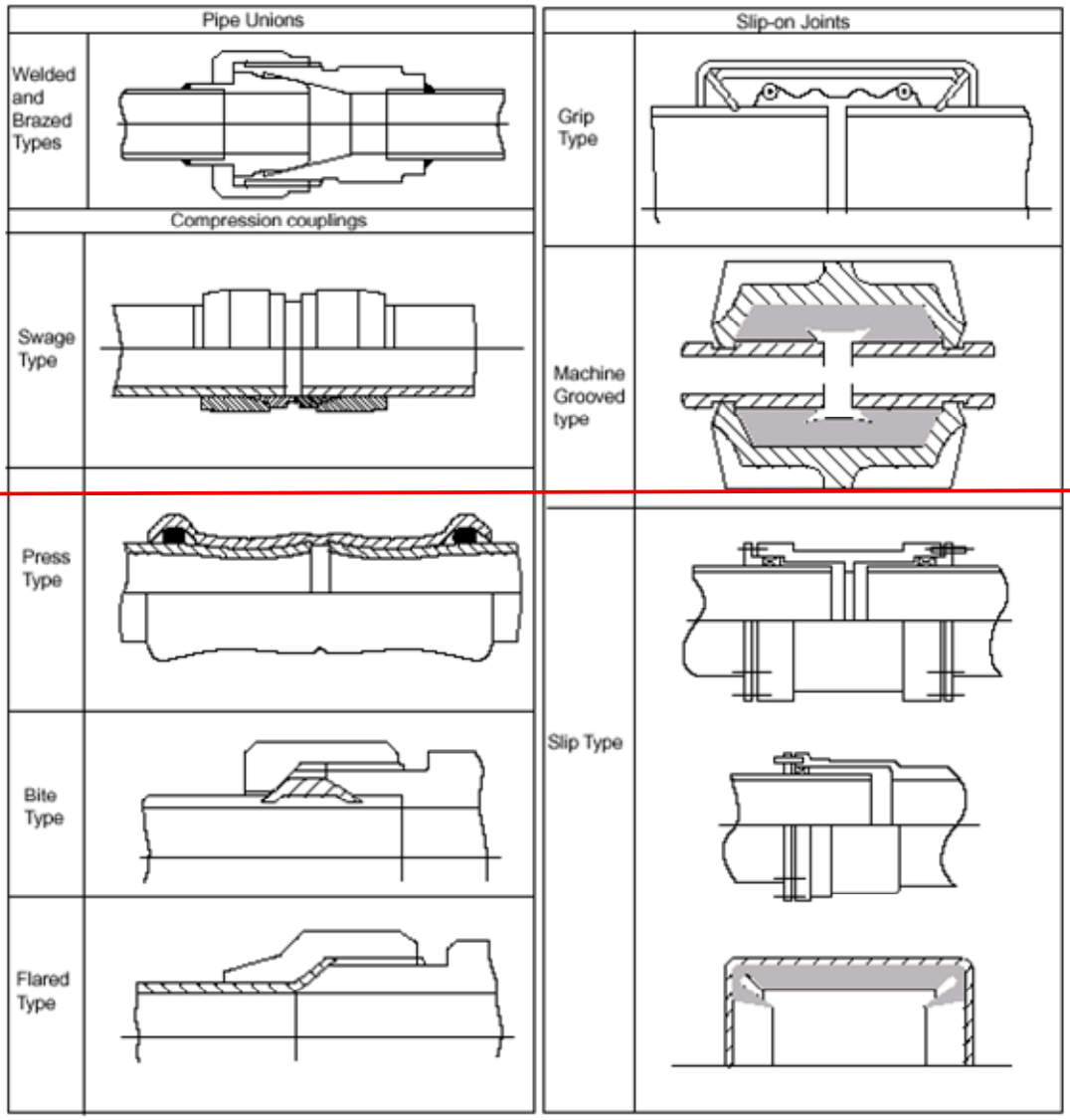


Fig. 2.7 : Examples of Mechanical Joints

Fig. 2.7 : Examples of mechanical joints



Section 5

Plastic Pipes and Fittings

5.1 General

5.1.2 “Guidelines for the Application of Plastic Pipes on Ships” contained in IMO Resolution A.753(18) (as amended by Res MSC.313(88) and 399(95)) are to be complied with.

Section 8

Hydraulic Tests on Pipes and Fittings

8.2 Testing after assembly on board

8.2.1 In general, all the piping systems covered by this chapter are to be checked for leakage under operational conditions and, if necessary, using other techniques other than hydraulic testing. In particular, ~~H~~heating coils in tanks and liquid ~~or gas~~ fuel ~~oil~~ piping ~~are~~is to be tested by hydraulic pressure, after installation on board, to 1.5 times the design pressure but in no case to less than 4 bar.

8.2.4 Where bilge pipes are accepted in way of double bottom tanks or deep tanks, the pipes after fitting are to be tested by hydraulic pressure to the same pressure as the tanks through which they pass.

8.2.5 Pneumatic leak testing may be carried out on water sensitive systems, in lieu of hydrostatic testing. In certain circumstances, a combined hydrostatic – pneumatic strength test may also be applied, where the system is partially filled with water and the free space above is pressurized with a test gas (typically air or nitrogen). When pneumatic tests cannot be avoided, appropriate safety precautions are to be taken.

End of Chapter

Chapter 12

Main and Auxiliary Machinery

Section 1

General Requirements for Machinery

1.13 Inclination~~s~~, Accelerations and Motions of the ship

1.13.1 Inclinations of the ship

1.13.1.1 General

~~1.13.1~~.1 The main and auxiliary machinery is to be designed and installed such that it operates satisfactorily under the conditions as shown in Table 1.13.1. These requirements of inclination are not applicable for Ships less than 150 GT. However, if specifically insisted by the Indian Coast Guard in the building contract the same need to be catered by the shipyard.

~~1.13.~~2 The arrangements for lubricating bearings and for draining crankcase and other oil sumps of main and auxiliary engines, gearcases, electric generators, motors and other running machinery are to be so designed that lubrication will remain efficient with the ship inclined under the conditions as shown in Table 1.13.1.

~~1.13.~~3 Deviations from these conditions may be accepted taking into consideration type and size of the ship and the class notation. The shipbuilder is to ensure that the main and auxiliary machinery is capable of operating at the proposed angles of inclination.

Table 1.13.1 : Inclinations

Installations, components	**Angle of inclination, degrees (see Note 1)**			
	Athwartship		**Fore-and-aft**	
	Static	**Dynamic**	**Static**	**Dynamic**
Main and auxiliary machinery essential to the propulsion and safety of the ship	15	22.5	5 (see Note 2)	7.5
Switch gear, electrical and electronic appliances and remote control systems. Safety equipment e.g. Emergency machinery and equipment fitted in accordance with statutory requirements[3]	22.5	22.5	10	10

Notes:
1. Athwartships and fore-and-aft inclination may occur simultaneously.
2. Where the length of the ship exceeds 100 m, the fore-and-aft static angle of inclination may be taken as:
   500/L degrees

where,
L = Length of ship, in metres

3. Switches and controls are to remain in their last set position. No undesired switching operations or operational changes are to occur.

1.13.2 Accelerations and motions of the ship

1.13.2.1 General

.1 Main propulsion and steering machinery and auxiliary machinery that is essential to the propulsion and steering, and the safety of the ship is to be capable of operation under the effects of acceleration and motions.

.2 The requirements in 1.13.2.2 to 1.13.2.4 apply where documented evidence of equipment suitability is specifically required by the Rules.

1.13.2.2 Documentation

.1 The ship builders are to identify and document the ship accelerations and motions periods to which machinery and equipment might be subjected to. The expected accelerations and ship motions periods are to be within machinery and equipment manufacturers requirements. The estimations are to consider vessel type, machinery or equipment location and expected service conditions.

1.13.2.3 Evaluation of equipment suitability

.1 Machinery and equipment manufacturers are to submit evidence of their machinery or equipment, that can operate under the required static and dynamic conditions stated in Table 1.13.1 and at least at the levels of shipboard accelerations as stated in 1.13.2.2 and/or specified in the Rules. Documentation of satisfactory performance is to take the form of:

- Report of testing under representative conditions; or
- Report of theoretical verification using recognized computational techniques accompanied by detailed and relevant validation data: or
- Historical data which provides relevant demonstration of satisfactory experience in service.

1.13.2.4 Installation and operation

.1 Machinery and equipment manufacturers are to submit details of the requirements /recommendations for installation of the machinery and equipment onboard to ensure satisfactory operation in service under the required static and dynamic conditions as described in Table 1.13.1 and at least at the levels of shipboard accelerations as stated in 1.13.2.2 and/or specified in the Rules.

Note: Consideration should be given for positioning machinery in order to minimize the dynamic load on bearings due to ship motion.

.2 Shipbuilders are to submit details demonstrating that the installation of the machinery and equipment onboard is in accordance with manufacturer's requirements /recommendations.

1.23 Surveys during construction

1.23.1 Machinery is to be surveyed at the manufacturer's works from the commencement of work until the final test under working conditions. The Surveyors are to be satisfied that the materials, workmanship and arrangements are satisfactory and in accordance with the Rules. For internal combustion engines, also refer Sec. 3.1.1.5

1.24.7 Testing of the control system of controllable pitch propellers

1.24.7.1 General

.1 The purpose of the tests is to ascertain that the pitch control system of controllable pitch propellers for main propulsion is working correctly.

1.24.7.2 Application

.1 The requirements in this sub-section apply to all new buildings and to all replacements, modifications, repairs, or re-adjustments that may affect the pitch control or response characteristics for main propulsion.

1.24.7.3 Scope of the tests

1.24.7.3.1 Pitch response test

.1 A full range of tests is to be carried out to get the pitch response and verify that it coincides with the combinator curve of the propeller (Note1). The tests are to be carried out for at least three positions of the control lever in ahead and astern directions (e.g., dead slow ahead / astern, half ahead / astern, full ahead / astern).

.2 The tests are to be carried out in normal and emergency operating conditions.

.3 Tests that are not affected by the control position may be carried out from one control position only.

Note1: The combinator curve is the relationship between the propeller pitch setting and the propeller speed.

1.24.7.3.2 Test of the fail-to-safe characteristics

.1 A test of the fail-to-safe characteristics of the propeller pitch control system is to be carried out to demonstrate that failures in the pitch command and control or feedback signals are alarmed and do not cause any change of thrust. Such failures are to be clearly identified and included in the test procedure.

1.24.7.3.3 Test procedure

.1 Test procedure is to be prepared and proposed by the pitch control system manufacturer or integrator and agreed with IRS.

1.24.7.4 Parameters to be recorded

.1 The list of the parameters to be recorded during the pitch response test is to be established by the pitch control system manufacturer or integrator and agreed with IRS. This is to at least the following parameters:

- Position of the control handle,
- Actual pitch indication (local indication, remote indications),
- Rotational speed of the propeller,
- Response time between the pitch change order (modification of the lever position) and the instant when the pitch and propeller speed have reached their final position,
- Propelling thrust variation during the transfer of the control from one location to another one.

1.24.7.5 Tests results

.1 Tests are to demonstrate:

- that the propelling thrust is not significantly altered when transferring control from one location to another and in case of failures in the pitch command and control or feedback signals.
- that the pitch response times measured during the test do not exceed the maximum value to be defined by the pitch control system manufacturer or integrator.

Section 2

Propulsion Shafting Systems

2.8 Design and Construction

2.8.15 Stern bushes and stern tube arrangement

2.8.15.2 The length of the aftmost propeller shaft bearing next to and carrying the propeller, whether the bearing is in a stern tube or in a strut is to be as follows:

a) For water lubricated bearings; the length is to be not less than 4 times the rule diameter for the tailshaft in way of the bearing;

i. For a bearing of synthetic material, consideration may be given to a bearing length not less than twice the rule diameter for the tail shaft in way of the bearing, provided the bearing design and material is substantiated by experiments to the satisfaction of IRS.

ii. Synthetic materials used for water lubricated aftmost propeller shaft bearings are to be type approved.

iii. For type approval testing requirement of synthetic material for the aftmost propeller shaft bearing, refer to IRS Classification Notes: *'Type approval testing of synthetic materials for aftmost propeller shaft bearings.'*

b) For bearings which are white-metal lined, oil lubricated and provided with an approved type of oil sealing gland;

i. the length of the bearing is to be not less than twice the rule diameter for the tailshaft in way of the bearing.

ii. the length of the bearing may be less provided the nominal bearing pressure will not exceed 0.8 [N/mm2] as determined by static bearing reaction calculation taking into account shaft and propeller weight which is deemed to be exerted solely on the aft bearing divided by the projected area of the shaft. However, the length of the bearing is to be not less than 1.5 times its actual diameter;

c) For bearings of cast iron, bronze which are oil lubricated and fitted with an approved oil sealing gland; the length of the bearing is, in general, to be not less than 4 times the rule diameter for tailshaft in way of bearing;

d) For bearings which are grease lubricated, the length of bearing is to be not less than 4 times the rule diameter for the tailshaft in way of the bearing;

e) For water lubricated bearings lined with two or more circumferentially spaced sectors of an approved plastics material, in which it can be shown that the sectors operate on hydrodynamic principles, the length of the bearing is to be such that the nominal bearing pressure will not exceed 0.55 [N/mm2]. The length of the bearing is not to be less than twice the rule diameter for the tail shaft in way of bearing;

f) For approved oil lubricated bearings of synthetic rubber, reinforced resin or plastic materials, the length of the bearing is to be not less than 2.0 times the rule diameter of the shaft in way of the bearing. The length of the bearing may be reduced provided the nominal pressure is not more than 6 bar as determined by static bearing reaction calculation taking into account shaft and propeller weight which is deemed to be exerted solely on the aft bearing divided by the projected area of the shaft. In any case the length is not to be less than 1.5 times the actual diameter. Where the material has proven satisfactory testing and operating experience, consideration may be given to an increased bearing pressure. Synthetic materials used for oil lubricated aftmost propeller shaft bearings are to be type approved. For type approval testing requirements of synthetic material for the aftmost propeller shaft

bearing, refer to IRS Classification Notes: *'Type approval testing of synthetic materials for aftmost propeller shaft bearings.'*

~~2.8.15.2 The length of the bearing in the sternbush next to and supporting the propeller is to be as follows:~~

~~a) For water lubricated bearings which are lined with rubber composition or staves of approved plastics material, the length is to be not less than four times the diameter required for the screw shaft under the liner.~~

~~b) For water lubricated bearings lined with two or more circumferentially spaced sectors, of an approved plastics material, without axial grooves in the lower half, the length of the bearing is to be such that the nominal bearing pressure will not exceed 0.55 [N/mm2]. The length of the bearing is to be not less than twice its diameter.~~

~~c) For bearings which are white-metal lined, oil lubricated and provided with an approved type of oil sealing gland, the length of the bearing is to be approximately twice the diameter required for the screw shaft and is to be such that the nominal bearing pressure will not exceed 0.8 [N/mm^2]. The length of the bearing is to be not less than 1.5 times its diameter.~~

~~d) For bearings of cast iron and bronze which are oil lubricated and fitted with an approved oil sealing gland, the length of the bearing is, in general, to be not less than four times the diameter required for the screw shaft.~~

~~Non metallic bearings are to be manufactured from approved material.~~

2.8.15.8 ~~Where sternbush bearings are oil lubricated, provision is to be made for cooling the oil by maintaining water in the after peak tank above the level of the sterntube or by other approved means. Means for ascertaining the temperature of the oil in the sterntube are also to be provided.~~ For vessels with tailshaft condition monitoring (TCM) notation, the following arrangements are to be provided/ requirements are to be met:

(a) Oil Lubricated Bearings:

i) Where sternbush bearings are oil lubricated, provision is to be made for cooling the oil by maintaining water in the after peak tank above the level of the sterntube or by other approved means. Means of ascertaining the temperature of the oil in the sternbush are also to be provided;

ii) At least two independent temperature sensors or other approved arrangements are to be provided for measuring the aft bearing temperature;

iii) The oil sealing glands used for sterntube bearings are to be of approved type;

iv) An arrangement for readily obtaining accurate oil samples is to be provided. The sampling point is to be taken from the lowest point in the lube oil system as far as practicable. Also, the arrangements are to be such as to permit the effective removal of the contaminants from the oil lubricating system. The oil sampling points are to be arranged with a test cock and fitted with a signboard;

v) Possible water content in stern tube lubricating oil is to be monitored by either a test kit provided onboard or by an accredited laboratory;

vi) An arrangement for bearing wear down measurements is to be provided. Hand operated gauges (like poker gauges) are considered to be acceptable.

