Guidance for Classification And Construction

Part 3 Special Ships

Volume B

Guidance for Certification of FRP Fishing Vessel less than 12 m

2020

Biro Klasifikasi Indonesia

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The following Rules come into force on 1 February 2020.

Amendments to the preceding Edition are marked by red color and expanded text.

Foreword

Guidance for Certification of FRP Fishing Vessel less than 12 m 2020 Edition amends Guidance for Certification of Undecked FRP Fishing vessel less than 12 m 2018 Edition. Reference sources of the Guidance are derived from Safety Recommendation of Decked Fishing Vessel of less than 12 m and Undecked Fishing Vessel, other Classification Society Rules, Procedural Requirements and inputs from BKI Branch Offices and Technical Division of BKI Head Office.

The summary of current amendments for each section including the implementation date are indicated on the page of Rules Amendment Notice.

This rules is available to be downloaded at www.bki.co.id. Once downloaded, this Rules will be uncontrolled copy. Please check the latest version on the website.

Further queries or comments concerning this Rules are welcomed through communication to BKI Head Office.

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Guidance Amendment Notice

These pages contain amendments within the following section of the Guidance for Certification of FRP Fishing Vessel, 2020 Edition.

These amendments will come into force as indicated in the table

Paragraph	Title/Subject	Status/Remark
Section 1 – Introduction		*The amendments are effective from 1 February 2020*
A	**Scope**	
A.1.1	No Title	To add type of ship use deck
C	**Definitions**	
C	Reference to Annex A	To add reference to annex A
C.2	Similar stage	To add new definition "A similar stage of construction"
C.6	Collision bulkhead	To add new definition of collision bulkhead
C.8	Decked vessel	To add new definition of decked vessel
C.9	Decked erection	To add new definition of decked erection
C.10	Deepest operating waterline	To add new definition of deepest operating waterline
C.12	Enclosed superstructure	To add new definition of enclosed superstructure
C.17	Height of superstructure	To add new definition of height of a superstructure
C.23	Superstructure deck	To add new definition of superstructure deck
C.25	Watertight	To add new definition of watertight means
C.26	Weathertight	To add new definition of weathertight means
C.27	Working deck	To add new definition of working deck
Section 2 – Certification systematics		*The amendments are effective from 1 February 2020*
C	**Technical documentation**	
C.1.3	Technical documentation	To change reference for document to be submitted
D	**Certificates**	
D.1.1	Certificates	To add kind of certificates to be published
D.1.2	List drawings	To add information on certificates
Section 3 – Procedures		*The amendments are effective from 1 February 2020*
B	**Series of Vessel**	
B.2	Design compliance	To change type approval requirement to design compliance requirement
B.2.2	Reference	To change reference
Section 4 – Testing/Sea trials		*The amendments are effective from 1 February 2020*
4.A.1	No Title	To complete old provision
Section 5 – Design principles		*The amendments are effective from 1 February 2020*
A	**Documentation**	
A.1.1	No Title	To add drawing group for document to be submitted
A.1.2	No Title	Deleted
Section 6 – Fibre reinforced plastics		*The amendments are effective from 1 February 2020*
A	**General requirements**	

A.	General requirements	To change sub-section title
A.2	No Title	To add kind of certification for raw material
B	**Material properties**	
B.1	No Title	Deleted
B.1.1	No Title	Deleted
B.1.2	No Title	Deleted
Section 7 – FRP structural design *The amendments are effective from 1 February 2020*		
A	**General**	
A.1.1	No Title	To add the requirements of decked vessel
A.1.2	No Title	To add the requirements of decked vessel and inboard engine
Table 7.1	Maximum operating speed	To add the requirement of maximum speed for LOA = 15 m
A.2.5.6	No Title	To state that requirement just for undecked vessel
A.2.5.16	No Title	To add the requirement of engine seating for inboard engine
A.2.5.17	No Title	To add the requirement of engine seating for inboard engine
A.2.6	Deck construction	To add the requirement of decked vessel
B	**FRP Structure**	
B.3	No Title	Repetition of the previous paragraph
Table 7.2	Cubic numeral and loaded displacement	To add the requirement of decked vessel
B.4	Hull and deck laminate	To add the requirement of decked vessel
B.4.1	No title	To match Table 7.3
B.4.2	No title	To add the requirement of decked vessel
Table 7.4	Minimum deck laminate weight	To add the requirement of decked vessel
Table 7.8	Deck stiffener- Section modulus	To add the requirement of decked vessel
C	**Watertight integrity**	
C	No title	To add the requirement of watertight integrity
D	**Anchoring and mooring equipment**	
D	No title	To add the requirement of anchoring and mooring equipment
Section 8 – Stability *The amendments are effective from 1 February 2020*		
A	**General**	
A.2.1	No title	To change requirements of documentation to submitted for approval FRP fishing Vessel
A.2.3	No title	To add new requirements of documentation to submitted for approval FRP fishing Vessel
B	**Stability**	
B.1	Stability criteria	To add new requirements regarding stability criteria for decked vessels
B.2	Alternative stability criteria	To add new requirements regarding alternative stability criteria for decked vessel
B.2.1.1	No title	To change requirements of alternative stability criteria for decked vessel
B.2.1.2	No title	To change requirements of alternative stability criteria for decked vessel
B.2.4	Offset load test	To add new requirements regarding offset load test
B.3	Stability criteria for undecked vessels	To add new requirements regarding alternative stability criteria for undecked vessel

B.4	Inclining test for decked vessels	To add new requirements regarding inclining test for decked vessels
B.5	Built-in buoyancy for undecked	To add new requirements regarding built-in buoyancy for undecked vessel
Section 9 – Machinery Installation *The amendments are effective from 1 February 2020*		
A	General	
A.2	No title	To add requirements of application for machinery spaces
A.3	No title	To add requirements of application for machinery spaces
A.4	No title	To add requirements of application for machinery spaces
A.5	No title	To add requirements of application for machinery spaces
A.6	No title	To add requirements of application for machinery spaces
A.7	No title	To add requirements of application for machinery spaces
A.8	No title	To add requirements of application for machinery spaces
A.9	No title	To add requirements of application for machinery spaces
B	Propulsion engine	
B.1	Inboard engine	To add requirements of application for propulsion engine
B.1.1	No title	To add requirements of application for inboard engine
B.1.2	No title	To add requirements of application for inboard engine
C	Shaft and propeller	To add new requirements regarding shaft and propeller
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E	Control and instruments	To add new requirements regarding control and instruments
F	Steering arrangement	To add new requirements of application for steering arrangement
G	Pumping and piping system	To add new requirements of application for pumping and piping systems
H	Ventilation of the engine room	To add new requirements of application for Ventilation of the engine room
Section 10 – Electrical Installation *The amendments are effective from 1 February 2020*		
New Requirements		
Section 11 – Fire fighting and life saving appliances *The amendments are effective from 1 February 2020*		
A	Structure	
A.1	No title	To add requirements of application for fire fighting in engine spaces
A.2	No title	To add requirements of application for fire fighting in engine spaces
C	Miscellaneous items	
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Section 12 – Protection of the Crew *The amendments are effective from 1 February 2020*		
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Annex C – Recommended Practice for Exhaust Systems *The amendments are effective from 1 February 2020*		
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Section 1 Introduction

A. Scope

1. General

1.1 The purpose of this Guidance is to provide a certification service provided by BKI for FRP fishing vessel of less than 12 m in length[1] intended to operate at sea. The sea definition includes but not limited to oceans, rivers, lakes and dams with significant wave height up to 1.5 m.