(b) Water Lubricated Bearings:

i) An arrangement for bearing wear down measurements is to be provided. Hand operated gauges (like poker gauges) are acceptable. Where used, methods to remotely

monitor the aft propeller shaft bearing performance and wear are to be approved and provided with redundancy. Sensors used for wear down monitoring are to be of approved type. Where a single sensor is installed, spare sensor is to be kept onboard the ship. Documentation for trending of rate of bearing weardown obtained from performance monitoring devices is to be in place onboard;

ii) The lubricant sampling points are to be arranged with a test cock and fitted with a signboard. The open end of the sample pipe is to be located such that the condition of the lubricant and shafting arrangements are most accurately reflected. The sample is not to be taken downstream of filters fitted in the system;

iii) Filters in the system are to be provided with sufficient redundancy to ensure safe and uninterrupted operation of the propulsion system. Automatic start of pumps is to be arranged on failure of circulation of the lubricant below acceptable limits;

iv) Provision for alternative means of lubricant supply is to be arranged in order to maintain lubrication in case of loss of system integrity;

v) Monitoring of lubricant temperature, flow and pressure is to be provided on the lubricant supply piping to the stern tube with means of warning;

vi) Means of warning to detect contamination by sea water are to be provided (for closed loop systems);

vii) High/ low level alarm on the lubricant header tanks is to be provided;

viii) For closed loop systems, suitable provisions (such as relief valves, vents) for relieving the pressure are to be provided, if the system is capable of building up pressure above the maximum pressure, that the sealing devices are designed to.

Section 3

Prime Mover and Gearing

3.1 Diesel Engines

3.1.1 General Requirements

3.1.1.5 Engine type testing

3.1.1.5.2 Engines below 100[kW] including gear boxes used for propulsion and for essential auxiliary machinery may be accepted based on certificate from approved manufacturers. Engines of 100 (kW) and over including gear boxes used for propulsion and for essential machinery are to be type approved and undergo unit certification. Unit certification may be exempted for those engines approved in accordance with the Alternate Certification Scheme of IRS (Refer Pt.1, Ch. 1, Sec. 4 of the 'Rules and Regulations for the Construction and Classification of Steel Ships'.

3.1.2 Material, design and construction

3.1.2.6 For requirements related to storage and use of selective catalytic reduction (SCR) reductants, refer to Part 4, Chapter 4, Section 4, 4.14 of the 'Rules and Regulations for the Construction and Classification for Steel Ships'. The requirement for reductant tanks to be "of steel or other equivalent material" (as specified in 4.14.2.10 of Part 4, Chapter 4, Section 4 of the above Rules) with a melting point above 925 [°C].

3.1.8 AC generating sets

3.1.8.1 General

3.1.8.1.1 This sub-section provides requirements for AC Generating sets (i.e. reciprocating internal combustion engines, alternators and couplings), in addition to those stated in this Chapter and Ch.7.

3.1.8.1.2 The requirements are applicable to AC generating sets driven by reciprocating internal combustion engines irrespective of their types (i.e. diesel engine, dual fuel engine, gas-fuel engine), except for those sets consisting of a propulsion engine which also drives power take off (PTO) generator(s).

3.1.8.2 Requirements

3.1.8.2.1 The generating set is to show torsional vibration levels which are compatible with the allowable limits for the alternator, shafts, coupling and damper.

3.1.8.2.2 The coupling selection for the generating set is to take into account the stresses and torques imposed on it by the torsional vibration of the system. The torsional vibration calculations are to be submitted to IRS for approval when the engine power is 110 [kW] or above.

3.1.8.2.3 The rated power is to be appropriate for the actual use of the generator set.

3.1.8.2.4 The firm responsible for assembling the generating set is to install a rating plate marked with at least the following information:

i) the generating set manufacturer's name or mark;

ii) serial number of the set;

iii) date of manufacture (month/year) of the set;

iv) the rated power (both in kW and KVA) with one of the prefixes COP, PRP (or, only for emergency Generating sets, LTP) as defined in ISO 8528-1:2018;

v) the rated power factor;

vi) the set rated frequency [Hz];

vii) the set rated voltage [V];

viii) the set rated current [A]; and

ix) the mass [kg].

--subsequent clauses and subclauses are suitably renumbered--

End Of Chapter

Chapter 15

Ships with Integrated Platform Management System

Contents

Section 2

System Design

2.3 Control systems

2.3.3 Protection against flooding

2.3.3.1 Bilge wells in periodically unattended machinery spaces are to be located and monitored in such a way that the accumulation of liquids is detected at normal angles of trim and heel, and are to be large enough to accommodate easily the normal drainage during unattended period.

2.3.3.2 Where the bilge pumps are capable of being started automatically, means are to be provided to indicate when the influx of liquid is greater than the pump capacity or when the pump is operating more frequently than would normally be expected. In these cases, smaller bilge wells to cover a reasonable period of time may be permitted. Where automatically controlled bilge pumps are provided, special attention is to be given to oil pollution prevention requirements.

2.3.3.3 The location of the controls of any valve serving a sea inlet, a discharge below the waterline or a bilge injection system is to be so sited as to allow adequate time for operation in case of influx of water to the space, having regard to the time likely to be required to reach and operate such controls. If the level to which the space could become flooded with the ship in the fully loaded condition so requires, arrangements are to be provided to operate the controls from a position above such level.

IR 2.3.3.3.1 'Bilge injection system' referred above is same as 'Emergency bilge suction' referred in Ch.11, Sec 1.3.8 which is used to discharge overboard large quantities of sea water accumulated in engine room bilges using the main circulating pump or another suitable pump as permitted by Ch.11, Sec 3.7.4.

IR 2.3.3.3.2 The requirements for the controls are referred in 2.3.3.3 above are not applicable to valves serving an emergency bilge system provided:

(1) The emergency bilge valve is normally maintained in a closed position;

(2) A non-return device is installed in the emergency bilge piping; and

Note: A normally closed non-return valve with positive means of closing is considered to satisfy both (1) and (2) above.

(3) The emergency bilge suction piping is located inboard of a shell valve (overboard valve) that is fitted with the control arrangements required by 2.3.3.3.

2.4 Alarm systems

2.4.1 An alarm system is to be provided indicating any fault requiring attention and is to :

a) be capable of sounding an audible alarm in the main machinery control room or at the propulsion machinery control station, and indicate visually each separate alarm function at a suitable position;

b) have a connection to the public rooms and to each of the engineers' cabins through a selector switch, to ensure connection to at least one of those cabins. Equivalent arrangements will be specially considered;

c) activate an audible and visual alarm on the navigating bridge for any situation which requires action by or attention of officer on watch;

d) as far as is practicable be designed on the fail-to-safety principle; and

e) activate an alarm in the engineers accommodation if an alarm function has not received attention locally within a limited time.

~~e)~~f) satisfy the requirements of IRS Classification Notes "*Type Approval of Electrical Equipment used for Control, Monitoring, Alarm and Protection Systems for use in Ships" and the SOTRs for the specific vessel.*

2.7 Automatic start/connection of diesel generator units by Automated Power Management System (APMS)

2.7.9 If there is no arrangement for automatic synchronization, paralleling and load sharing, direct connection of generator to bus bar through closing of generator circuit breaker is to be possible only when there are no generators on the bus bar. ~~connection is only to be possible when auxiliary contacts on the generator circuit breakers show directly that all generators are disconnected from the main switchboard.~~

Section 3

~~Ships fitted with Internal Combustion Propulsion Engines of 1000[kW] or more~~Requirements for Monitoring

3.1 Extent of monitoring

3.1.11 The fault conditions listed below are to effect an alarm requiring manual stop or alternatively automatic stop:

- lubricating oil pressure, inlet engine, low;
- lubricating oil pressure, inlet gear, low;
- thrust bearing temperature, high;
- crankcase explosive conditions for medium and high speed engines(for cylinder dia > 300 [mm] or engine power ≥ 2250 kW).

For transmitters for propulsion engines in Table 3.1.1, refer Note 7) in Table 3.1.1.

~~The above alarms are to have separate transmitters and in addition to the transmitters required by Table 3.1.1 and Table 3.1.4.~~The alarm for gear is to have separate transmitter and in addition to the transmitters required by Table 3.1.4.

Table 3.1.1 : Cross-Head Diesel Engines

	Gr 1 (Common sensor)			Gr 2	Gr 3
Monitored parameters for cross-head diesel engines	**Remote Indication**	**Alarm activation**	**Slow down with alarm**	**Automatic start of standby pump with alarm**	**Shut down with alarm**
2.0 Lubricating oil system					
Activation of oil mist detection arrangements (or activation of the temperature monitoring systems or equivalent devices of:- the engine ~~M~~main, crank~~,~~ and crosshead bearing~~,~~ oil outlet; or – the engine main, crank and crosshead bearing)[3] ~~temp or Oil mist concentration in crankcase~~[3]		~~high~~x	x		
3.0 Turbocharger system					
Speed of turbocharger[11]	x	high			

Notes :

11 Only required for turbochargers of categories B and C (see IRS Classification Note *"Approval of IC Engines"*)

Table 3.1.2 : Trunk-Piston Engines					
	Gr 1 (Common Sensor)			**Gr 2**	**Gr 3**
Monitored parameters for trunk-piston diesel engines	**Remote Indication**	**Alarm activation**	**Slow down with alarm**	**Automatic start of standby pump with alarm**	**Shut down With alarm**
2.0 Lubrication oil system					
~~Oil mist concentration in crankcase~~[3] Activation of oil mist detection arrangements (or activation of the temperature monitoring systems or equivalent devices of:- the engine main, crank and crosshead bearing oil outlet; or- the engine main, crank and crosshead bearing)[3]		high			x
3.0 Turbocharger system					
Speed of turbocharger[9]	x	high			

Notes :

3 Alarm and automatic shut off is to be provided for Engines of 2250 [KW] and above or having cylinders of more than 300 [mm] bore. For each engine one oil mist detector (or engine bearing temperature monitoring system or equivalent device) ~~for each engine~~ having two independent outputs for initiating the alarm and shut-down would satisfy the requirement for independence between alarm and shut-down system.

9 Only required for turbochargers of categories B and C (see IRS Classification Note "*Approval of IC Engines"*)

Table 3.1.5 : Monitoring of Electric Power Generating Plant				
System		**Required monitoring (stated by an x)**		**Comments**
		Alarm	**Automatic shut down of prime mover with alarm**	
Generators driven by trunk piston IC engines	Lubricating oil pressure, low	x	x	
	Lubricating oil temperature, high	x		
	Fuel oil leakage from high pressure pipes	x		
	~~Oil mist concentration in crank case, high~~[4] Activation of oil mist detection arrangements (or activation of the temperature monitoring systems or equivalent devices of:- the engine main and crank bearing oil outlet; or- the engine main, crank bearing)[1]	x	x	
	Pressure or flow of cooling water, low	x		
	Temperature of cooling water or cooling air, high	x		
	Level in cooling water expansion tank, low	x		If not connected to main system
	Level in fuel oil daily service tank, low	x		
	Starting air pressure, low	x		
	Over speed activated		x	
	Fuel oil viscosity before injection pumps or fuel oil temp before injection pumps, low/ high	x		For heavy fuel oil burning engines only
	Exhaust gas temperature after each cylinder, high	x		For engine power above 500 kW/cyl
	Common rail servo oil pressure, low	x		
	Common rail fuel oil pressure, low	x		
	~~Voltage, high~~Speed of turbocharger high	x		Only required for turbochargers of categories B and C (see IRS Classification Note "Approval of IC Engines")
	Voltage, low	x		
	Frequency, low	x		
	Disconnection of non-essential consumers	x		

	1. Alarm and automatic shut off is to be provided for Engines of 2250 [KW] and above or having cylinders of more than 300 [mm] bore. For each engine ~~O~~one oil mist detector (or engine bearing temperature monitoring system or equivalent device) ~~for each engine~~ having two independent outputs for initiating the alarm and shut-down would satisfy the requirement for independence between alarm and shut-down systems.

Section 6

Testing of the System

6.2 Environmental testing

6.2.1 The IPMS hardware is to be qualified for usage in marine environment. Test Certificates are to be provided indicating compliance with relevant test requirements. Test requirements specified in IRS Classification Note *"Type approval ~~certification scheme~~ of Electrical equipment used for Control, Monitoring, Alarm and Protection Systems for use in Ships"*, would be generally applicable.

End of Chapter

Chapter 16

Integrated Bridge System

Contents

Section 1

General

1.1 Application

1.1.1 ~~This chapter provides the requirements for integrated bridge system that allows simplified and centralized bridge operation of the main functions of navigation, communication and manouvering of the vessel including monitoring of such critical systems.~~The requirements in this Chapter are intended to achieve a successful ergonomic design of the bridge and bridge equipment, which will improve the reliability and efficiency of navigation. These contain ergonomic requirements as well as functionality-oriented bridge layout to support watch-keeping personnel in their tasks by a user-centric design of the bridge equipment and layout.

1.1.2 Ships complying with the requirements of the chapter may be assigned additional Class notations **BD**, **BDS** or **IBS** as indicated in 1.1.3 to 1.1.5. ~~fitted with integrated bridge system complying with the requirements of this chapter will be eligible to be assigned additional class notation 'IBS'.~~

1.1.3 Additional class notation '**BD**' (Bridge Design) will be assigned to ships complying with requirements of Section 1 through Section 3 of this Chapter, as applicable. Requirements for bridge design and layout are indicated in these Sections.

1.1.4 Additional class notation '**BDS'** (Bridge Design and Systems) will be assigned to ships complying with requirements of Section 1 through Section 4 of this Chapter, as applicable. Requirements for vital equipment and systems are indicated in Section 4.

~~1.1.2~~1.1.5 Additional class notation '**IBS'** (Integrated Bridge System) will be assigned to ships fitted with integrated bridge system which allows simplified and centralized bridge operation of the main functions of Navigation, Communication and Manoeuvering of the vessel including monitoring of such systems, and complying with Section 1 through Section 8 of this Chapter, as applicable.