1.2 The certification aims at providing an appropriate safety level for the fishing vessels, their intended application and design limitations.

1.3 This Guidance apply only to FRP fishing vessel build by the hand lay-up method in single skin construction.

1.4 The certification services described in this Guidance apply only to newbuilding vessel. No services for operational phase are provided.

1.5 Certification according to this Guidance does not ensure compliance with any mandatory national or international regulations.

B. Requirements

1. General

1.1 The regulations with respect to certification systematic and formalities are given in Section 2 and Section 3. The technical requirements are given in Section 5 through Section 12.

1.2 The requirements which are in force at the date of the written agreement are the basis for the certification.

C. Definitions

For the application of this Guidance, unless expressly provided otherwise, the following definitions apply. Illustration for the dimensions are given in Annex A.

1. **Amidships** means the mid-length of L_{OA}.

2. "A similar stage of construction" is the date that the first structural reinforced of the complete thickness of the approval hull laminate schedule is laid either in or on the mould.

3. **Baseline** is the horizontal line intersecting at amidships the keel line.

[1] A vessel of less than 12 m in length (L) could be in excess of 15 m in length overall (LOA).

4. **Bow height** is defined as the vertical distance at the forward perpendicular between the waterline corresponding to the maximum permissible draught and the designed trim and the top of the exposed deck at side.

5. **Breadth (B)** is the maximum breadth of the vessel, measured at maximum beam to the outer surface of the hull in a vessel.

6. **Collision bulkhead is a watertight bulkhead up to the working deck in the fore part** of the vessel as approved by BKI.

7. **Cubic Numeral (CuNo)** is the result of multiplying length overall x breadth x depth (L_{OA} x B x H).

8. **Decked vessel** is a vessel having a fixed watertight deck covering the entire hull above the deepest operating waterline. Where open wells or cockpits are fitted in this deck the vessel is considered a decked vessel if flooding of the well or cockpit will not endanger the vessel.

9. **Deck erection** is any decked structure on the working deck.

10. **Deepest operating waterline** is the waterline related to the maximum permissible operating draft.

11. **Depth (H)** is the moulded depth amidships.

12. **Enclosed superstructure** is a superstructure with:

1) enclosing bulkheads of efficient construction;
2) access openings, if any, in those bulkheads fitted with permanently attached weathertight doors of a strength equivalent to the unpierced structure that can be operated from each side; and
3) other openings in sides or ends of the superstructure fitted with efficient weathertight means of closing. A raised quarter-deck is regarded as a superstructure. A bridge or poop shall not be regarded as enclosed unless access is provided for the crew to reach machinery and other working spaces inside those superstructures by alternative means that are available at all times when bulkhead openings are closed

13. **Operating vessel** is a vessel that is not a new vessel.

14. **Fishing vessel** (here to after referred to as vessel) means any vessel used commercially for catching fish, whales, seals, walrus or other living resources of the sea.

15. **Forward and after perpendiculars** shall be taken at the forward and after ends of the length (L). The forward perpendicular shall be coincident with the foreside of the stem on the waterline on which the length is measured.

16. **Freeboard (f)** is the actual minimum freeboard, the distance from the gunwale or a down-flooding opening, whichever is lower, measured perpendicularly to the waterline. A downflooding opening is an opening in the hull.

17. **Height of a superstructure** or **other erection** is the least vertical distance measured at side from the top of the deck beams of a superstructure or an erection to the top of the working deck beams.

18. **Keel line** is the line parallel to the slope of keel passing amidships through:

1) the rabbet lower line of the keel of a vessel with a shell of composite material; or

2) the intersection of a fair extension of the outside of the shell contour at the bottom with the centreline of a vessel with a FRP shell.

19. **Least depth** is the depth measured from the keel line to the top of the moulded depth beam at side.

20. **Length (L)** shall be taken as 96 percent of the total length on a waterline at 85 percent of the least depth, or as the length from the foreside of the stem to the axis of the rudder stock on that waterline, if that length is greater. In vessels designed with rake of keel, the waterline on which this length is measured shall be parallel to the designed waterline.

21. **Length overall (L_{OA})** shall be taken as the distance in a straight line parallel to the design waterline between the foremost point of the bow and the aftermost point of the stern.

22. **New vessel** is a vessel the keel of which is laid, or which is at a similar stage of construction, on or after the date of adoption of these guidances.

23. **Superstructure deck** is that complete or partial deck forming the top of a deck erection situated at a height of not less than 1.8 m above the working deck. Where this height is less than 1.8 m, the top of such deck erection shall be treated in the same way as the working deck.

24. **Undecked vessel** is a vessel which is not a decked vessel.

25. **Watertight** means capable of preventing the passage of water through the structure in any direction under a head of water for which the surrounding structure is designed.

26. **Weathertight** means that in any sea conditions water will not penetrate into the vessel.

27. **Working deck** is generally the lowest complete deck above the deepest operating waterline from which fishing is undertaken. In vessels fitted with two or more complete decks, BKI may accept a lower deck as a working deck provided that that deck is situated above the deepest operating waterline.

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Section 2 Certification Systematics

A. General

1. General

1.1 The relation between the Customer and BKI is regulated in an Agreement signed by both parties. The agreement specifies the scope of the service, the fee, terms of payment and legal obligations.

1.2 The certification service is performed on the basic assumption that all parties involved (designer, builder/yard, manufacturer, design-owner, sub-contractor, owner, etc.) fulfil their individual obligations. The certification service is not performed in substitution of other parties' role or obligations. Nothing contained in BKI services, certificate, report or document issued in connection with or pursuant to these requirements, shall relieve any designer, engineer, builder, manufacturer, yard, seller, owner, operator or other parties from any obligations or consequences of default whatsoever. In particular, compliance with the requirements does not imply acceptance or commissioning of a vessel. This is the exclusive responsibility of the owner.

B. Certification - Procedures

1. General

1.1 The certification procedures are based on two phases; approval of design phase and manufacturing phase. The procedures are described in Section 3. Information about what procedures to choose and detailed requirements for each phase is given in Section 3.

1.2 Application for certification shall be sent to the BKI office and include :

- The name and address of the applicant (ship owner)
- The name and address of the builder (yard, manufacturer)
- Chosen procedure(s)
- Technical documentation.