1.2 Functional requirements

1.2.1 Following functions are to be carried out from the integrated bridge system

- Passage execution will cover -

i) route monitoring
ii) route planning

- External and internal ~~C~~communications ~~system~~related to safety in bridge operations and distress situations.
- Monitoring of machinery installations
- Navigational safety and security including collision avoidance.

1.2.2 Pollution monitoring and monitoring of HVAC may also be carried out from the integrated bridge system if considered necessary by Coast Guard Authority.

1.3 Reference testing and performance standards

1.3.1 The following international standards and IMO requirements are referred to in this ~~chapter~~Chapter.

- IEC 60945:~~1996~~2002, Maritime navigation and radio-communication equipment and systems – General requirements – Methods of testing and required test results.

- IEC:61162 (all parts) Maritime navigation and radio-communication equipment and systems – Digital interfaces.

- IEC 61174:2015 - Electronic Chart Display and Information System (ECDIS) – Operational and performance requirements, methods of testing and required test results.

- ISO 8468:~~1990~~ 2007 – Ship's bridge layout and associated equipment – requirements and guidelines.

~~a) IMO International Convention for the Safety of Life at Sea (SOLAS), as amended.~~

- IMO A.823(19) – Performance standards for automatic radar plotting aids (ARPAs).

- IMO A.1021(26)~~830(19)~~ – Code on ~~alarms~~ alerts and indicators 2009. ~~(amendments to IMO 686:1991).~~

- IMO A.694(17) – General requirements for shipborne radio equipment forming part of the global maritime distress and safety system (GMDSS) and for electronic navigational aids.

- SN.1/Circ.288 – Guidelines for Bridge Equipment and Systems, their Arrangement and Integration (BES)

- IMO MSC.Res.302(87) – Adoption of performance standards for Bridge Alert Management

~~b) IMO MSC.64(67) – Annex I – Performance standards for integrated bridge systems.~~

~~c) IMO MSC.64(67) – Annex 4 – Recommendation on performance standards for radar equipment.~~

- IMO MSC/Circular 566:1991 – Provisional guideline on the conduct of trials in which the officer of the navigational watch acts as the sole lookout in periods of darkness.

- IMO MSC.Res.252(83) (as amended by MSC.Res.452(99)) – Performance standards for integrated navigation systems.

1.4 Definitions

1.4.1 Configuration of complete system : all operational functions of the IBS bridge as installed.

1.5 Abbreviations

1.5.1 Abbreviations used in this Chapter :

GLONASS	Global Orbiting Navigating ~~satellite~~Satellite Systems

~~**1.6 Equipment list**~~

~~1.6.1 The list of equipment required for IBS notation is to be as given in Table 6.1.~~

Section 2

Documentation

2.1 Documents to be submitted

2.1.2 The documents/details given below are required to be submitted for **BD, BDS and IBS** notations:
A complete layout and dimensional details of the bridge area and workstations installed therein. This is to include:

a) Arrangements of windows, including dimensions and angles of inclination, dimensions of frames, height above deck surface of upper and lower edges, type of glass and details of clear view arrangements (wipers, fresh water wash, de-icing / de-misting, sunscreens, etc.)

b) Fields of vision from the bridge workstations, including any blind sectors caused by obstructions outside of the wheelhouse.

c) Location and arrangement of workstations, including dimensions of consoles, layout of instrumentation and controls, handrails, seating, etc.

d) Clearances between floor and ceiling or between floor and the underside of ceiling mounted instruments, throughout the wheelhouse.

e) Arrangements for the general illumination of the bridge and the individual illumination of workstation instruments and controls.

f) Details of wheelhouse ventilation and heating systems.

g) Details of internal communication systems operable from the bridge.

h) Arrangements / details of exterior catwalk in front of bridge windows.

i) Details of non-skid flooring

j) Details of wheelhouse doors, including hold-back arrangements.

k) Location of toilet.

l) Arrangements for drainage of bridge decks.

m) Arrangements / details as to the measures to be taken to minimize hazards to personnel.

2.1.3 All electrical and electronic appliances installed on the bridge and vicinity of the bridge (also refer Section 4, Cl. 4.6) other than mandatory navigation and communication equipment; having been type tested according to IEC 60945:2002 (EMC tested for conducted and radiated emission), as well as loose equipment placed on board by the builder or owner are to be listed, and be provided with at least the following information. The list and the evidence of equipment are to be kept onboard.

- Equipment description
- Manufacturer
- Type / Model
- Evidence of EMC compatibility which may be:
    - type approval certificate covering EMC requirements for bridge installations;
    - test certificate or report / conformity statement; or exemption statement.

~~2.1.2 A list of navigational equipment. This is to include for each item the manufacturer's name and code number, together with copies of relevant type approval certificates.~~

~~2.1.3 A complete operational description of the relevant monitoring systems including a list of alarms and displays. This may be accomplished by means of simplified block diagrams of navigation equipment, internal communication systems and watch monitoring and alarm transfer systems and central alarm panel (where provided) including a list of alarms.~~

~~2.1.4 A simplified one-line diagram of power supplies to the bridge equipment, circuit protection ratings and settings, cable sizes, rating of connected loads, detailed description and interactions, etc.~~

~~2.1.5 Operating / technical manuals for the installed navigational equipment / systems is to be submitted for information.~~

~~2.1.6 Sea trial test schedule.~~

~~2.1.7 Details and arrangements of the workstations and systems.~~

~~2.1.8 The sea trial program is to include test details of the electronic chart display and information systems (EDCIS) and integrated bridge system (IBS).~~

Section 3

~~System Requirements~~Bridge Design

3.1 ~~General~~Bridge Design

3.1.1 General

a) The bridge is to be designed and arranged with the aim of:

- Facilitating tasks to be performed by the bridge team and the pilot in making full appraisal of the situation and in navigating the ship safely under all operational conditions.
- Promoting effective and safe bridge resource management.
- Allowing for expeditious, continuous and effective information processing and decision-making by the bridge team and the pilot.

- Preventing or minimizing excessive or unnecessary work and any condition or distraction on the bridge which may cause fatigue or interfere with the vigilance of the bridge team and the pilot.

b) The design of bridge is to be governed by:

- The functions and related tasks to be carried out on the bridge, systems used and methods of task performance.

- The fields of vision required for visual observations from each of the workstations.

- Composition of the bridge team and the procedures required for safe operations under all identified conditions.

- The type and range of equipment to be provided for performance of the tasks at the individual workstations and elsewhere on the bridge.

- Performance standards for equipment mentioned in 1.3.

3.1.2 Arrangement

a) Consoles, including the chart table, are to be positioned, so that the instrumentation they contain is mounted in such a manner as to face a person looking forward. As far as practicable, operating surfaces are to be normal to the operator's line of sight.

b) From other workstations within the wheelhouse it is to be possible to monitor the navigation workstation and to maintain an effective lookout.

c) The main access to the bridge is to be by means of an internal stairway. Secondary external access is also to be provided.

d) Clear passage of at least 700 [mm] width is to be available to allow movement around the bridge with a minimum of inconvenience. Particular attention is to be paid to the following routes which are to be as direct as possible:

- From bridge wing to bridge wing, a clear passage of at least 1200 [mm] in width;

- Between the internal entrance to the bridge and the route as above a clear passage of at least 700 [mm] in width is to be provided;

- Between adjacent workstations, a clear passage of at least 700 [mm] is to be provided.

e) The distance from the bridge front bulkhead or from any console and installation placed against the front bulkhead, to any console or installation placed away from the bridge front is to be preferably 1000 [mm] and not less than 800 [mm].

f) Space necessary for operating at a workstation is to be considered as part of the workstation and is not to be part of the passageway.

g) The clear height between the wheelhouse deck surface covering and the underside of the deckhead is to be at least 2250 [mm]. The lower edge of deckhead mounted equipment is to be at least 2100 [mm] in open areas, passageways and at standing workstations.

h) The height of entrances and doors to the wheelhouse from adjacent passageways is to be at-least 2000 [mm].

i) All wheelhouse doors are to be operable with one hand. Bridge wing doors are not to be self-closing and means are to be provided to hold the doors open.

j) Toilet facilities are to be provided on or adjacent to the bridge.

3.1.3 Lighting

3.1.3.1 The level of lighting is to enable bridge personnel to perform all bridge tasks, including maintenance and chart and office work, by day and night. Controls, indicators, instruments, keyboards, etc. on the bridge are to be capable of being seen in the dark, either by means of internal lighting within the equipment or the wheelhouse lighting system. A satisfactory level of flexibility within the lighting system is to be available to enable the bridge personnel to adjust the lighting in brightness and direction as required in different areas of the bridge and by the needs of individual instruments and controls.

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

3.1.4 Field of Vision

3.1.4.1 It is to be possible to observe all objects necessary for navigation, including other traffic and navigation marks, in any direction from inside the wheelhouse. In this respect, there is to be a field of view around the ship of 360º obtained by an observer moving within the confines of the wheelhouse.

3.1.4.2 The view of the sea surface from the conning position and the navigation workstation is not to be obscured by more than two ship lengths, or 500 [m], whichever is less, forward of the bow to 10° on either side, irrespective of the ship's draught, trim and deck cargo.

3.1.4.3 Blind sectors caused by cargo, cargo gear and other obstructions outside of the wheelhouse forward of the beam obstructing the view of the sea surface as seen from the conning position and the navigation workstation are not to exceed 10º each. The total arc of blind sectors is not to exceed 20º and the clear sector between blind sectors shall be at least 5º. However, in the view described in 3.1.4.2 each individual blind sector is not to exceed 5 º.

3.1.4.4 The horizontal field of vision from the conning position and the navigation workstation is to extend over an arc from more than 22.5 º abaft the beam on one side, through forward, to more than 22.5 º abaft the beam on the other side.

3.1.4.5 From the main steering position, the field of vision is to extend over an arc from dead ahead to at least 60 º on each side.

3.1.4.6 From each bridge wing, the field of vision is to extend over an arc from at least 45 º on the opposite bow through dead ahead and then aft to 180 º from dead ahead.

3.1.4.7 There is to be a line of sight from the port wing to the starboard wing through the wheelhouse.

3.1.4.8 The ship's side is to be visible from the bridge wing.

3.1.4.9 From work stations for functions other than navigation, the field of vision is to enable an effective lookout to be maintained and, in this respect, is to extend at least over an arc from 90 º on the port bow, through forward, to 22.5 º abaft the beam on the starboard side.

~~3.1.1 The IBS is to comply with all applicable statutory requirements as defined in para 1.3. Parts of the system executing multiple operations are to meet the requirements specified for each individual function they can control, monitor or perform.~~

~~3.1.2 Each part of a IBS is to meet the relevant requirements of IMO Resolution A.694(17) (as amended) as detailed in IEC 60495.~~

~~3.1.3 Any additional requirements of Coast Guard authority including system configuration are also to be complied with.~~

~~3.2 Integration~~

~~The system should provide functional integration meeting the following requirements:~~

~~a) The functionality of the IBS should ensure that its operation is at least as effective as for stand-alone equipment.~~

~~b) Continuously displayed information should be reduced to the minimum necessary for safe operation of the ship. Supplementary information should be readily accessible.~~

~~c) Where multifunction displays and controls are used to perform functions necessary for safe operation of the ship they should be duplicated and interchangeable.~~

~~d) It should be possible to display the complete system configuration, the available configuration and the configuration in use.~~

~~e) Each part to be integrated should provide details of its operational status and the latency and validity of essential information. Means should be provided within the IBS to make use of this information.~~

~~f) An alternative means of operation should be provided for essential functions.~~

~~g) An alternative source of essential information should be provided. The IBS should identify loss of either source.~~

~~h) The source of information (sensor, result of calculation or manual input) should be displayed continuously or upon request.~~

~~i) IBS is to be integrated with following ship systems:~~

- ~~Ring Laser Gyros~~
- ~~Echo Sounder~~
- ~~Anemometer~~
- ~~EM Log~~
- ~~GPS~~
- ~~Steering System with Autopilot~~
- ~~Analog Video of Navigation Radar~~
- ~~Radar Data Distribution Unit (RDDU)~~
- ~~Automatic Identification System (AIS)~~
- ~~Integrated Platform Management System (including CCTV)~~
- ~~Radio Receiver Beacon (RRB)~~
- ~~Transmitting Magnetic Compass~~
- ~~Any other system as identified by Indian Navy.~~

~~3.3 Data exchange and data logging~~

~~3.3.1 Interfacing within the IBS is to comply with IEC 61162 (as amended), as applicable.~~

~~3.3.2 Data exchange is to be consistent with safe operation of ship.~~

~~3.3.3 The integrity of the data flowing on the network is to be ensured.~~

~~3.3.4 A failure in the connectivity is not to affect independent functionality.~~

~~3.3.5 The network is to be such that in the event of a single failure between nodes a clear indication of the failure is available, the sensors and displays on the network continue to operate and the data transmission between them is maintained.~~

~~3.4 Failure analysis~~

~~3.4.1 A failure analysis is to be performed and documented.~~

~~3.4.2 Parts, functions and connectivity are to be identified.~~

~~3.4.3 Possible failures of parts and connectivity associated with essential functions and information are to be identified.~~

~~3.4.4 Consequences of failures with respect to operation, function or status of the IBS are to be identified.~~

~~3.4.5 Each failure is to be classified with respect to its impact on the IBS taking into account relevant characteristics, such as detectability, diagnosability, testability, replaceability and compensating and operating provisions.~~

~~3.4.6 The results of the failure analysis are to confirm the possibility of continued safe operation of the ship.~~

~~3.5 Quality Assurance~~

~~3.5.1 The IBS is to be designed, developed, produced, installed and serviced by companies certified to ISO 9001:2000 Standard.~~

~~3.6 Alarm management~~

~~3.6.1 The IBS alarm management, as a minimum, is to comply with the requirements of "IRS Type approval certification scheme of Electrical equipment used for Control, Monitoring, Alarm and Protection Systems for use in Ships".~~

~~3.6.2 Appropriate alarm management on priority and functional groups is to be provided within the IBS.~~

~~3.6.3 The number of alarm types and their release are to be kept as low as possible by providing indications for information of lower importance.~~

~~3.6.4 Alarms are to be displayed so that the alarm reason and resulting functional restrictions can be easily understood. Indications are to be self-explanatory.~~

~~3.6.5 Alarms are to be prioritized as follows:~~

~~a) emergency alarms : Alarms which indicate that immediate danger to human life or to the ship and its machinery exists and that immediate action is to be taken.~~

~~b) Distress, urgency and safety alarms: Alarms which indicate that a mobile unit or a person is in distress, or the calling station has a very urgent message concerning the safety of the mobile unit or person ,or has an important warning to transmit.~~

~~c) Primary alarms : Alarms which indicate a condition that requires prompt attention to prevent an emergency condition as specified in statutory and classification rules and regulations.~~

~~d) Secondary alarms : Alarms which are not included above.~~

~~3.6.6 The following alarms are to be provided and are to be centralized for efficient identification. Repeater displays may be fitted on the bridge wings and at other appropriate positions on the bridge where necessary.~~

- ~~Off course~~
- ~~Off track (where automatic track following is provided)~~
- ~~Way point approaching, (where automatic track following is provided)~~
- ~~Position fix inaccurate/lost~~
- ~~Loss of heading input~~
- ~~Loss of speed log input~~
- ~~Equipment or sub-system failure~~
- ~~Gyro mis-match~~

- Echo sounder
- Radar CPA
- Navigational light failure
- Steering gear alarms
- Bridge navigational watch alarm system failure.