1.3 If the Applicant subcontract design or production, the applicant remains responsible for the execution of conformity assessment for all technical documentation, sub-supplies and the finished vessel.

1.4 Any subcontracting will be subject to separate agreement, handling and approval.

1.5 BKI decides the extent of examinations, tests and inspections required to complete the relevant procedure (phase) in each case.

1.6 Requirement for manufacturing shall be surveyed and accepted according to requirement in Section 6.

C. Technical Documentation

1. General

1.1 The Applicant shall submit Technical Documentation for approval irrespective of certification procedure.

1.2 Technical Documentation shall enable understanding of the design and construction of the vessel, and shall confirm compliance with the requirements given in these guidances.

1.3 Requirements for technical documentation are found in Section 5.

D. Certificates

1. General

1.1 The type of certificates to be issued by BKI will be:

- Certificate of Compliance (CoC)
- Design Compliance Certificate

1.2 The certificates shall contain the following information as applicable:

- The name and address of the ship owner
- The name and address of the builder (yard, manufacturer)
- The identification of the product-vessel type designation
- Reference to the Standards and regulations applied
- List of drawings (for Design Compliance Certificate)
- Any restrictions/limitations in the use of the vessel
- Validity (if applied)
- Date of issue and signatures.

Section 3 Procedures

A. One-off Vessel

1. General

1.1 The procedure is applicable for One-off certification, i.e. a design on which only one vessel is built.

2. Procedure

2.1 BKI will verify that the Technical Documentation complies with the requirements.

2.2 BKI will carry out surveys during production, examine the complete vessel and carry out the appropriate tests as set out in the relevant requirements to ensure its conformity.

2.3 Upon successful completion of the certification procedure, BKI will issue a Certificate of Compliance (CoC).

B. Series of Vessel

1. General

1.1 The procedures described in 2. and 3. are applicable to one design on which a series of vessel is manufactured. 2. covers the design phase and shall always be followed by a procedure covering the production phase in 3.

2. Design assessment

2.1 The procedure shall normally be used for assessment of a design (drawings) produced in series and must be followed by a procedure covering the production phase.

2.2 The procedure shall be according to Guidance for The Approval and Type Approval of Materials and Equipment for Marine Use (Pt.1, Vol.W), Sec. 4.A.

2.3 BKI verifies that the Technical Documentation complies with the requirements.

2.4 Upon successful completion with the certification procedure, BKI will issue a Design Compliance Certificate with validity of 5 years.

3. Product verification

3.1 The procedure covers the production phase and follows procedure for design assessment in 2.

3.2 The builder shall take necessary actions to ensure that the manufacturing process ensures conformity of the products with the type as described in the approved technical documentation.

3.3 Normally all products will be individually examined and appropriate tests carried out in order to verify their conformity with the type as described in the Design Compliance Certificate and the approved technical documentation.

3.4 If non individually test and examination is carried out, the number of sample shall be according to the following :

1) Number of personil/group who conducted hand lay-up or Number of vessel series (1 sample for max 100 vessels) and
2) Number of laminate schedule

If sample not meet the requirements, re-test shall be carried out according to Rules for Non Metallic Material (Pt.1, Vol.XIV) Chapter 1, Sec.2

3.5 Upon successful completion of the certification procedure, BKI will issue a Certificate of Compliance (CoC) covering each unit.

Section 4 Testing/Sea Trials

A. General

1. All equipment shall be function tested after installation to demonstrate compliance with the requirements in this Guidance. The testing shall include sea trial(s) with all equipment installed. All testing shall be carried out according to a plan approved by Inspector. The Inspector may require witnessing of all or part of the testing and/or sea trials.

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Section 5 Design Principles

A. Documentation

1. Plans and particulars

1.1 The following particulars and/or plans, as applicable, shall be submitted for approval:

1.1.1 Main plans

- General arrangement including main particulars (Lwl, Bwl, Δ, L) and maximum speed V
- Lines plan including table offset

1.1.2 Hull plans

- Transverse section including laminate schedule
- Profile construction
- Aft peak structures (if applicable)
- Forepeak structures (if applicable)
- Superstructure or deckhouse construction (if applicable)
- Transverse bulkhead
- Rudder and rudder stock
- Hatch cover (if applicable)
- Appendages with their attachments to the hull (if applicable)
- Additional documentation may be required.

1.1.3 Machinery and electrical plans

- Machinery arrangement
- Propeller shaft
- Shafting arrangement
- Propeller
- Fuel oil system
- Bilge and ballast piping diagram
- Wiring diagram
- Steering gear systems
- Additional documentation may be required.

B. Alternative design standards

1. The application of other standards for structural design is subject to special consideration by BKI and agreement with client. Other standard for structural design recognized by BKI is ISO 12215.

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Section 6 Fibreglass Reinforced Plastics

A. General Requirements

1. This Section applies to raw materials and laminate of Fibreglass Reinforced Plastics (FRP) in single skin construction from E-glass consisting Chopped Strand Mat (CSM) and Woven Roving (WR).

2. Raw materials shall be delivered under a certification scheme recognized by BKI (Type Approval). The following materials shall be certified:

- Fibreglass reinforcement
- Resin product (gelcoat and laminating resins)

3. Marking of product

3.1 Each batch shall be marked with the manufacturers name, type designation, approval certificate reference, batch number and date of manufacture.

3.2 Products lacking the marking specified in 3.1 shall be subject to a product control testing verified by a recognized institution.

B. Material Properties

1. Properties of raw materials

All raw materials shall comply with the requirements given in one of the following standards:

- Rules for Non Metallic Material (Pt.1, Vol.XIV), Chapter 1, Sec.2.
- ISO 12215-1
- Other recognized standards.

2. Properties of laminate

The laminates shall comply with the requirements given in Rules for Small Vessel up to 24 m (Pt.3, Vol.VII) Sec.1.B.3.

C. Manufacturing

1. Introduction

1.1 In this sub-section requirements related to the manufacturing, quality assurance and quality control of FRP structures are given. It is to be recognised by the yard that there are limited or no means for non-destructive examination of FRP structures available. The yard shall therefore recognise the importance of exercising a rigorous control of all steps of the fabrication to ascertain that the finished product complies with its specification(s).

1.2 The use of fabricating procedures differing from those specified in this section will be subject to special consideration.

2. Storage of raw materials

2.1 Laminating resins shall be stored in accordance with the manufacturer's instructions. If no such instructions are provided, then they shall be stored in dark, dry rooms at a temperature between 10°C and 18°C. The temperature of the storage-rooms shall be recorded continuously by means of thermographs.

2.2 Hardeners, catalysts and accelerators shall be stored separately in well-ventilated rooms in accordance with the manufacturer's instructions. If no instructions are provided, they shall be stored in dark, dry rooms at temperatures between 10 °C and 18 °C.