The audible alarms at the central panel and the relevant workstation are to be silenced when acknowledged from either location. However, it is to be possible to acknowledge the flickering light and bring to steady state only from the relevant work station.

3.6.7 Manual adjustment of any of the facilities of the integrated bridge system is to reset automatically the watch safety interval timer.

3.7 Power system requirement

3.7.1 Power interruptions and shutdown

3.7.1.1 If subjected to an orderly shut-down, the IBS should, upon turn-on, come to an initial default state.

3.7.1.2 After a power interruption full functionality of the IBS should be available after recovery of all subsystems. The IBS should not increase the recovery time of individual subsystem functions after power restoration.

3.7.1.3 If subjected to a power interruption the IBS should, upon restoration of power, maintain the configuration in use and continue automated operation, as far as practicable. Safety related automatic functions should only be restored upon confirmation by the operator.

3.7.2 Power supply

3.7.2.1 Attention is drawn to the relevant statutory requirement in respect of power supply to IBS which are to be complied with.

3.7.2.2 The power to IBS should be supplied from :

a) The main and emergency sources of electrical power with automated changeover through a local distribution board with provision to preclude inadvertent shutdown.

b) A transitional source of electrical power for a duration of not less than 1 min; and

c) Where required, parts of the IBS should also be supplied from a reserve source of electrical power.

d) Uninterrupted power supplies : Each vital item in the IBS shall be connected to an UPS. The UPS shall supply this vital IBS equipment with continuous power during a loss of ships power for a minimum period of 60 minutes. The UPS shall prevent power transients as ship service power is lost and restored such that no loss of control or mal-operation of the IBS units results from these transitions. Battery charge circuits within each unit shall be capable of recharging the battery from 40% capacity to 80% capacity within 8 hours. They shall be protected from undercharge and overcharge. Battery charging shall be automatic and shall not affect normal unit operation.

3.8 Communication systems

3.8.1 A telephone system is to be provided to enable two-way speech communication between the wheelhouse and at least in the following locations:

- machinery control station space;

- emergency steering position in the steering gear compartment;

~~— commanding officers' and navigating officers' cabins, offices, mess and public rooms.~~

~~3.8.2 The bridge control is to have priority over the system.~~

~~3.8.3 A list of extension numbers is to be clearly displayed adjacent to each telephone.~~

3.2~~9~~ Environmental conditions

3.9.1 An adequate air conditioning or mechanical ventilation system ~~(upto 45°C ambient temperature)~~, together with sufficient heating according to climatic conditions, is to be provided in order to maintain the temperature within 22°C to 30°C and the humidity within the range 20 percent to 60 percent. The discharge of hot or cold air is not to be directed towards bridge personnel. Control of this system is to be provided in the wheelhouse.

~~**3.10 EMI / EMC**~~

~~3.10.1 Electrical and electronic equipment are to be installed so that electromagnetic interference does not affect the proper functioning of the navigational systems and equipment. Installation of the equipment in accordance with the guidelines and recommendations included in IEC 60533 Electrical and electronic installations in ships – Electromagnetic compatibility or an acceptable equivalent standard would generally be considered to meet the requirement.~~

Section 4

~~Operational and Technical Requirements~~Bridge Design and Systems

4.1 ~~Human factors~~Documentation

4.1.1 In addition to the documents indicated in Section 2, the following are to be submitted for **BDS** notation:

(a) A list of navigational equipment. This is to include for each item, the manufacturer's name and code number, together with copies of relevant type approval certificates. The workstations with navigational equipment are to be fitted in line with requirements of Table 6.1 (for navigation and traffic surveillance, monitoring, manual steering and docking);

(b) A complete operational description of the relevant monitoring systems including a list of alarms and displays. This may be accomplished by means of simplified block diagrams of navigation equipment, internal communication systems and watch monitoring and alarm transfer systems and central alarm panel (where provided) including a list of alarms;

(c) A simplified one-line diagram of power supplies to the bridge equipment, circuit protection ratings and settings, cable sizes, rating of connected loads, detailed description and interactions, etc.;

(d) Operating / technical manuals for installed navigation equipment / systems;

(e) Sea trial test schedule.

~~4.1.1 The IBS is to be capable of being operated by personnel holding appropriate certificates.~~

~~4.1.2 The man-machine interface (MMI) is to be designed to be easily understood and in a consistent style for all integrated functions.~~

~~4.1.3 Operational information is to be presented in a readily understandable format without the need to transpose, compute or translate.~~

~~4.1.4 Indications, which may be accompanied by a short low intensity acoustic signal are to occur when:~~

~~- An attempt is made to execute an invalid function~~
~~- An attempt is made to use invalid information.~~

~~4.1.5 If an input error is detected by the system it is to require the operator to correct the error immediately. Messages actuated by an input error are to guide the correct responses, e.g. not simply "Invalid entry", but "Invalid entry, re-enter set point between 0 to 100".~~

~~4.1.6 Layered menus are to be presented in a way which minimizes the added workload to find and return from the desired functions.~~

~~4.1.7 An overview is to be easily available to assist the operator in the use of a multiple page system. Each page is to have a unique identifier.~~

~~4.1.8 Where multi-function displays are used, they are to be in colour. Continuously displayed information and functional areas, e.g. menus, are to be presented in a consistent manner.~~

~~4.1.9 For actions which may cause unintended results, the IBS is to request confirmation from the operator.~~

~~Note 1 : Examples of such actions are:~~

~~- Attempting to change position and next waypoint while in track mode steering.~~

~~- Attempting to switch on bow thruster when insufficient electrical power is available.~~

~~4.1.10 Functions requested by the operator are to be acknowledged or clearly indicated by the IBS on completion.~~

~~4.1.11 Default values, where applicable, are to be indicated by the IBS when requesting operator input.~~

~~4.1.12 The size, colour and density of text and graphic information presented on a display are to be such that it may be easily read from the normal operator position under all operational lighting conditions. (Ref ISO 8468-6.2.3).~~

~~4.1.13 Symbols used in mimic diagram are to be standardized throughout the system's displays.~~

~~4.1.14 All information is to be presented on a background providing high contrast and emitting as little light as possible at night.~~

~~4.2 Bridge layout~~

~~4.2.1 General~~

~~a) The bridge shall be designed and arranged with the aim of:~~

~~- Facilitating the tasks to be performed by the bridge team and the pilot in making full appraisal of the situation and in navigating the ship safely under all operational conditions.~~

~~- Promoting effective and safe bridge resource management.~~

~~- Allowing for expeditious, continuous and effective information processing and decision-making by the bridge team and the pilot.~~

~~- Preventing or minimizing excessive or unnecessary work and any condition or distraction on the bridge which may cause fatigue or interfere with the vigilance of the bridge team and the pilot.~~

~~b) The design of bridges is to be governed by:~~

~~- The functions and related tasks to be carried out on the bridge, systems used and methods of task performance.~~

~~- The range, layout and location of workstations required for performance of bridge functions~~

~~- The fields of vision required for visual observations from each of the workstations.~~

~~- Composition of the bridge team and the procedures required for safe operations under all identified conditions.~~

~~- The type and range of equipment to be provided for performance of the tasks at the individual workstations and elsewhere on the bridge.~~

4.2.~~2~~ Arrangement

a) The bridge configuration, arrangement of consoles and equipment location are to be such as to enable the officer of the watch to perform navigational tasks and other functions allocated to the bridge, as well as maintain an effective lookout. The following tasks are to be supported:

- Navigation and manoeuvring;
- Monitoring;

- Manual steering;
- Docking;
- Voyage planning;
- Safety;
- Communications; and
- Conning.

b) Equipment and associated displays and indicators are to be sited at clearly defined workstations.

c) Consoles, including the chart table, are to be positioned, so that the instrumentation they contain is mounted in such a manner as to face a person looking forward. As far as practicable, operating surfaces are to be normal to the operator's line of sight.

~~d) From other workstations within the wheelhouse it is to be possible to monitor the navigation workstation and to maintain an effective lookout.~~

~~e) The main access to the bridge is to be by means of an internal stairway. Secondary external access is also to be provided.~~

~~f) Clear passage of at least 700 [mm] width is to be available to allow movement around the bridge with a minimum of inconvenience. Particular attention is to be paid to the following routes which are to be as direct as possible:~~

~~o From bridge wing to bridge wing, a clear passage of at least 1200 [mm] in width.~~
~~o Between the internal entrance to the bridge and the route above a clear passage of at least 700 [mm] in width is to be provided.~~
~~o Between adjacent workstations, a clear passage of at least 700 [mm] is to be provided.~~

~~ii) Between the bridge front bulkhead or any consoles and installations placed against the front bulkhead, to any consoles or installations placed away from the bridge front, a clear passage of at least 800 [mm] is to be provided.~~

~~iii)~~ d) Space necessary for operating at a workstation is to be considered as part of the workstation and is not to be part of the passageway.

~~g) The clear height between the wheelhouse deck surface covering and the underside of the deckhead is to be at least 2250 [mm]. The lower edge of deckhead mounted equipment is to be at least 2100 [mm] in open areas, passageways and at standing workstations.~~

~~h) Toilet facilities are to be provided on or adjacent to the bridge.~~

4.3 ~~Lighting~~Communication System

4.3.1 A telephone system is to be provided to enable two-way speech communication between the wheelhouse and at least in the following locations:

- machinery control station space;
- emergency steering position in the steering gear compartment;
- Commanding Officer's and navigating officers' cabins, offices, mess and public rooms.

4.3.2 The bridge is to have priority over the system.

4.3.3 A list of extension numbers is to be clearly displayed adjacent to each telephone.

~~4.3.1 The level of lighting is to enable bridge personnel to perform all bridge tasks, including maintenance and chart and office work, by day and night. Controls, indicators, instruments, keyboards, etc. on the bridge are to be capable of being seen in the dark, either by means of internal lighting within the equipment or the wheelhouse lighting system. A satisfactory level of flexibility within the lighting~~

~~system is to be available to enable the bridge personnel to adjust the lighting in brightness and direction as required in different areas of the bridge and by the needs of individual instruments and controls.~~

~~4.3.2 All illumination and lighting of instruments, keyboards and controls are to be adjustable down to zero, except the lighting of alarm indicators and the controls of dimmers which are to remain readable.~~

4.4 ~~Field of vision~~Power Interruptions and shutdown

4.4.1 The distribution boards supplying power to the navigation equipment / system are to be fed by two exclusive circuits, one from main source of power and one from an emergency source of power. The power supplies to the distribution boards are to be arranged with automatic changeover facilities between the two sources.

4.5 Power supply

4.5.1 Power to the navigation equipment / system is to be supplied:

a) from the main and emergency sources of electrical power with automated changeover through a local distribution board with provision to preclude inadvertent shutdown;

b) from a transitional source of electrical power for a duration of not less than 1 min;

c) where required, parts of the IBS are also to be supplied from a reserve source of electrical power.

d) Uninterrupted power supplies: Each vital equipment listed below is to be connected to an UPS. The UPS is to supply the vital bridge equipment with continuous power during a loss of ship's power for a minimum period of 15 minutes. The UPS is to prevent power transients as ship service power is lost and restored such that no loss of control or mal-operation of the bridge units results from these transitions.

4.5.2 Battery charge circuits within each unit are to be capable of re-charging the battery from 40% capacity to 80% capacity within 8 hours. Batteries are to be protected from undercharge and overcharge. Battery charging is to be automatic and is not to affect normal operation. The equipment regarded as vital is at least one each of the following:

i) one radar with ARPA (including antenna) installed at work station for navigation and manoeuvring;
ii) ECDIS;
iii) GNSS;
iv) Gyro compass; and
v) Internal Communication System.

4.6 EMI/EMC

4.6.1 All electrical and electronic equipment on the bridge and vicinity of the bridge are to be installed such that electromagnetic interference does not affect the proper functioning of the navigational systems and equipment. Installation of the equipment in accordance with the guidelines and recommendations included in IEC 60533:2015 or an acceptable equivalent standard would generally be considered to meet the requirement.

Note: Bridge and vicinity of the bridge covers deck and bridge zone, i.e.

- The wheelhouse including bridge wings
- Control rooms, characterized by equipment for inter-communication, signal processing, radio communication and navigation, auxiliary equipment

- Area in close proximity to receiving and/or transmitting antennas and large openings in the metallic structure (equipment beyond 5 meters need not be considered for this purposes).

4.6.2 Passive-EM equipment, defined in 4.6.3, which is excluded from the scope of EMC since it is considered not liable to cause or be susceptible to disturbances need not be tested, but are to be provided with an exemption statement.

4.6.3 Passive EM equipment: Equipment is considered a passive EM equipment if, when used as intended (without internal protection measures such as filtering or shielding) and without any user intervention, it does not create or produce any switching or oscillation of current or voltage and is not affected by electromagnetic disturbances. Examples of such equipment are as follows:

- Cables and cabling systems, cables accessories;
- equipment containing only resistive loads without any automatic switching device; e.g. simple domestic heaters with no controls, thermostat, or fan;
- batteries and accumulators.

4.7 Earthing

4.7.1 Earthing of the navigational equipment and systems is to be as per manufacturer's instructions.

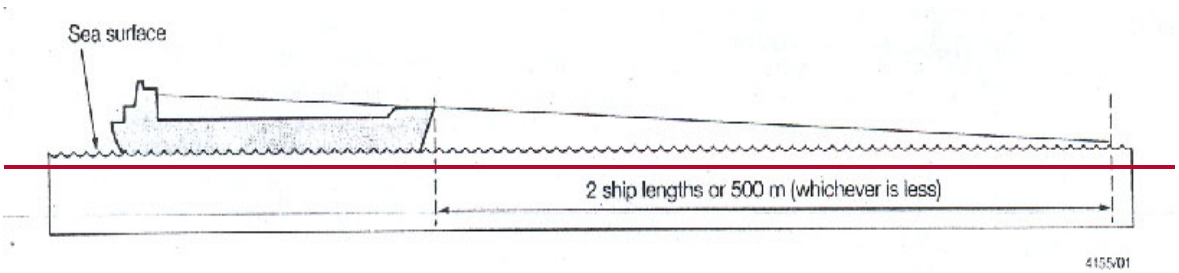
4.8 Tests and Trials

4.8.1 Navigational equipment and systems are to be tested to the satisfaction of the attending surveyor meeting the relevant performance standards.

~~4.4.1 The requirements of the Coast Guard Authority are to be complied with.~~

~~4.4.2 It is to be possible to observe all objects necessary for navigation, including other traffic and navigation marks, in any direction from inside the wheelhouse. In this respect, there is to be a field of view around the ship of 360° obtained by an observer moving within the confines of the wheelhouse.~~

~~4.4.3 The view of the sea surface from the conning position and the navigation workstation is not to be obscured by more than two ship lengths, or 500 [m], whichever is less, forward of the bow to 10° on either side, irrespective of the ship's draught, trim and deck cargo, See Fig.4.4.1.~~



~~**Fig.4.4.1 : View of sea surface from conning position and navigation workstation**~~

~~4.4.4 Blind sectors caused by cargo, cargo gear and other obstructions outside of the wheelhouse forward of the beam obstructing the view of the sea surface as seen from the conning position and the navigation workstation are not to exceed 10° each. The total arc of blind sectors is not to exceed 20° and the clear sector between blind sectors shall be at least 5°. However, in the view described in 4.3.3, each individual blind sector is not to exceed 5°.~~

4.4.5 The horizontal field of vision from the conning position and the navigation workstation is to extend over an arc from more than 22.5° abaft the beam on one side, through forward, to more than 22.5° abaft the beam on the other side, See Fig.4.4.2.

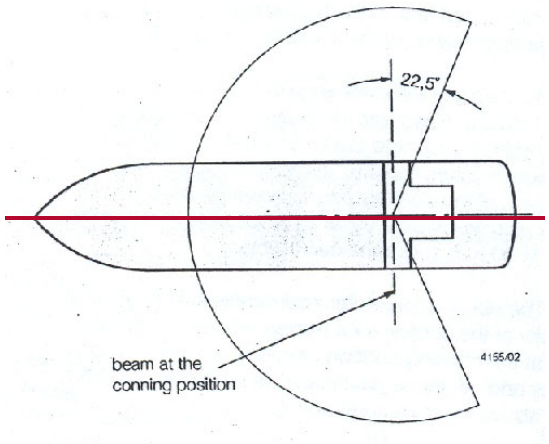


Fig.4.4.2 : Horizontal field of view from conning position and navigation workstation

4.4.6 From the main steering position, the field of vision is to extend over an arc from dead ahead to at least 60° on each side, See Fig.4.4.3.

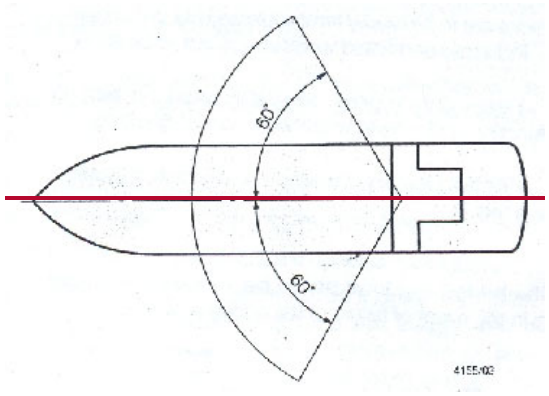


Fig.4.4.3 : Field of view from main steering position

4.4.7 From each bridge wing, the field of vision is to extend over an arc from at least 45° on the opposite bow through dead ahead and then aft to 180° from dead ahead, See Fig.4.4.4.

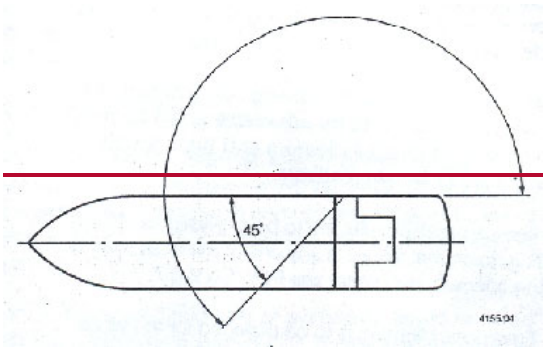


Fig.4.4.4 : Field of view from starboard bridge wing

4.4.8 There is to be a line of sight from the port wing to the starboard wing through the wheelhouse.

4.4.9 The ship's side is to be visible from the bridge wing.

4.4.10 From work stations for functions other than navigation, the field of vision is to enable an effective lookout to be maintained and, in this respect, is to extend at least over an arc from 90° on the port bow, through forward, to 22.5° abaft the beam on the starboard side, See Fig.4.4.5.

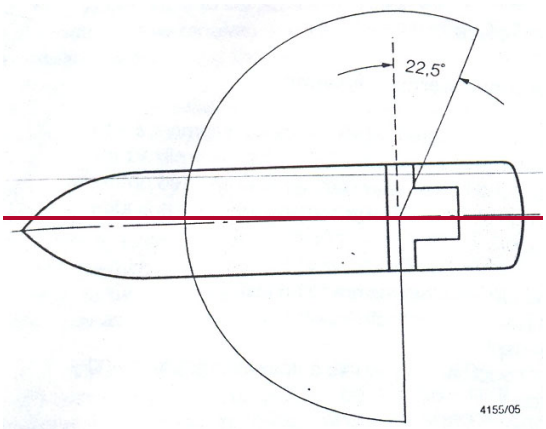


Fig.4.4.5 : Field of view from workstation other than for navigation

4.5 Training

4.5.1 Manufacturers of integrated bridge systems are to provide training facilities for the ship's crew. This training may take place ashore or on board and is to be carried out using suitable material and methods to cover the following topics:

a) General understanding and operation of the system:

- Knowledge and understanding of the system's configuration and application.
- Usage and understanding of the operating manual.
- Usage and understanding of electronic "HELP" functions, if provided in the system.
- Familiarization with the system using safe trial modes.

b) Mastering of uncommon conditions in the system:

- Detecting and locating of failures.
- Resetting the system to safe default values and modes.
- Operating safely without certain sensor data or parts.
- Possibilities for repair on board.
- Identifying the potential for unintended results.

Section 5

~~Work Station~~Integrated Bridge System

5.1 ~~General~~Documentation

5.1.1 In addition to the documents indicated in Section 4, the following documents are to be submitted for **IBS** notation:

(a) Details and arrangements of the workstations and systems. The functions available are to be as given in Table 6.1.

(b) The sea trial program is to include test details of the electronic chart display and information systems (EDCIS) and integrated bridge system (IBS).

5.2 System requirements

5.2.1 General

In addition to the requirements indicated in Section 3 and Section 4, the following requirements are to be complied with:

.1 The IBS is to comply with all applicable IMO requirements as contained in the reference regulations listed in Section1, 1.3 or other relevant IEC Standards. Parts of the system, executing multiple operations are to meet the requirements specified for each individual function they can control, monitor or perform.

.2 Each part of an IBS is to meet the relevant requirements of IMO Resolution A.694(17) as detailed in IEC 60945:2002.

.3 The integrated bridge system is to be of an approved type.

5.2.2 Integration

5.2.2.1 The system is to provide functional integration meeting the following requirements:

a) The functionality of the IBS is to ensure that its operation is at least as effective as for stand-alone equipment.

b) Continuously displayed information is to be reduced to the minimum necessary for safe operation of the ship. Supplementary information is to be readily accessible.

c) Where multifunction displays and controls are used to perform functions necessary for safe operation of the ship they are to be duplicated and interchangeable.

d) It is to be possible to display the complete system configuration, the available configuration and the configuration in use.

e) Each part to be integrated is to provide details of its operational status and the latency and validity of essential information. Means are to be provided within the IBS to make use of this information.

f) An alternative means of operation is to be provided for essential functions.

g) An alternative source of essential information is to be provided. The IBS is to identify loss of either source.

h) The source of information (sensor, result of calculation or manual input) is to be displayed continuously or upon request.

i) IBS is to be integrated with following ship systems:

- Ring Laser Gyros
- Echo sounder
- Anemometer
- EM Log
- GPS
- Steering System with Autopilot
- Analog Video of Navigation Radar
- Radar Data Distribution Unit (RDDU)
- Automatic Identification System (AIS)
- Integrated Platform Management System (including CCTV)
- Radio Receiver Beacon (RRB)
- Transmitting Magnetic Compass

5.2.3 Data Exchange

5.2.3.1 Interfacing within the IBS is to comply with IEC 61162, as applicable.

5.2.3.2 Data exchange is to be consistent with safe operation of ship.

5.2.3.3 The integrity of the data flowing on the network is to be ensured.

5.2.3.4 A failure in the connectivity is not to affect independent functionality.

5.2.3.5 The network is to be such that in the event of a single failure between the nodes, a clear indication of the failure is available, the sensors and displays on the network continue to operate and the data transmission between them is maintained.

5.2.4 Failure Analysis

5.2.4.1 A failure analysis is to be performed and documented.

5.2.4.2 Parts, functions and connectivity are to be identified.

5.2.4.3 Possible failures of parts and connectivity associated with essential functions and information are to be identified.

5.2.4.4 Consequences of failures with respect to operation, function or status of the IBS are to be identified.

5.2.4.5 Each failure is to be classified with respect to its impact on the IBS taking into account relevant characteristics, such as detectability, ease of diagnosis, testability, replaceability and compensating and operating provisions.

5.2.4.6 The results of the failure analysis are to confirm the possibility of continued safe operation of the ship.

5.2.5 Quality Assurance

5.2.5.1 1 The IBS is to be designed, developed, produced, installed and serviced by companies certified to ISO 9001:2015.

5.2.6 Alarm Management

5.2.6.1 The IBS alarm management, as a minimum, is to comply with the requirements of the Code of Alerts and Indicators (IMO resolution A.1021(26)) and the alarms required for each navigational equipment by IMO standards.

5.2.6.2 Appropriate alarm management on priority and functional groups is to be provided within the IBS.

5.2.6.3 The number of alarm types and their release are to be kept as low as possible by providing indications for information of lower importance.

5.2.6.4 Alarms are to be displayed so that the alarm reason and resulting functional restrictions can be easily understood. Indications are to be self-explanatory.

5.2.6.5 Alarms are to be prioritized as follows:

a) Emergency Alarms: Alarms which indicate that immediate danger to human life or to the ship and its machinery exists and that immediate action is to be taken.

b) Alarms: conditions requiring immediate attention and action by the bridge team to avoid any kind of hazardous situation and to maintain the safe operation of the ship and escalation required as alarm from not acknowledged warning.

c) Warning: conditions or situations which require immediate attention for precautionary reasons, to make the bridge team aware of conditions which are not immediately hazardous, but may become so.

d) Caution: awareness of a condition which still requires attention out of the ordinary consideration of the situation or of given information.

5.2.6.6 The following alarms are to be provided and included in the centralized alarm system:

- Off-course
- Off-track (where automatic track following is provided)
- Way point approaching, (where automatic track following is provided)
- Position fix inaccurate/lost
- Loss of heading input
- Loss of speed log input
- Equipment or sub-system failure
- Gyro mismatch
- Echo-sounder
- Radar CPA
- Navigational light failure
- Steering gear alarms
- Bridge navigational watch alarm system failure.

The audible alarms at the central panel and the relevant workstation are to be silenced when acknowledged from either location. However, it is to be possible to acknowledge the flickering light and bring to steady state only from the relevant work station.

5.2.6.7 Manual adjustment of any of the facilities of the integrated bridge system is to reset automatically the watch safety interval timer.

5.2.7 Power interruptions and shutdown

5.2.7.1 If subjected to an orderly shut-down, the IBS should, upon turn-on, come to an initial default state.

5.2.7.2 After a power interruption full functionality of the IBS is to be available after recovery of all subsystems. The IBS is not to increase the recovery time of individual subsystem functions after power restoration.

5.2.7.3 If subjected to a power interruption the IBS is to, upon restoration of power, maintain the configuration in use and continue automated operation, as far as practicable. Safety related automatic functions are to be restored only upon confirmation by the operator.

5.2.8 Power Supply

5.2.8.1 Power supply requirements indicated in 4.5 are applicable.

5.2.8.2 Power supply requirements applying to parts of the IBS as a result of other IMO requirements are also to remain applicable.

5.3 Operational Requirements

In addition to the operational requirements indicated in Section 4, following requirements are to be complied with.

5.3.1 Human factors

5.3.1.1 The IBS is to be capable of being operated by personnel holding appropriate certificates.

5.3.1.2 The man-machine interface (MMI) is to be designed so as to be easily understood and in a consistent style for all integrated functions.

5.3.1.3 Operational information is to be presented in a readily understandable format without the need to transpose, compute or translate.

5.3.1.4 Indications, which may be accompanied by a short low intensity acoustic signal are to occur when:

- An attempt is made to execute an invalid function
- An attempt is made to use invalid information.

5.3.1.5 If an input error is detected by the system it is to require the operator to correct the error immediately. Messages actuated by an input error are to guide the correct responses, e.g. not simply “Invalid entry”, but “Invalid entry, re-enter set point between 0 to 100”.

5.3.1.6 Layered menus are to be presented in a way which minimizes the added workload to find and return from the desired functions.

5.3.1.7 An overview is to be easily available to assist the operator in the use of a multiple page system. Each page is to have a unique identifier.

5.3.1.8 Where multi-function displays are used, they are to be in colour. Continuously displayed information and functional areas, e.g. menus, are to be presented in a consistent manner.

5.3.1.9 For actions which may cause unintended results, the IBS is to request confirmation from the operator.

Note 1 : Examples of such actions are:

- Attempting to change position and next waypoint while in track mode steering.

- Attempting to switch on bow thruster when insufficient electrical power is available.

5.3.1.10 Functions requested by the operator are to be acknowledged or clearly indicated by the IBS on completion.

5.3.1.11 Default values, where applicable, are to be indicated by the IBS when requesting operator input.

5.3.1.12 The size, colour and density of text and graphic information presented on a display are to be such that it may be easily read from the normal operator position under all operational lighting conditions. (ref ISO 8468-6.2.3).

5.3.1.13 Symbols used in mimic diagram are to be standardized throughout the system's displays.

5.3.1.14 All information is to be presented on a background providing high contrast and emitting as little light as possible at night.

5.3.1.15 The design of bridges is to be governed by:

a) The range, layout and location of workstations required for performance of bridge functions

b) The fields of vision required for visual observations from each of the workstations.

c) The type and range of equipment to be provided for performance of the tasks at the individual workstations.

5.3.2 Arrangement

5.3.2.1 Equipment and associated displays and indicators are to be sited at clearly defined workstations.

5.3.2.2 It is to be possible to monitor the navigation workstation and to maintain an effective lookout from other workstations within the wheelhouse.

5.3.2.3 Space necessary for operating at a workstation is to be considered as part of the workstation and is not to be part of the passageway.

5.3.3 Training

5.3.3.1 Manufacturers of integrated bridge systems are to provide training for the ship's crew. This training may take place ashore or on board and is to be carried out using suitable material and methods to cover the following topics:

a) General understanding and operation of the system:

- Knowledge and understanding of the system's configuration and application.
- Usage and understanding of the operating manual.
- Usage and understanding of electronic "HELP" functions, if provided in the system.
- Familiarization with the system using safe trial modes.

b) Mastering of uncommon conditions in the system:

- Detecting and locating of failures.
- Resetting the system to safe default values and modes.
- Operating safely without certain sensor data or parts.
- Possibilities for repair on board.
- Identifying the potential for unintended results

5.4 Work Stations

5.4~~1~~.1 The bridge and workstation arrangement ~~shall~~ is to be based on relevant functional requirements and designed in accordance with established principles of ergonomics for safe and efficient operations,

enabling the navigator to perceive all relevant information and execute pertinent actions with a minimum workload.

5.4~~1~~.2 Workstations for additional functions may be located on the bridge provided the performance of such functions does not interfere with the tasks of maintaining safe control of the ship. Workstations for additional functions may include workstations for:

- Extended communication functions
- Monitoring and control of ballasting and cargo operations
- Extended monitoring of machinery
- Remote control of accommodation ladder, hatches and side ports
- Miscellaneous.