2.3 Reinforcing materials, fillers and additives shall be stored in closed containers, in dry and dust-free conditions.

2.4 Storage shall be arranged in such a way that the identification of the materials, their storage conditions and maximum period of storage (expiry date) as prescribed by the manufacturer are clearly visible. Materials whose duration of storage exceeds the expiry date shall be removed immediately from the stores.

2.5 Quantities of materials due to be processed shall be brought to the production shops as early as possible to ensure complete adjustment to the processing temperature ($\Delta T \leq 2°$ C), with the containers remaining closed.

2.6 Materials taken from the stores and partially used shall only be replaced in the stores in special cases and with the consent of BKI.

3. Manufacturing premises and conditions

3.1 Manufacturing premises shall be so equipped and arranged that the material supplier's directions for handling the materials, the laminating process and curing conditions can be followed.

3.2 The manufacturing premises shall be free from dust and other contamination that may in any way impair the quality of the end product and safe working condition.

3.3 The workshop shall be closed spaces capable of being heated and having supply and exhaust ventilation. The air temperature in the workshop shall not be less than +18°C. The stipulated minimum temperature shall be attained at least 24 hours before commencement of lamination and shall be maintainable regardless of the outdoor air temperature.

The temperature in the moulding shop shall not vary more than ±5°C. This limit can be exceeded provided it has no detrimental effect on the product and provided there is no risk for condensation of humidity.

3.4 The relative humidity of the air shall be kept so constant that condensation is avoided and shall not exceed 80%. A higher relative humidity can be accepted on a case by case basis provided an adequate margin against the risk for condensation of humidity is provided. The stipulated air humidity shall be maintainable regardless of outdoor air temperature and humidity. More stringent requirements to humidity shall be adhered to if recommended by the manufacturer.

3.5 Other manufacturing conditions may be accepted based on special agreement with BKI provided that condensation of humidity can be safely avoided.

3.6 Air temperature and relative humidity shall be recorded regularly and the records filed for a period of at least two years. In larger shops there shall be at least one thermohydrograph for each 1500 m^2 where lamination is carried out. The location of the instruments shall be such as to give representative measurement results.

3.7 Draught through doors, windows etc. and direct sunlight is not acceptable in places where lamination and curing are in progress.

3.8 The ventilation plant shall be so arranged that the curing process is not negatively affected.

3.9 Sufficient scaffoldings shall be arranged so that all lamination work can be carried out without operators standing on the sandwich core or on surfaces on which lamination work is taking place.

3.10 During lamination of larger constructions the temperature shall be recorded at least at two levels vertically in the workshop and the curing system shall be adjusted to compensate for possible temperature differences.

3.11 Prefabrication of panels and other components shall be carried out on tables, fixtures etc. above the shop floor level. No fabrication shall be carried out on the shop floor.

3.12 Completed mouldings shall not be taken outside the workshop environment for seven days from the start of the moulding process. Where mouldings are moved outside after this period, they shall be protected from rain.

3.13 The addition of a catalyst to polyester products shall be strictly controlled within the limits set by the manufacturers. Tables giving the amounts of catalyst/resin shall be provided in the workshop.

3.14 The catalyst must be properly dispersed through the resin by very thorough mixing.

3.15 Where a primary bond would be achieved, little preparation of the surface is required prior to further laminating or bonding. A primary bond is generally achieved if the surface has cured for about 24 hours to 48 hours and is still chemically active, allowing a chemical bond.

3.16 Where a secondary bond would be achieved, additional surface preparation is required in the form of abrasion and cleaning. A secondary bond is achieved when the surface has cured for over 48 hours and is no longer chemically active; in this case the bond relies on the adhesive properties of the resin.

4. General requirements to production procedures and workmanship

4.1 Raw materials for all structural members covered by the rules shall be of approved type in accordance with B. The supplier's directions for application of the materials shall be followed.

4.2 Specified procedures shall be implemented for all tasks with significance to the quality of the end product. Where necessary to exercise a satisfactory control of the quality, these procedures shall be documented in writing in controlled documents.

4.3 The reference direction of reinforcement shall after being laid not deviate from that specified by more than ±5°.

4.4 Adjacent sheets of reinforcement shall in the normal case overlap to give structural continuity. the overlap shall not be smaller than 50 mm. In areas of low utilisation, overlaps may be dispensed with subject to the approval of BKI. Overlaps shall be staggered through the thickness of the laminate. The distance between two overlaps in adjacent plies shall not be smaller than 100 mm.

4.5 Thickness changes in a laminate shall be tapered over a minimum distance equal to 20 times the thickness difference.

5. Manual lamination

5.1 The reinforcement material shall be applied in the sequence stated on the approved plan(s).

5.2 When the laminate is applied in a mould a CSM of maximum 450 g/m^2 shall be applied next to the gelcoat. The mat can be dispensed with provided a satisfactory resistance against water can be ensured.

5.3 The resin shall be applied on each layer of reinforcement. Gas and air pockets shall be worked out of the laminate before the next layer is applied. Rolling of the layers shall be made carefully, paying special attention to sharp corners and transitions. The viscosity and gel-time of the resin shall be adequate to prevent drain-out of resin on vertical and inclined surfaces. The tools and methods used when working the laminate shall not damage the fibres.

5.4 The time interval between applications of each layer of reinforcement shall be within the limits specified by the resin supplier. For thicker laminates care shall be taken to ensure a time interval sufficiently large to avoid excessive heat generation.

5.5 Curing systems shall be selected with due regard to the reactivity of the resin and in accordance with the supplier's recommendations. Heat release during curing shall be kept at a safe level in accordance with the material manufacturer's recommendations. The quantity of curing agents shall be kept within the limits specified by the supplier.

5.6 After completion of lamination, polyester laminates shall cure for at least 48 hours at an air temperature of minimum +18°C. Curing at a higher temperature and a shorter curing time may be accepted on the basis of control of the curing rate. For other types of resins curing shall be carried out according to the specified cure cycle and according to the resin manufacturer's recommendations.

6. Curing

6.1 Cure cycles shall be documented by temperature records.

6.2 For cure taking place at room temperature in the workshop the registrations made in the workshop are sufficient to document the cure cycle.

6.3 For cure at elevated temperature, fans with ample capacity shall be operated in the compartment in which the cure is carried out to ensure an even distribution of temperature. Continuous records of temperature throughout the complete cure cycle shall be provided. Recording points shall be distributed throughout out the length, width and height of the cure compartment to the extent necessary to verify that the temperature distribution is even.

7. Secondary bonding

7.1 A secondary bonding is defined as any bond between two FRP structures which is made after one or both of the individual structures has effectively cured.

7.2 The surface ply of a laminate subject to secondary bonding and the first ply of the bonding laminate shall normally be of CSM. This mat can be dispensed with provided the necessary bond strength is reached.

7.3 Surfaces in way of secondary bonding shall be clean and free from dust and other forms of contamination.

7.4 Where a secondary bond would be achieved, additional surface preparation is required in the form of abrasion and cleaning. A secondary bond is achieved when the surface has cured for over 48 hours and is no longer chemically active; in this case the bond relies on the adhesive properties of the

resin. Laminates on which secondary bonds are to be carried out shall have an adequate surface preparation, normally including grinding.

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Section 7 FRP Structural Design

A. General

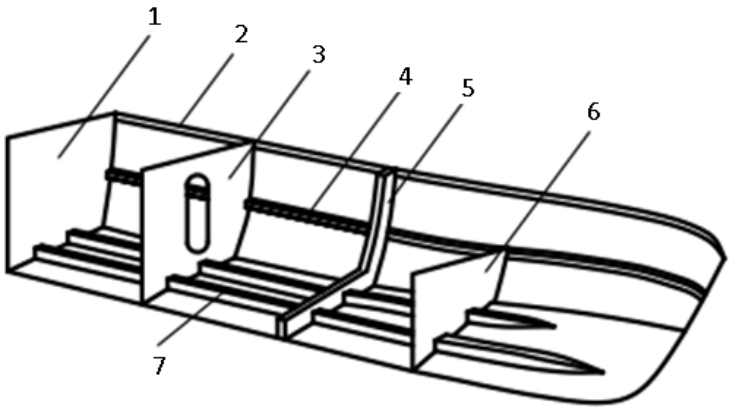
1. Application

1.1 The requirements in this Section apply to fibreglass reinforced plastic (FRP) single skin construction for decked and undecked fishing vessel less than 12 m in length.

1.2 In general, these Guidances apply to vessel by hand lay-up lamination method and of fibreglass reinforced plastic construction (FRP). That is, single-hull vessels of glass roving and mat and polyester/epoxy resin construction, which, in general, shall consist of:

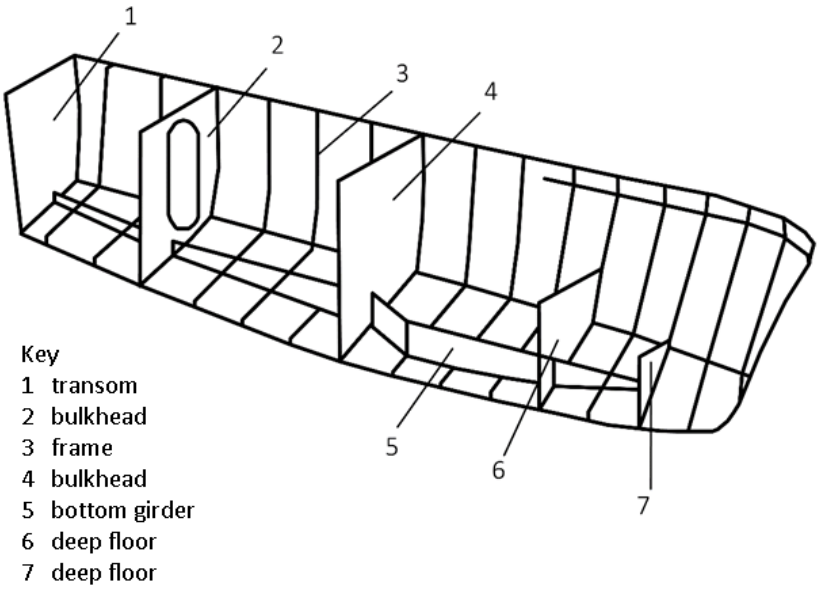
- a moulded hull of single-skin construction;
- a deck of FRP construction;
- transverse framing;
- a longitudinal structure, including gunwale, stringers, engine beds; and
- In small vessels, internal furniture and hull form which may provide adequate stiffening.

Typical framing for FRP vessel see Figs. 7.1 to 7.3.



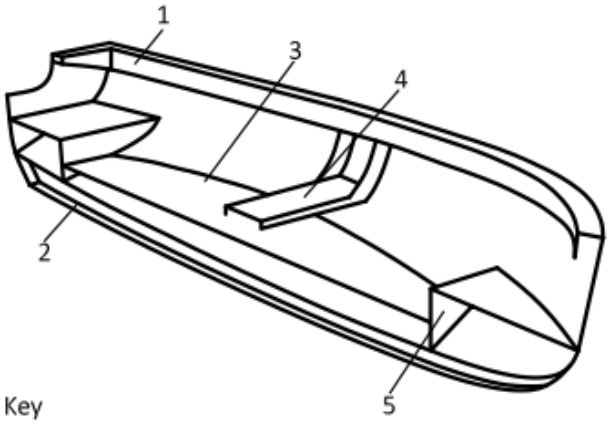
Key
1 transom
2 gunwale stringer
3 bulkhead
4 side longitudinal stiffener (stringer)
5 web frame
6 deep floor
7 bottom longitudinal stiffener (girder or stringer)

Fig 7.1 Typical longitudinal framing in a FRP vessel



Key
1 transom
2 bulkhead
3 frame
4 bulkhead
5 bottom girder
6 deep floor
7 deep floor

Fig 7.2 Typical transverse framing in a FRP vessel



Key
1 gunwale stringer
2 keel
3 structural sole
4 thwarts
5 deep floor

Fig 7.3 Typical framing in a small FRP vessel

1.3 These Guidances apply for vessels operating at speeds up to 18 knots, as shown in Table 7.1.

Table 7.1 Maximum operating speed

Length overall LOA (m)	4	6	8	10	12	15
Maximum speed (knots)	9	11	13	15	16	18

2. Construction standard

2.1 The appropriate standard of construction for FRP fishing vessel shall be determine as set out in this Section.

2.2 Consideration shall be given to increasing the scantlings given in these Guidances in parts of a vessel where special conditions may arise, including:

- operation of fishing gear likely to damage structure by impact or abrasion; and
- landing and hauling out of vessels on beaches and riverbanks.

2.3 Materials

2.3.1 Raw material shall be approved for marine use (see Section 6) and be mixed and used in accordance with the manufacturer's recommendations.

2.3.2 Colour pigment may be used in the gelcoat sufficient to give a satisfactory colour; the amount used shall be in accordance with the manufacturer's recommendations. No pigment shall be used in the lay-up resin of the hull laminates.

2.3.3 Formers for stiffeners shall be of rigid foam, timber, metal or other approved materials. Where timber is used, it shall have a moisture content of not more than 15 percent. A common type of former for top-hat stiffeners is made of one layer of mat in a mould of the required stiffener dimensions.

2.4 Workshop practice and hand lay-up laminate process shall be refer to Section 6.

2.5 Hull construction

2.5.1 The hull bottom shall be a solid laminate of glass reinforcements in resin, laid up to a satisfactory weight. The keel and sheerstrake areas of the hull shall have additional reinforcements.

2.5.2 Hulls shall be adequately stiffened; this reinforcement may be in the form of longitudinal or transverse stiffeners or a combination of both.

2.5.3 Stiffeners may be constructed by moulding over foam or hollow formers which shall be bonded to the inside hull laminate; for a description of primary and secondary bonding, see Section 6, C. 3.15 and 3.16 . Frame formers may be of top-hat or rectangular section (see Fig. 7.4). Where frames have gunwales or through-bolted stringers, the core of the frames is to be of timber.