5.5~~2~~ Navigation workstation

5.5~~2~~.1 A workstation for navigation is to be arranged to enable efficient operation by one person under normal operating conditions. The workstation area is to be sufficient to allow at least two operators to use the equipment simultaneously. The arrangement of instruments and controls is to allow the use of all instruments and controls necessary for navigating and manoeuvring in any normal working position.

5.5~~2~~.2 An adequate conning position is to be provided close to the forward center window. If the view in the centerline is obstructed by large masts, cranes, etc. two additional conning positions giving a clear view ahead are to be provided, one on the port side and one on the starboard side of the centerline, no more than 5 [m] apart. In addition to the conning position, a second position with a view of the area immediately in front of the bridge superstructure is to be provided close to a forward window or, alternatively, the conning position is to be wide enough to accommodate two persons.

5.5~~2~~.3 The main steering position is to be located on the ship's centerline, unless the view ahead is obstructed by large masts, cranes, etc. In this case, the steering position is to be located a distance to starboard of the centerline sufficient to obtain a clear view ahead and special steering references for use by day and night are to be provided, e.g. sighting marks forward.

5.5~~2~~.4 The following facilities are to be provided at the navigation workstation:

- Radar and radar plotting facilities
- Position-fixing system displays
- Echo sounder display
- Speed and distance indications
- Gyrocompass displays
- Magnetic compass display
- Wind speed and direction indication
- Steering controls and indication
- Rate of turn indication
- Course/track controls and indications
- Main propulsion and thruster controls and indication
- Watch safety system acknowledge
- Watch safety system manual initiation
- Internal communications system
- VHF radiotelephone
- Time indication
- Window clear view controls
- Navigation lights controls
- Whistle control
- Morse light keys
- Wheelhouse/equipment lighting controls
- Automatic ship identification system (AIS) information
- Sound reception system where fitted.

Section 6

Navigational Equipment Requirements

6.1.1 The navigation equipment to be carried on board for the performance of various functions are listed in Table 6.1.

6.1.2 Two functionally independent radars or alternative means are to be provided to determine and display the range and bearing of radar transponders and other surface craft, obstructions, buoys, shorelines and navigational marks. One of the radars is to operate in the X-band (9 GHz) and the other is to operate in the S-band (3 GHz). Both radars are to include automatic plotting aids to determine collision risks, and at least one radar is to be equipped with an automatic radar plotting aid (ARPA), capable of tracking at least 20 targets, while the other is to be either ARPA or an automatic tracking aid (ATA).

6.1.3~~2~~ At least two different automatic position-fixing systems giving a continuous display of latitude and longitude are to be provided. One of these is to be GPS or equivalent. The other is to be by means of Radar or equivalent, depending on the area of operation.

6.1.4~~3~~ A gyrocompass or alternative means for determining, displaying and transmitting the ship's heading is to be provided. The heading information is to be used directly by the radars, radar plotting aids and automatic identification system. The gyrocompass is to be provided with a gyrocompass heading repeater located at the emergency steering position in the steering gear compartment and a gyrocompass bearing repeater allowing bearings to be taken over 360°.

6.1.5~~4~~ An autopilot, track control system or alternative means of automatically maintaining the ship's heading or a straight track is to be provided. At any time, it is to be possible to immediately restore manual control.

6.1.6~~5~~ Where automatic track following is provided, sufficient warning is to be given of the approach of a waypoint, so that, in the event of no acknowledgement from the officer of the watch, there is adequate time for the backup navigator to reach the bridge and accept the change of course.

6.1.7~~6~~ A speed log or alternative means of indicating the ship's speed and distance through water is to be provided. The speed through water measurement is to be used directly by the ARPA as an aid to collision avoidance.

6.1.8~~7~~ A speed log or alternative means of indicating the ship's speed and distance over ground is to be provided. Speed over ground is to be indicated in both the fore-aft and athwartships directions.

6.1.9~~8~~ Navigational systems and equipment are to be of a type approved by the national administration and in conformity with appropriate performance standards not inferior to those adopted by IMO from time to time. Documentary evidence to this effect is to be submitted. See SOLAS 1974 as amended, Ch.V, Reg.18.

6.1.10~~9~~ Where alternative means of fulfilling the navigational requirements are permitted, the means are to be approved by the Coast Guard Authority and in conformity with appropriate performance standards.

Table 6.1 : Navigational Equipment

Workstation for	Main functions to be performed	Equipment	Remarks
Navigation and traffic surveillance manoeuvering (See Note 1)	• Observation of all vessels and objects	Gyro compass heading indicator	For IBS notation, two independent gyro compasses are to be provided on the bridge
	• Recognizing dangerous situations	Magnetic compass heading indicator	
		Course reminder (set course) indicator	
	• Deciding on collision avoidance actions	Auto pilot/ track control system/ alternative means	Automatically maintaining ship's heading or a straight track. Immediate restoration of manual control to be possible when required.
		Steering gear pump selector switch	
		Steering mode selector switch	
	• Checking vessel's own signal	Steering position indicator	
		Rudder angle indicator	
	• Checking own course and speed	Pitch indicator	For controllable-pitch propeller
		Rate-of-turn indicator and controller	If required by Coast Guard authority
	• Keeping and/or changing own course and speed (track keeping)	Speed and distance indicator	For IBS notation, the speed measuring system is to be independent of the position-fixing systems
		Echo sounders with adjustment controls	
	• Checking own position	9 GHz radar and 3 GHz radar	
	• Handling own internal communication on board	Automatic traffic surveillance system including ARPA	
	• Handling communication vessel/vessel and vessel/shore (VHF)	Position fixing equipment/system including automatic visual position indicator	Two types of receivers are to be provided. One of the systems is to be GPS or equivalent and the other GLONASS, or other means such as radar
	• Releasing alarms	Officer of the watch check-alertness acknowledgement device	

Table 6.1 (Contd.)

Workstation for	Main functions to be performed	Equipment	Remarks
		Clock	
		Group alarms and reset controls	
Monitoring (See Note 1)	• Observation of all vessels and objects • Recognizing dangerous situations • Checking own course and speed • Handling own internal communication on board • Handling communication vessel/ vessel and vessel/shore • Perception of group alarms with aids for decision-making • Releasing alarms • Observation of weather and seaway • Acknowledging watch check alertness alarm • Keeping deck log • When workstation is occupied by an additional navigator, provides assistance to navigator at the navigation and traffic surveillance/ maneuvering workstation • When workstation is occupied by a pilot advisers to vessel's command	Gyro compass heading indicator	For IBS notation, the speed measuring system is to be independent of the position-fixing systems
		Rudder angle indicator	
		Pitch indicator	For controllable-pitch propeller
		Rate-of-turn indicator	If required by Coast Guard authority
		Speed and distance indicator	For IBS notation, the speed measuring system is to be independent of the position-fixing systems
		~~Depth water indicators~~Echosounders	
		9GHZ and 3GHz radar	
		Officer of the watch check-alertness acknowledgment device	
		Propulsion engines/ thrusters emergency stops	
		Propeller revolutions indicator	
		Automatic telephone system	
		Radio-communication/ GMDSS equipment	
		Signal transmitter for whistle/ foghorn	
		Controls for windscreen wiper, washer, heater	
		Workstation lighting control device	
		Clock	

Table 6.1 (Contd.)

Workstation for	Main functions to be performed	Equipment	Remarks
Docking (Bridge wings)	• Giving instructions, performing and controlling change of course • Giving instructions, performing and controlling change of speed • Giving instructions, performing and controlling change of thruster • Handling communication with maneuvering stations • Handling communication with tugs, pilot boat • Watching water surface along vessel's side • Releasing signals • Acknowledging watch check alertness alarm	Gyro compass heading indicator	
		Steering position selector switch	
		Rudder controls	
		Rudder angle indicator	
		Pitch indicator	For controllable pitch propeller
		Rate-of-turn indicator	If required by Coast Guard authority
		Propulsion engines/ thrusters controls	
		Propulsion engine revolution	If reduction geared engine
		Propeller revolutions indicator	
		Lateral thrust and lateral movement of vessel, indicator	If thrusters are fitted
		Longitudinal movement of vessel, indicator	
		Wind direction and velocity indicator	
		Echo sounder	
		Officer of the watch check-alertness acknowledgement device	
		Whistle controls	
		Search light and Morse lamp controls	
		Automatic telephone system	
		Radio-communication/ GMDSS equipment	
		Workstation lighting control device	
Centralized Bridge	As listed in 1.4.9~~2~~	Equipment required for the navigation and traffic surveillance / maneuvering and monitoring workstations	
		Central alarm panel	
		ECDIS	

Table 6.1 (Contd.)

Note:

1) As the navigation and traffic surveillance / maneuvering, monitoring and manual steering workstations are functionally interrelated and usually installed in close proximity from each other, consideration will be given to the omission of duplicate equipment required at each of the aforementioned workstations.

~~Section 7~~

~~Bridge Navigational Watch Alarm System~~

~~7.1 The requirements complying with the IMO performance standards for a bridge navigational watch alarm system (BNWAS) and approved by the Coast Guard Authority is to be provided to monitor the well-being and awareness of the watchkeeper. The system is not to cause undue interference with the performance of bridge functions.~~

~~7.2 The BNWAS safety system is to automatically become operational whenever the ships heading or track control system is activated.~~

~~7.3 The system is to be such that, at a predetermined time, the watchkeeper receives warning that he must indicate his well-being by accepting the warning.~~

~~7.4 The time interval between warnings is to be adjustable upto a maximum of 12 minutes.~~

~~7.5 It is to be possible to acknowledge the warning at the navigation workstation and at other appropriate locations on the bridge where an effective look-out may be kept. Acknowledgement of any alarm is automatically to reset the time interval between warnings. Manual adjustment of controls may also be used for this purpose.~~

~~7.6 Visual warning indications are to be visible and audible warning indications are to be audible, from all operational positions on the bridge where the watchkeeper may reasonably be expected to be stationed. The colour of visual indicators is not to impair night vision.~~

~~7.7 In the event that the watchkeeper fails to respond and accept the warning or if any alarm has not been acknowledged on the bridge, within a period of 30 seconds, the system is to immediately initiate a watch alarm to warn the Master and the appointed backup navigator through a fixed installation.~~

~~7.8 In the event that the watch alarm is not acknowledged, the system is to initiate the watch alarm at the locations of further crew members capable of taking corrective actions following a time delay sufficient to allow the Master or backup navigator to reach the bridge. The time interval is to be adjustable between 90 seconds upto a maximum of 3 minutes. In ships, other than passenger ships, the watch alarms to warn the further crew members may be initiated at the same time as the watch alarm to warn the Master and backup navigator.~~

~~7.9 The watch alarms which sound in the locations of the Master, officers and further crew members capable of taking corrective action should be easily identifiable by its sound and should indicate urgency. The volume of this alarm should be sufficient for it to be heard throughout the locations above and to wake sleeping persons.~~

~~7.10 Manual initiation of the watch alarm from the bridge is to be possible at any time.~~

~~7.11 The system is to be designed and arranged such that only the ship's Master has access for enabling and disabling it and setting the appropriate intervals, so as to prevent accidental or unauthorized operation, e.g. removing the fuses or keeping the acknowledgement button permanently depressed either accidentally or deliberately.~~

~~7.12 The fixed installation is to be connected to the Master's and navigating officers' cabins, offices, mess and public rooms.~~

~~7.13 Acknowledgement of the watch alarm is only to be possible on the bridge.~~

~~7.14 If, depending upon the shipboard work organization, the backup navigator may attend locations not connected to the alarm transfer system, a wireless portable device is to be provided enabling both the transfer of alarms and two-way speech communication with the bridge. An audible warning from the portable device is to be provided in the event of loss of the wireless link with the bridge. Alternative arrangements will be considered.~~

~~7.15 Failure of the watch alarm system is to activate an audible and visual alarm at the centralized alarm system.~~

Section 7~~8~~

Tests and Trials

7~~8~~.1 General

7~~8~~.1.1 The tests to be carried out as indicated in this section are intended to supplement and not to replace the testing of parts that is required to meet the relevant IMO performance standards. The tests are intended to ensure that when the parts are integrated there is no degradation of their individual functionality.

7~~8~~.1.2 In all instances the performance standards for parts will form the minimum test requirement for an integrated system.

7~~8~~.1.3 During trials, navigational equipment and systems are to be tested to the satisfaction of the attending surveyor in accordance with the test program. The test program is to include following systems as minimum:

a) Course information system
b) Automatic steering system
c) Speed measuring system
d) Depth measuring system
e) Radar system
f) Automatic traffic surveillance system
g) Position fixing system
h) Watch monitoring and alarm transfer system
i) Route planning system
j) Vessel's automatic identification system
k) Sound reception in bridge , if fitted
l) Radio communication system
m) Centralised bridge workstation provided to enable the navigator to perform necessary navigational, monitoring/alarm and communication functions as required for IBS.

7~~8~~.1.4 The trial program is to include test details of ECDIS and IBS. The system is to be tested to verify that failure of one sub system does not affect any other sub system. In case of failure of integrated navigational system, it is to be possible to operate the primary navigational equipment / systems functions independently.

End of Chapter

Chapter 17

Dynamic Positioning Systems

Section 1

General

1.2 Definitions

1.2.1 **Bus-tie breaker** means a device connecting/ disconnecting switchboard sections ('closed bus-tie(s)" means connected).

1.2.2 **Computer system** means a system consisting of one or more computers and associated hardware, software and their interfaces.

1.2.3 **Consequence analysis** means a software function continuously verifying that the vessel will remain in position even if the worst-case failure occurs.

1.2.4 **Dynamic Positioning control station (DP control station)** means a workstation designated for DP operations, where necessary information sources, such as indicators, displays, alarm panels, control panels and internal communication systems are installed (this includes but not limited to: DP control and independent joystick control operator stations, position reference systems' Human Machine Interface (HMI), when considered necessary, manual thruster levers, mode change systems, thruster emergency stops, internal communications).

1.2.5 **DP control system** means all control components and systems, hardware and software necessary to dynamically position the vessel. The DP-control system consists of the following:

a) Computer system and/ or joystick system
b) Sensor system (s)
c) Control stations and Display system
d) Operator panels
e) Position reference system (s)
f) Associated cabling and cable routing
g) Networks

1.2.6 **Dynamic Positioning operation (DP operation)** means using the DP system to control at least two degrees of freedom in the horizontal plane automatically.

1.2.7~~1~~ **Dynamically positioned vessel** means a vessel which automatically maintains its position and/ or heading (fixed location, relative location or predetermined track) depending on purpose of the vessel, by means of thruster force.

1.2.8~~2~~ **Dynamic positioning system** means the complete installation necessary for dynamically positioning a vessel, comprising, but not limited to, ~~of~~ the following sub-systems:

a) Power system,
b) Thruster system,
c) DP-control system, and
d) Independent joystick system.

1.2.9 **Failure** is an occurrence in a component or system causing one or both of the following effects:

- loss of component or system function

- deterioration of functional capability to such an extent that the safety of the vessel, personnel, or environment protection is significantly reduced.

1.2.10 **Failure Modes and Effects Analysis (FMEA)** means a systematic analysis of systems and sub-systems to a level of detail that identifies all potential failure modes down to the appropriate sub-system level and their consequences.

1.2.11 **FMEA proving trials** means the test program for verifying the FMEA.

1.2.12 **Hidden failure** means a failure that is not immediately evident to operations or maintenance personnel and has the potential for failure of equipment to perform an on-demand function, such as protective functions in power plants and switchboards, standby equipment, backup power supplies or lack of capacity or performance.

1.2.13 **Joystick system** means a system with centralized manual position control and manual or automatic heading control.

1.2.14 **Loss of position and/or heading** means that the vessel's position and/or heading is outside the limits set for carrying out the DP activity in progress.

1.2.15~~3~~ **Position/ heading keeping** means maintaining a desired position keeping and/or heading within the normal excursions of the control systems and environmental conditions.

1.2.16 **Power management system** means a system that ensures continuity of electrical supply under all operating conditions.

1.2.17~~4~~ **Power system** means all components and systems necessary to supply the DP-system with power. The power system includes:

a) Prime movers with necessary auxiliary systems including piping, fuel, cooling, pre-lubrication, hydraulic, pre-heating, and pneumatic systems
b) Generators
c) Switchboards,
d) Distributing system (cabling and cable routing),
e) Uninterrupted Power Supply (UPS), and
f) Power Management System (PMS) or equivalent arrangements, as applicable.

1.2.18 **Redundancy** means ability of a component or system to maintain or restore its function, when a single failure has occurred. Redundancy can be achieved for instance by installation of multiple components, systems or alternative means of performing a function.

1.2.19 **Time to safely terminate (operations)** means the amount of time required in an emergency to safely cease operations of the DP vessel.

1.2.20~~5~~ **Thruster system** means all components and systems necessary to supply the DP system thrust force and direction. The thruster system includes:

a) Thrusters with drive units and necessary auxiliary systems and piping
b) Main propellers and rudders if these are under the control of the DP-system
c) Thruster controls
d) Associated cabling and cable routing.

1.2.21 **Worst-Case Failure Design Intent** means the specified minimum DP system capabilities to be maintained following the worst-case failure. The worst-case failure design intent is used as the basis of the design. This usually relates to the number of thrusters and generators that can simultaneously fail.

1.2.22 **Worst case failure** means the identified single fault in the DP system resulting in maximum detrimental effect on DP capability as identified through FMEA study.

~~1.2.6 **DP-control system** means all control components and systems, hardware and software necessary to maintain the position the vessel. The DP-control system consists of the following:~~

~~a) Computer system~~
~~b) Sensor system~~
~~c) Display system~~
~~d) Position reference system~~
~~e) Associated cabling and cable routing.~~

~~1.2.7 **Redundancy** means ability of a component or system to maintain or restore its function, when a single failure has occurred. Redundancy can be achieved for instance by installation of multiple components, systems or alternative means of performing a function.~~

~~1.2.8 **Failure** is an occurrence in a component or system causing one or both of the following effects:~~

~~loss of component or system function~~

~~deterioration of functional capability to such an extent that the safety of the vessel, personnel, or environment is significantly reduced.~~

~~1.2.9 **Worst case failure** means the identified single failure mode in the DP system resulting in maximum effect on DP capability as identified through FMEA study.~~

~~1.2.10 **Reliability** is the ability of a component or system to perform its required function without failure for specified time interval under stated environmental conditions.~~

1.3 Classification notations ~~:~~ : definition and general principles

1.3.1 In addition to the Hull and Machinery class notations, ships complying with the requirements of this Chapter will be eligible to be assigned any of the following class notations:

DP(0) This notation may be assigned when a ship is fitted with a dynamic positioning system without any redundancy. It may be noted that there is no corresponding IMO equipment class for DP(0) notation.

DP(1) This notation may be assigned when a ship is fitted with automatic controls for position k~~K~~eeping and/or heading, an independent joystick system back-up and a position reference back-up.

DP(2) This notation may be assigned when a ship is fitted with automatic controls for position keeping and/or heading, with automatic standby controls, an independent joystick system back-up and redundancy in design and equipment as required by these rules.

DP(3) This notation may be assigned when a ship is fitted with automatic controls for position keeping and/or heading, with automatic standby controls, an independent joystick system back-up and redundancy in design and equipment. In addition, physical separation of components is to be provided by locating in different compartments as required by these rules. Full stop of thrusters and subsequent start-up of available thrusters is not considered as an acceptable disruption.

1.4 Design redundancy and failure modes

~~1.3.2~~1.4.1 The ~~worst case~~worst-case failure modes for the above class notations are to be as follows:

1.~~3.2~~4.1.1 For notation DP(1), loss of position and/or heading may occur in the event of a single fault.

1.~~3.2~~4.1.2 ~~—~~For notation DP(2), a loss of position and/or heading is not to occur in the event of a single fault in any active component or system. Common static components may be accepted

in systems which will not immediately affect position keeping capabilities upon failure (e.g. ventilation and seawater systems not directly cooling running machinery). Normally, static components will not be considered to fail where adequate protection from damage is demonstrated and properly documented with respect to protection and reliability. Single failure criteria for DP(2) include:

a) Failure of any active component or system (generators, thrusters, switchboards including the short circuit of switchboard bus bars, remote controlled valves, coolers, filters etc.)
b) Fault in any normally static component (cables, pipes, manual valves etc) which is not properly documented with respect to protection
c) A single inadvertent act if such an act is reasonably probable
d) Systematic failures or faults that can be hidden until a new fault appears
e) Automatic interventions caused by external events, when found relevant (e.g. automatic action upon detection of gas).

- 1.4.1.3 For notation DP(3), loss of position is not to occur after any of the following failures in addition to ~~1.3.2.2~~1.4.1.2 above:

a) Fault in any normally static component in the system
b) Failure to all components in any watertight compartment, from fire or flooding
c) Failure to all components in any fire sub-division, from fire or flooding.

1.4.2~~3.3~~ Based on the failure definitions in ~~1.3.2~~1.4.1, the worst case failure is to be determined with the help of FMEA and used as the criteria for consequence analysis. For class notations DP(2) and DP(3), a single inadvertent act is to be considered as a single fault, if such an act is reasonably probable and it need not be used as a criterion for consequence analysis. Requirement for failures to be considered are summarized in Table ~~1.3.3~~1.4.2.

Table 1.4.2~~3.3~~ : Failures to be considered for various class notations

Notation	Position and/or heading keeping criterion	FMEA required	Failures to be considered				
			Static components	Active components	Inadvertent acts, if reasonably probable	Hidden failure	Failure of all components in a watertight compartment / fire subdivision due to fire or flooding
DP0	Loss of position and/ or heading may occur after single failure	-	-	-	-	-	-
DP1	Loss of position and/or heading may occur after single failure	-	-	-	-	-	-

DP2	Loss of position and/or heading is not to occur after single failure	Yes	Yes[1]	Yes	Yes	Yes	No
DP3	Loss of position and/or heading is not to occur after single failure including fire / flooding in one compartment	Yes	Yes	Yes	Yes	Yes	Yes
Note 1 : Not required if the static component (cables, pipes, manual vales etc.) is properly documented with respect to protection.							

The objective of FMEA is to provide a comprehensive, systematic and documented analysis to establish the significant failure modes with regards to position keeping and demonstrate that the vessel maintains position in the event of single failure.

Essentially the FMEA is to

- Breakdown the DP system into functional blocks and function of each block is to be described
- Identify potential failure modes and their causes
- Evaluate effect on the system for each failure mode
- Identify measures for eliminating and reducing the associated risks
- Identify the trials required to prove the conclusion
- Provide information to operators on system limitations and capabilities.

1.4.3 A DP (2) or DP (3) vessel is to be operated in such a way that the worst-case failure, as determined in 1.4.1, can occur at any time without causing a breach of acceptable excursion criteria set for loss of position and/or heading for equipment classes 2 and 3, as defined in MSC Circ. 1580.

1.4.4 If external forces from mission-related systems (cable lay, pipe lay, mooring, etc.) have a direct impact on DP performance, the influence of these systems is to be considered and factored into the DP system design. Where available from the DP system or equipment manufacturer, such data inputs are to be provided automatically to the DP control system. Additionally, provisions are to be made to provide such data inputs into the DP control system manually. These systems and the associated automatic inputs would be subject to surveys, testing and analysis as specified in Section 5.

1.~~3.4~~4.5 In order to meet the failure criteria, redundancy of components will normally be necessary as follows:

a) For class notation DP(2), redundancy of all active components;

b) For class notation DP(3), redundancy of all components and physical separation of the components by A-60 class fire divisions, watertight below the damage control deck (maximum possible separation of sensors above deck).

1.~~3.5~~4.6 For class notation DP(3), full redundancy of the control systems may not be possible (.i.e there may be a need for a single changeover system from the main computer system to the backup computer system) ~~non-redundant connections between otherwise redundant and separated systems may be~~

~~accepted provided that it gives clear safety advantages and their reliability can be demonstrated and documented to the satisfaction of IRS~~. Such connections between otherwise redundant and separated systems may be accepted when these are operated so that they do not represent a possible failure propagation path during DP operations.~~are to be kept to the absolute minimum and made to fail to the safest condition.~~ Failure in one system is not to transfer to the other redundant system.

1.4.7 For class notation DP(2) and DP(3), connections between otherwise redundant and separated systems are to be kept to a minimum and made to fail to the safest condition. Failure in one system is not to be transferred to the other redundant system.

1.~~3.6~~4.8 Redundant components and systems are to be immediately available without needing manual intervention from the operators and with such capacity that the DP operation can be continued for such a period that the work in progress can be terminated safely. ~~The transfer to redundant component or system is to be automatic as far as possible, and the operator intervention is to be kept to a minimum.~~ The transfer is to~~should~~ be smooth and within the ~~specified~~ acceptable limits of the DP operation (s) for which the vessel is designed.

1.4.9 For class notation DP(2) and DP(3), hidden failure monitoring is to be provided on all devices where the FMEA shows that a hidden failure will result in a loss of redundancy.

1.4.10 For class notation DP(2), piping systems for fuel, lubrication, hydraulic oil, cooling water and cables are to be located with due regard to fire hazards and mechanical damage.

1.~~3.7~~4.11 For class notation DP(3), cables for redundant equipment or systems are not to be routed together through the same compartments. Where this is unavoidable, such cables may be run in independent cable ducts of A-60 class. Cable connection boxes are not allowed in such ducts. On open deck, cables in separate pipes that are separately routed may be accepted. Suitable means are to be provided to keep the ambient temperature inside of an A-60 cable duct within maximum temperature for the cables, when necessary, taking into account the temperature rise of cables under full power.

1.~~3.8~~4.12 For class notation DP(3), redundant piping systems (e.g. fuel oil, lubrication oil, cooling water, hydraulic oil, pneumatic etc) are not to be routed together through the same compartments. Where this is unavoidable, such pipes may be run together in ducts of A-60 class.

Redundant fuel oil supply systems are to be arranged with separate dedicated service tanks.

1.~~3.9~~4.13 The requirements for various class notations in these rules are considered to satisfy the equipment classes in IMO guidelines for vessels with dynamic positioning systems (MSC.1/ Circ.~~645~~1580) as noted in Table 1.~~3.9~~4.13.

Table 1.~~3.9~~4.13 : Correlation with IMO equipment classes

IRS Class notation	IMO equipment class
DP(0)	No corresponding equipment class
DP(1)	Equipment Class 1
DP(2)	Equipment Class 2
DP(3)	Equipment Class 3

~~**1.4 Summary of requirements for various class notations**~~

1.4.14 The basic requirements for systems and equipment to be provided for various class notations are summarized in Table 1.4.14. The detailed requirements for thrusters, power systems and DP-control systems are given in Sections 2, 3 and 4 of this Chapter.

Table 1.4.14 : Requirements for various class notations

Item	Requirement for class notation:			
	DP(0)	DP(1)	DP(2)	DP(3)
1. Thrusters:				
a) Arrangement	No redundancy	No redundancy	Redundant	Redundant and in separate compartments
b) Manual single lever control of individual thruster	yes	yes	yes	yes
2. Power systems:				
a) Electrical power generation and distribution systems	No redundancy	No redundancy	Redundancy in design	Redundancy in design and physical separation by A-60 divisions in separate compartments
b) Bus tie breakers	no	no	yes	yes
c) Main Switchboard (MSB)	yes	yes	yes	yes
d) Automatic Power Management System (APMS) or equivalent arrangements	no	no	yes	yes
3. DP control system [1]:				
a) Computer systems for automatic control	1	1	2	2 plus one additional system in back-up control station
b) Consequence analysis	no	no	yes	yes
c) Independent common joystick control with manual/ automatic heading control	no	yes	yes	yes
4. Position reference systems [2]	1	2	3	3, of which one system is in back-up control station
5. External sensors:				
a) Wind	1	1	2	2, of which one is connected to back-up control station
b) Gyro Compass	1	1	3	3, of which one in back-up control station
c) Vertical reference system	1	1	3	3, of which one in back-up control station
6. Uninterrupted Power Supply (UPS)	0[3]	1	2	~~2~~ 3 plus one in back-up control station
7. Back-up control station	no	no	no	yes
8. Printer	yes	yes	yes	yes

	Notes : 1) **Operational mode** is the manner of control under which the DP-system may be operated, e.g.: — automatic mode (automatic position and heading control) — joystick mode (manual position control with selectable automatic or manual heading control) — manual mode (individual control of thrust, azimuth, start/stop of each thruster) — auto track mode (considered as a variant of automatic position control, with programmed movement of reference point). 2) **Position/heading reference system** consists of all hardware, software and sensors that supply information and or corrections necessary to give position/heading reference, including power supply. 3) A UPS need not be provided, unless required by the manufacturer.

1.5 Information and plans required to be submitted

1.5.2 Electrical load calculation for dynamic positioning operation is to be submitted for approval. For class notations DP(2) and DP(3), the load calculations are to consider the situation after the worst single failure. (See 1.3.2)

1.5.7 Performance capability evaluation report is not required for DP(0) notation, unless specifically required by the Coast Guard Authority.

1.6 Performance capability of the DP system

1.6.1 DP capability polar plots are to be produced to demonstrate position and/ or heading keeping capacity for fully operational and post worst-case single failure conditions. The capability plots are to represent the environmental conditions in the area of operation and the mission-specific operational condition of the vessel.

1.6.2 The performance capability of the dynamic positioning system to provide sufficient thruster forces and moments for maintaining position and heading in specified environmental conditions is to be evaluated. The wind, wave and current conditions in a specified area are to be considered for this purpose.

1.6.3~~2~~ A performance capability rating may be assigned by IRS for the DP system, if requested. The rating would indicate the percentage of time that environmental forces in a specified area may be withstood by the system.

1.6.4~~3~~ The following parameters are considered in the evaluation of the performance capability rating:

a) Thruster forces

b) Wind loads on the ship

c) Wave drift loads on the ship

d) Current loads on the ship.

Section 2

Thruster System

2.2 Thruster system

2.2.1 Each thruster on a DP system is to be capable of being remote-controlled individually, independently of the DP control system.

2.2.2 The thruster system is to be designed to provide adequate thrust in longitudinal and lateral directions, and yawing moment for heading control.

2.2.3~~2~~ The response and repeatability of thrusters to changes in propeller pitch or propeller speed/direction of rotation are to be suitable for maintaining the area of operation and the heading deviation specified.