Fig 7.4 Typical frame construction

2.5.4 Floors moulded over formers are to be fitted to the tops of the frames at the centre line and bonded to the frames.

2.5.5 Stringers, where fitted, may use foam or hollow formers and shall be bonded to the hull shell; for a description of primary and secondary bonding, see Section 6, C. 3.15 and 3.16. Alternatively, these may be formed of a combination of other longitudinal structural members, such as soles, decks and lockers.

2.5.6 In undecked vessels, the required bottom stiffening may be provided wholly or partly formed by the bonded-in flooring arrangement.

2.5.7 Where through-bolting connections are required, e.g. for gunwales or beam stringers, fastenings shall be hot-dipped galvanized or of stainless steel. The edges of the laminate and the fastening holes shall be sealed with resin or other suitable material.

2.5.8 The hull surface gel coat is to be adequately protected in way of all fishing gear hauling positions by FRP sheathing, metal, hard rubber or plastic, to prevent damage.

2.5.9 Discontinuities and hard points in the structure shall be avoided. Where the strength of a stiffener may be reduced by attachment of fittings, openings, etc., additional laminates shall be included.

2.5.10 Transoms not subjected to loads from outboard en

gines shall have scantlings as required for the shell laminate.

2.5.11 The glass weight at the corner of the transom and hull shell shall be increased to provide additional reinforcement.

2.5.12 Transoms that are to be used for the mounting of outboard engines shall be constructed to include a marine-grade plywood panel of sufficient dimension and of adequate strength for the proposed installation.

2.5.13 The stem shall be moulded to include a gradual reduction from the keel weight to that required for the sheer.

2.5.14 The centre of the hull aft of the keel to the transom is to be stiffened by lay-ups as required for the keel.

2.5.15 Where fitted, rubbing strakes may be of hardwood, rubber or plastic; securing bolts shall be hot-dipped galvanized and sealed to prevent leakage.

2.5.16 Engine seatings shall generally be continuous structures and, where space permits, the seatings shall extend at least twice the length of the engine.

2.5.17 The seatings shall be bonded to the hull and stiffened transversely with floor sections and side support brackets. A continuous flat steel plate of adequate thickness and width is to be fitted to the top of the seating in way of the engine and gearbox and bonded to the seating.

2.5.18 Where included, it is recommended that bulkheads are fitted to a rigid foam core seating or frame section, see Fig. 7.5. When not practical to fit on a frame position, the bulkhead shall be bonded to the shell with double angles of a satisfactory weight.

2.5.19 Bolt connections shall be well-sealed and glassed over to prevent leakage.

2.5.20 Consideration shall be given to including easily replaceable sacrificial structures and additional layers of laminate in locations where impact or abrasion could occur. These include areas subject to wear, such as gunwales and keels, and areas subject to impact or abrasion by fishing gear.

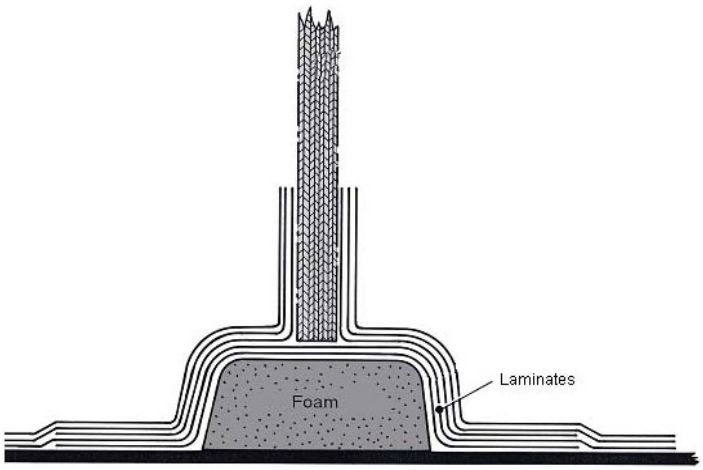


Fig 7.5 Typical bulkhead installation

2.6 Deck construction

2.6.1 A beam shelf or stringer is to be bonded to the hull shell to support the deck beams. A system combining through-bolting and bonding is recommended.

2.6.2 Deck beams shall be fitted at each frame position, with longitudinal stiffening provided by hatches and carlings as required.

2.6.3 Decks in way of gallows, warp leads, deck machinery and heavy work positions shall have additional stiffening and pillars.

2.6.4 Main beams shall be fitted in way of all deck openings, machinery and deckhouse casings, and in way of masts and heavy deck machinery.

2.6.5 Openings in the deck may be stiffened by forming continuously moulded flanges, the weight of which shall be 25 percent greater than the laid-up deck laminate weight. Deck openings over 500 mm in length shall be fitted with longitudinal stiffening.

B. FRP Structure

1. All vessels shall meet requirements that are compatible with these Guidances or an equivalent recognized standard (see Section 5) and be built to the satisfaction of BKI.

2. The hull constructions are based on the loaded displacement of the vessel, including vessel, crew, fishing gear, fuel, fish and ice, stores and equipment. Where this is not known, an approximation can be made from the Cubic Numeral (CuNo) of the vessel; approximate values are shown in Table 7.2.

3. The nominal thickness (t) of the laminate is:

- for chopped strand mat (CSM) based on 0,70 mm per 300 g/m^2 weight of laminate reinforcement with 30% glass content.
- for woven roving (WR) based on 0,974 mm per 800 g/m^2 weight of laminate reinforcement with 50% glass content.

Table 7.2 Cubic numeral and loaded displacement

Cubic numeral (CuNo) (m^3)	Undecked vessel approximate loaded displacement (kg)	Decked vessel approximate loaded displacement (kg)
4	600	-
6	900	-
8	1200	-
10	1500	-
12	1800	-
14	2100	-
16	2400	-
18	2700	-
20	3000	4800
25	3750	6000
30	4500	7200
35	-	8400
40	-	9600
45	-	10800
50	-	12000
60	-	14400
70	-	16800
80	-	19200
90	-	21600
100	-	24000

Note :
The figures given are approximate and, where possible, it is better to obtain accurate displacement figures from calculations and measurements.

4. Hull and deck laminate

4.1 Hull laminate shall be of a thickness that is suitable for the loaded displacement of the vessel and the spacing of the framing. Table 7.3 shows the minimum required laminate weight (w) and equivalent thickness (t).

4.2 Deck laminate shall be of a thickness that is suitable for the size of the vessel and the spacing of the frames (or panel size). Table 7.4 shows the minimum required laminate weight (w) and equivalent thickness (t).

4.3 Additional factors shall be applied to the minimum laminate weight according to the intended use of the vessel; appropriate factors are shown in Table 7.5. The factors account for the design and use of the vessel and shall be applied as considered necessary by BKI.