2.2.4~~3~~ For class notations DP(2) and DP(3), in the event of failure of the most effective thruster the ship is to be capable of maintaining its predetermined area of operation and desired heading in the environmental conditions for which the ship is designed and/or classed.

2.2.5 For class notations DP(2) and DP(3), the thruster system is to be connected to the power system in such a way that 2.2.2 can be complied with even after failure of one of the constituent power systems and the thrusters connected to that system.

2.2.6~~4~~ Thruster installations are to be designed to minimize potential interference with other thrusters, sensors, hull or other surfaces which could be encountered in the service for which the ship is intended.

2.2.7~~5~~ The values of thruster force used in the consequence analysis (see 4.2.14) is to be corrected for any unavoidable interference between thrusters and other effects which would reduce the effective force.

2.2.8~~6~~ Thruster intakes are to be located at sufficient depth to reduce the possibility of ingesting floating debris and vortex formation.

2.2.9~~7~~ Steerable thrusters and thrusters having variable pitch propellers are to be provided with independent supplies of motive power to the pitch and direction actuating mechanisms.

2.2.10~~8~~ Each thruster unit is to be provided with a high power alarm. The setting of this alarm is to be adjustable and below the maximum thruster output.

2.2.11~~9~~ Failure of thruster system including pitch, azimuth or speed control is not to result in an increase in thrust magnitude or change in thrust direction. ~~rotation or uncontrolled full pitch and speed of the thruster.~~

2.2.12~~0~~ The thrust unit housing is to be tested at a hydraulic pressure of not less than 1.5 times the maximum service immersion head of water or 1.5 bar, whichever is the greater.

Section 3

Power Systems

3.1 General

3.1.1 The power systems are to be designed, constructed and installed in accordance with the relevant requirements of Chapter 13, together with the requirements of this Chapter. The power system is to have an adequate response time to changes in power demand. For class notations DP (0) and DP (1), the power system need not be redundant.

3.1.2 For class notation DP (2), the power system is to be ~~divided~~ divisible into two or more systems such that in the event of failure of one system, at least one other system will remain in operation and provide sufficient power for station keeping. The power system may be run as one system during operation, but should be arranged by bus tie breakers to separate automatically upon failures which could be transferred from one system to another, including, but not limited to, overloading and short-circuits.

3.1.3 For class notation DP(3), the power system is to be divisible ~~divided~~ into two or more systems such that in the event of failure of one system, at least one system will remain in operation and provide sufficient power for station keeping. The divided power systems are to be located in different spaces separated by A-60 class division. Where the power systems are located below the damage control deck, the separation is also to be watertight. The bus tie breakers are to be open during operations unless equivalent integrity of power operation can be accepted according to 1.4~~3~~.5.

3.1.6 For class notations DP(2) and DP(3), the power available for position keeping is to be sufficient to maintain the vessel in position after the worst-case failure according to 1.4.2.

3.1.7 For class notations DP(2) and DP(3), at least one automatic power management system (PMS) is to be provided and is to have redundancy according to the equipment class and a blackout prevention function.

3.1.8 Alternative energy storage (e.g. batteries and fly-wheels) may be used as sources of power to thrusters as long as all relevant redundancy, independency and separation requirements for the relevant notation are complied with for class notations DP(2) and DP(3). The available energy from such sources may be included in the consequence analysis function required in 4.2.13 when reliable energy measurements can be provided for the calculations.

3.1.9 Sudden load changes resulting from single faults or equipment failures should not create a blackout.

3.2 Generators

3.2.1 For class notations DP(0) and DP(1), the total generating capacity of the power system is to be not less than the maximum dynamic positioning load together with the maximum auxiliary load. This may be achieved by parallel operation of two or more generating sets provided the requirements of ~~Pt.4~~ Ch.13 are complied with.

~~3.2.5 For class notations DP(2) and DP(3), the power available for position keeping is to be sufficient to maintain the vessel in position after the worst case failure according to 1.3.2.~~

3.4 Control system power supply

3.4.1 An uninterrupted power supply (UPS) is to be provided for each DP control and measuring system (i.e. minimum one UPS for DP(1), two UPSs for DP(2) and three UPSs for DP(3) to ensure that any power failure will not affect more than one computer system and its associated components. The reference systems and sensors are to be distributed on the UPSs in the same manner as the control systems they serve, so that any power failure will not cause loss of position keeping ability. An alarm is

to be initiated in case of loss of charge power. UPS battery capacity is to be sufficient to provide output power at maximum load for 30 minutes operation following mains supply failure. For DP(2) and DP(3), the charge power for the UPSs supplying the main control system is to originate from different power systems. ~~The power supply for the independent joystick system is to be independent of the DP control system UPS.~~

3.4.2 A UPS need not be provided for ships assigned with DP(0) notation, unless required by the manufacturer.

3.5 Auxiliary supplies

3.5.1 Where the auxiliary services and dynamic positioning thrusters are supplied from a common source, the voltage regulation and current sharing requirements defined in Part ~~5~~ 4 of the Rules and Regulations for Construction and Classification of Steel Ships, are to be maintained over the full range of power factors that may occur in service.

Section 4

DP - Control System

4.1 General

4.1.1 The DP control system is to be designed, constructed and installed in accordance with the relevant requirements of Part 4~~5~~, Chapter 8~~2~~ of the Rules and Regulations for Construction and Classification of Steel Ships together with the relevant requirements of this Chapter.

4.2 System arrangement and functions

4.2.2 The DP control station ~~should~~ is to display information from the power system, thruster system and the DP control system to ensure that these systems are functioning correctly. Information necessary to operate the DP system safely is to be visible at all times.

4.2.5 At least one computer system for automatic control is to be provided for class notation DP(0) and DP(1).

4.2.6 The ~~range~~ area of operation is to be adjustable, but should not exceed the specified limits which are to be based on a percentage of water depth, or if applicable a defined absolute surface movement. Arrangements are to be provided to fix and identify the set point for the area of operation. It is to be possible to individually enter new position and heading set points in automatic control mode.

4.2.7 Alarms and warnings for failures in systems interfaced to and/or controlled by the DP-control system are to be audible and visual. A ~~permanent~~ record of their occurrence and of status changes are to be provided together with any necessary explanations.

4.2.8 The DP control system should prevent failures being transferred from one system to another. The redundant components are to be so arranged that a failure of one component is to be isolated and the other component activated smoothly with no loss of position and/ or heading. When combining position reference systems and/or sensors in one unit where more than one function or system can be lost upon one common failure, the consequence to the total system upon such a failure is not to exceed the loss if non-combined installation was adopted.

~~4.2.9 Manual control of the thrusters is to be possible individually and by a common joystick independent of the DP control system. Automatic heading control is to be available along with manual joystick control.~~ Any failure causing operator loss of control of the thrusters in the independent joystick control system is to freeze the thrust commands or set the thrust commands to zero. If the failure affects only a limited number of thrusters, the command to these affected thrusters may be set to zero, while keeping the other unaffected thrusters in joystick control.

4.2.9~~10~~ For class notation DP(2), the DP control system is to consist of at least two independent computer systems so that, in case of any single failure, automatic position keeping ability will be maintained. Common facilities such as self-checking routines, data transfer arrangements and plant interfaces are not to be capable of causing failure of both/ all systems. An alarm is to be initiated if any computer fails or is not ready to take control.

4.2.10~~1~~ Redundant computer systems are to be arranged with automatic transfer of control after a detected failure in one of the computer systems. The automatic transfer of control from one computer system to another is to be smooth~~-~~, with no loss of position and/ or heading ~~and within the acceptable limits of the operation.~~ It is not to be possible to automatically or manually select a controller which is not ready to assume command as the active controller.

4.2.11~~2~~ For class notation DP(3), in addition to the requirements in 4.2.9~~10~~ above, a back-up control system is to be arranged in a room separated by A-60 class division from the main DP control station. During DP operation, this back-up control system is to be continuously updated by input from the sensors, position reference system, thruster feedback etc, and be ready to take over control. The switch-over of control to the back-up computer is to be manual, situated at the back-up computer and not affected by the failure of the main DP-control system. A backup controller status is to be updated at main controller at regular intervals. An alarm is to be initiated if the back up control system fails or is not ready to take control. The back-up DP-control centre is to be arranged with similar view to the vessel's exterior limits and the surrounding area as the main DP-control station. Main and backup DP control systems are to be so arranged that at least one system will be able to perform automatic position keeping after any single failure.

4.2.12 Each DP computer system is to be isolated from other on-board computer systems and communications systems to ensure the integrity of the DP system and command interfaces. This isolation may be effected via hardware and/or software systems and physical separation of cabling and communication lines. Robustness of the isolation is to be verified by analysis and proven by testing. Specific safeguards are to be implemented to ensure the integrity of the DP computer system and prevent the connection of unauthorized or unapproved devices or systems.

4.3 Independent joystick control

4.3.1 A joystick system independent of the automatic DP control system is to be arranged. The power supply for the independent joystick system is to be independent of the DP control system UPSs. An alarm is to be initiated upon failure of the independent joystick system.

4.3.2 It is to be possible to control the thrusters manually, by individual levers and by an independent joystick, in the vent of failure of the DP-control system. Automatic heading control is to be available along with manual joystick control.

4.3.3 If an independent joystick is provided with sensor inputs; failure of the main DP control system is not to affect the integrity of the inputs to the independent joystick.

4.3.4 Any failure causing operator loss of control of the thrusters in the independent joystick control system is to freeze the thrust commands or set the thrust commands to zero. If the failure affects only a limited number of thrusters, the command to these affected thrusters may be set to zero, while keeping the other unaffected thrusters in joystick control.

4.3.5 The power supply for the independent joystick system is to be independent of the DP-control system UPS (as indicated in 3.4.1).

4.43 Position reference systems and environmental sensors

4.43.1 Position reference systems and environmental sensors are to be provided to ensure that the specified area of operation and heading deviation can be effectively maintained. Sensors are to provide new data with a refresh rate and accuracy suitable for the intended DP operations.

4.43.2 Position reference systems are to incorporate suitable position measurement techniques which may be by means of acoustic devices, radio, radar, inertial navigation, satellite navigation, taut wire or other acceptable means depending on the service conditions for which the ship is intended.

4.43.3 For class notation DP(0), at least one position reference system is to be provided. For class notation DP(1), at least two position reference systems are to be provided, ~~each~~ using a different measurement technique and simultaneously available to the DP-control system during operation. Special consideration may be given to cases where the use of two different measuring techniques would not be practicable during DP operation. In such cases, alternative arrangements may be accepted (for e.g. two DGPS systems).

4.34.4 For class notations DP(2) and DP(3), at least three position reference systems incorporating at least two different measurement techniques are to be provided and simultaneously available to the DP-control system during operation. The position reference systems are to be arranged so that a failure in one system will not render the other systems inoperative.

4.34.5 For class notation DP (3), at least one of the position reference systems is to be connected directly to the back-up control system and separated by A-60 class division from the other position reference systems.

4.34.6 Gyrocompass(es), or equivalent means are to be provided to measure the relative heading of the ship.

4.34.7 Vertical reference sensor(s) are to be provided, if applicable, to measure the pitch and roll of the ship.

4.34.8 Means are to be provided to ascertain the speed and direction of wind, acting on the ship.

4.34.9 For class notation DP(2) or DP(3), at least three sensors each are to be provided for measurement of parameters required by 4.3.6 and 4.3.7 and at least two sensors are to be provided for 4.3.8 above. In the event of a failure, of a reference or environmental sensor the control systems are to continue operating on signals from the remaining sensors without manual intervention.

4.34.10 For class notation DP(3), one of each type of sensors is to be connected directly to the back-up control system and separated by A-60 class division from the other sensors. If the data from these sensors is passed to the main DP control system for their use, this system is to be arranged so that a failure in the main DP control system cannot affect the integrity of the signals to the backup DP control system.

4.34.11 Suitable processing and comparative techniques are to be provided to validate the control system inputs from position and other sensors, to ensure the optimum performance of the dynamic positioning system. Abnormal signal errors revealed by the validity checks are to operate alarms. When several systems are combined to provide a mean reference, the mean value used is to not change abruptly by one system being selected or deselected.

4.34.12 The accuracy of the position reference data is generally to be within the following values as a guidance :

- a radius of 2% of water depth for bottom-based systems
- within a radius of 3 [m] for surface-based systems.

4.~~4~~ 5 Alarms

4.45.1 The alarms to be presented in the DP-control centre are normally to be limited to functions relevant to DP operation. Alarms are to be provided for the following fault conditions of the control system/ sensors:

a) Control computer system fault;
b) Automatic changeover to a standby control computer system.
c) Deviation from the predetermined area of operation of the ship;
d) Deviation from the predetermined heading limits of the ship;
e) Position reference system fault (for each reference system);
f) Gyrocompass fault;
g) Vertical reference sensor fault;
h) Wind sensor fault;
i) Taut wire excursion limit; and
j) Automatic changeover to a standby position reference system or environmental sensor.
k) Failure in the independent joystick control system;
l) Loss of charger input power and UPS on bypass power;
m) Limit alarms are to be provided for systems, which have defined range limits;
n) For DP(2) and DP(3), if the consequence analysis is not completed within 2 minutes then an alarm is to be initiated; and
o) Any failure of a standby position control system or positioning reference system selected is also to initiate an alarm.

4.45.2 A manually initiated emergency alarm, clearly distinguishable from all other alarms associated with the dynamic positioning system is to be provided at the dynamic positioning control station to warn all relevant personnel in the event of a total loss of dynamic positioning capability. In this respect consideration ~~should~~ is to be given to additional alarms being provided at locations such as the ~~master's~~ Captain's accommodation and operational control stations.

4.6~~5~~ Internal Communication

4.6.1 A two-way voice communication facility is to be provided between the DP-system control centre and the navigation bridge, ECR and relevant operation control centres.

4.6.2 The two-way voice communication system is to be supplied by a battery or an uninterruptible power supply as a stand-by power supply sufficient to operate the system for at least 30 minutes.

4.7 Requirements for essential non-DP systems

4.7.1 For DP(2) and DP(3), systems not directly part of the DP system, but which in the event of failure could cause failure of the DP system (e.g. common fire suppression systems, engine ventilation, heating, ventilation and air conditioning (HVAC) systems, shutdown systems, etc.), are also to comply with relevant requirements specified in this Section.

Section 5

Tests and Trials

5.1 General

5.1.1 Before a new installation (or any alteration or addition to an existing installation) is put into service, trials are to be carried out. These trials are in addition to any acceptance tests which may have been carried out at the manufacturers' works and are to be based on the approved test schedules list as required by 1.5.54.

5.1.5 For class notations DP(2) and DP(3), FMEA proving trials are to be carried out, to verify the conclusions of the FMEA. The FMEA trials are also to include a complete test of all systems and components and the ability to keep position after single failures associated with the assigned class notation. The type of tests carried out and results are to be recorded and kept on board.~~selected tests within each system analysed in the FMEA are to be carried out to verify the conclusions of the FMEA~~.

5.1.6 Three copies of the dynamic positioning system test schedules, as required by 1.5.54, signed by the Surveyor, the Coast Guard Authority and Shipbuilder are to be provided on completion of the survey. One copy is to be placed on board the vessel and the others to be submitted to IRS and the Coast Guard Authority.

End of Chapter