4.4 The following areas shall be reinforced by additional laminates:

- For keel, stem and chine shall be reinforced by additional laminates. Table 7.6 gives the total laminate weight required and the width of the reinforcement.
- For flange and deck edge shall be sufficient reinforced by additional laminates.

4.5 Alternative method of local reinforcement are acceptable provided a similar level of robustness to that implied by 4.3 is demonstrated either by calculation or by test.

4.6 The total required laminate thickness shall be corrected by translated total laminate weight required of the reinforcement and actual fibre content of schedule laminate; by taking into account the thickness of laminate and total laminate weight; according to the following formula.

$$\frac{t}{w} = \frac{1}{3,072}\left(\frac{2,56}{\psi} - 1,36\right)$$

$$\psi = \frac{2,56}{3,072\frac{t}{w} + 1,36}$$

5. Stiffeners

5.1 Hull and deck stiffeners shall be of a size that is suitable for the size of the vessel, the spacing of stiffeners or panel size. Tables 7.7 and 7.8 show the required section modulus.

5.2 The section modulus can be modified by the application of factors to the table values. Table 7.9 shows the factors for stiffener curvature and glass mat/roving content. If there is doubt about what factor to use, the table figures without factors shall be used.

5.3 The properties of various top hat type stiffeners are given in Tables 7.10 and 7.11.

Table 7.3 Minimum hull laminate weight

Panel width (mm)	500		600		800		1000		1200		1400	
Loaded displ. (kg)	t (mm)	w (g/m^2)	t (mm)	w (g/m^2)	t (mm)	w (g/m^2)	t (mm)	w (g/m^2)	t (mm)	w (g/m^2)	t (mm)	w (g/m^2)
250	3,9	1670	4,4	1880	5,2	2250	6,6	2810	7,9	3370	9,2	3930
500	4,3	1860	4,9	2090	5,8	2490	6,9	2960	8,3	3550	9,7	4140
1000	4,8	2070	5,4	2330	6,5	2780	7,7	3280	9,2	3930	10,7	4580
2000	5,4	2330	6,1	2620	7,3	3130	8,6	3690	10,3	4400	12,0	5140
4000	6,2	2640	6,9	2960	8,3	3540	9,8	4180	11,5	4930	13,4	5760
6000	6,6	2840	7,5	3190	8,9	3820	10,5	4500	12,3	5280	14,4	6160
8000	7,0	3000	7,9	3370	9,4	4030	11,1	4750	12,9	5530	15,1	6450
10000	7,3	3130	8,2	3520	9,8	4200	11,6	4960	13,4	5740	15,6	6700
12000	7,6	3240	8,5	3650	10,2	4360	12,0	5140	13,8	5920	16,1	6900
15000	7,9	3390	8,9	3810	10,6	4550	12,5	5370	14,3	6140	16,7	7160
18000	8,2	3510	9,2	3950	11,0	4720	13,0	5570	14,8	6330	17,2	7380
20000	8,4	3590	9,4	4030	11,3	4820	13,3	5680	15,1	6470	17,5	7510
22000	8,5	3660	9,6	4110	11,5	4910	13,5	5790	15,4	6590	17,8	7630
25000	8,8	3750	9,8	4220	11,8	5040	13,9	5950	15,8	6770	18,2	7790

Note:
The figures listed for a 500 mm panel width are the minimum figures to be used and weights below this shall not be used after the application of factors.

Table 7.4 Minimum deck laminate weight

Panel width (mm)	500		600		700	
Length overall (m)	t (mm)	w (g/m^2)	t (mm)	w (g/m^2)	t (mm)	w (g/m^2)
4	3,3	1420	3,8	1650	4,5	1920
5	3,5	1510	3,8	1650	4,5	1920
6	3,8	1650	3,8	1650	4,5	1920
7	4,0	1700	4,0	1700	4,5	1920
8	4,2	1790	4,2	1790	4,5	1920
9	4,4	1880	4,4	1880	4,5	1920
10	4,6	1970	4,6	1970	4,6	1970
11	4,8	2060	4,8	2060	4,8	2060
12	5,0	2150	5,0	2150	5,0	2150
13	5,2	2240	5,2	2240	5,2	2240
14	5,5	2340	5,5	2340	5,5	2340
15	5,7	2430	5,7	2430	5,7	2430

Note :

The table shows weights of laminates where chopped stand mat is 90 percent to 100 percent of the total glass weight. Correction for other combination of mat and roving are accounted for in Table 7.5.

The figures listed for a 500 mm panel width are the minimum figures to be used and weights below this shall not be used after the application of factors.

Table 7.5 Factors applied to minimum laminate

Panel curvature factor, Fc						
c / b	0,03 and below	0,06	0,09	0,12	0,15	0,18 and above
Fc	1	0,90	0,80	0,70	0,60	0,50
where c and b are illustrated in Table 7.12						

Glass mat/roving factor, Fw							
R	0,30	0,40	0,50	0,60	0,70	0,80	0,90–1,00
Fibreglass content	0,41	0,39	0,37	0,35	0,33	0,32	0,30
Mat/roving factor Fw	0,89	0,91	0,93	0,95	0,97	0,98	1,00
Where $R = \frac{\text{Weight of chopped strand mat (CSM) in g/m}^2}{\text{Total weight of glass fibre in g/m}^2}$							

Usage factor				
Usage factor		**Type**	**Conditions**	**Factor**
Fv	Vessel landing	River landing	Calm water	1,00
		Harbour landing	Impact on quays, walls, etc.	1,05
		Beach landing	Small surf	1,10
		Beach landing	Large surf	1,20
Fg	Fishing gear	Light fishing gear (nets and lines)	Damage unlikely	1,00
		Heavy fishing gear (trawl)	Impact structure	1,10
Usage factor = Fv x Fg				

Notes:

1) The minimum required weight in g/m of dry laminate shall be multiplied by the relevant factors from the table above. Thus the required weight of dry laminate = minimum weight x Fc x Fw x Fv x Fg.

2) The total factor applied (Fc x Fw x Fv x Fg) need not be greater than 1,2.

Table 7.6 Hull additional reinforcement weight and width

Loaded displacement (kg)	250	500	1000	2000	4000	6000	8000	10000	12000	15000	18000	20000	22000	25000
Width of additional reinforcement (mm)	50	60	70	90	110	120	130	140	150	160	170	180	190	200

Keel	Stem	Chine & deck edge
Multiply minimum fibre weight by		
2,2	2,0	1,7

Note:

The width of additional reinforcement is distributed either side of the keel/stem/chine; see Fig. 7.6

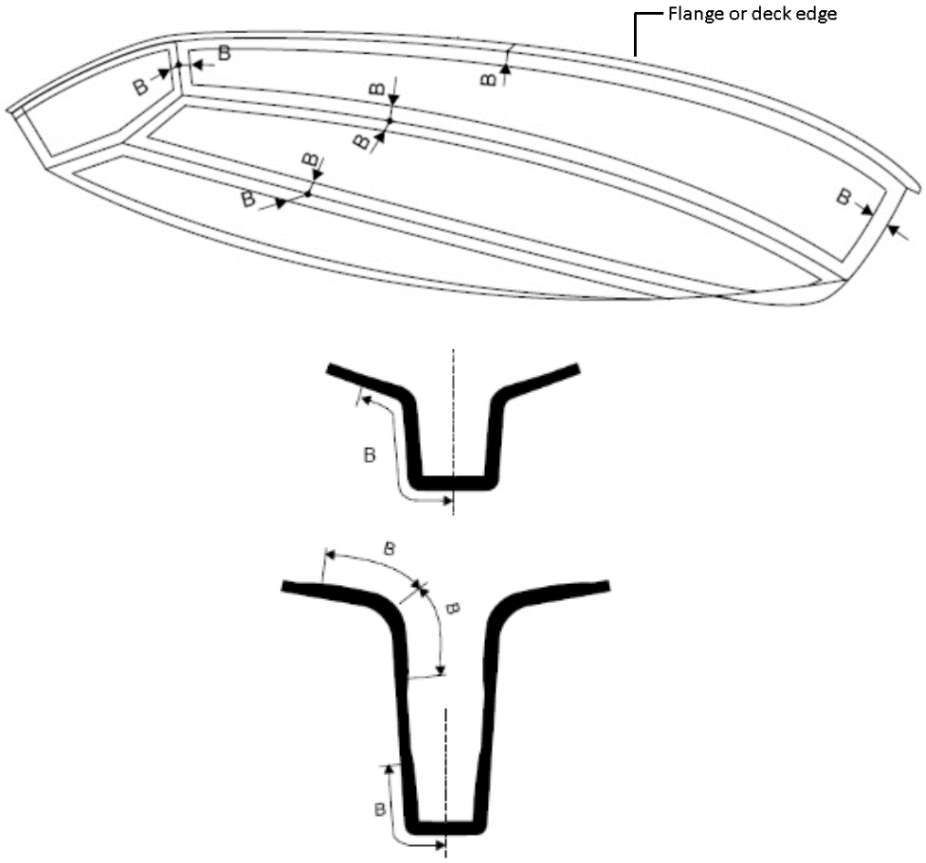


Fig 7.6 Additional reinforcement for hull structure

Table 7.7 Hull stiffeners – section modulus SM cm³

Loaded displacement m_{LDC} (kg)	Stiffener spacing s = 500 mm						
	Stiffener span l (mm)						
	500	750	1000	1250	1500	1750	2000
500	2,5	4,6	7,1	11	16	22	28
1000	3,1	5,9	9,0	13	19	26	34
5000	5,4	10	16	21	30	41	54
10000	7,0	13	20	28	38	52	68
15000	8,2	15	24	33	44	60	78
20000	9,2	17	27	36	48	65	86
25000	10	19	29	40	52	70	92

Loaded displacement m_{LDC} (kg)	Stiffener spacing *s* = 600 mm						
	Stiffener span l (mm)						
	500	750	1000	1250	1500	1750	2000
500	2,8	5,3	8,5	13	19	26	34
1000	3,5	6,6	10	16	23	32	41
5000	6,1	12	18	25	37	50	65
10000	8,0	15	23	32	46	63	82
15000	9,3	18	27	37	53	71	93
20000	10	20	30	41	58	79	103
25000	11	22	33	45	62	85	110

Loaded displacement m_{LDC} (kg)	Stiffener spacing *s* = 700 mm						
	Stiffener span l (mm)						
	500	750	1000	1250	1500	1750	2000
500	3,1	5,9	10	16	22	31	40
1000	3,9	7,3	12	19	27	37	48
5000	6,8	13	21	32	46	63	82
10000	9,0	17	26	37	54	73	95
15000	10	20	30	43	61	83	109
20000	12	22	34	47	67	92	120
25000	13	24	37	50	72	99	129

Loaded displacement m_{LDC} (kg)	Stiffener spacing *s* = 800 mm						
	Stiffener span l (mm)						
	500	750	1000	1250	1500	1750	2000
500	3,4	6,4	11	18	26	35	46
1000	4,3	8,0	14	22	31	42	55
5000	7,5	14	22	34	49	66	87
10000	9,7	18	28	43	61	83	109
15000	11	21	33	49	70	95	124
20000	13	24	37	53	77	105	137
25000	14	26	40	58	83	112	147

Table 7.8 Deck stiffeners – section modulus SM cm^3

Stiffener spacing s = 500 mm						
Stiffener span l (mm)						
1000	1500	2000	2500	3000	3500	4000
7,0	16	28	44	64	87	113

Stiffener spacing s = 600 mm						
Stiffener span l (mm)						
1000	1500	2000	2500	3000	3500	4000
9	19	34	53	77	104	136

Stiffener spacing s = 700 mm						
Stiffener span l (mm)						
1000	1500	2000	2500	3000	3500	4000
9,8	20	36	56	81	110	143

Table 7.9 Stiffener – curvature and roving factors

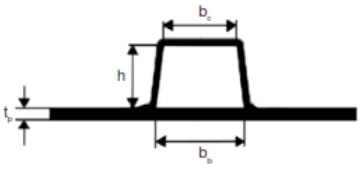
$\frac{c}{l}$	0,03 and below	0,06	0,09	0,12	0,15	0,18 and above
f_{cs}	1,0	0,90	0,80	0,70	0,60	0,50

R	0,3	0,4	0,5	0,6	0,7	0,8	0,9 – 1,0
Glass fibre content	0,32	0,31	0,30	0,28	0,27	0,26	0,25
f_{ws}	0,72	0,75	0,78	0,87	0,91	0,96	1,00

Table 7.10 Top hat stiffeners

TOP HAT STIFFENERS

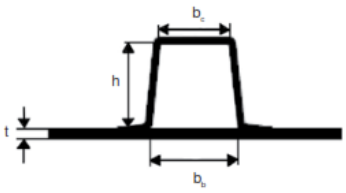
LOW TOP HAT STIFFENER



Glass content: g = 0.30
(Chopped strand mat CSM)

Dimensions of former			Plating thickness	Stiffener glass weight	Section modulus
h	b_b	b_c	t	w	SM_{min}
mm	mm	mm	mm	g/m²	cm³
25	36	30	5	600	1,8
			10	600	2,7
			15	600	5,1
40	60	50	5	600	4,5
			10	600	5,4
			15	600	7,5
50	75	65	5	900	10
			10	900	12
			15	900	14
60	90	75	5	1200	19
			10	1200	21
			15	1200	24
75	100	85	5	1200	27
			10	1200	30
			15	1200	33
100	150	125	5	1800	73
			10	1800	81
			15	1800	87
125	175	150	5	2100	125
			10	2100	140
			15	2100	149
150	220	190	5	2700	230
			10	2700	260
			15	2700	280

SQUARE TOP HAT STIFFENER



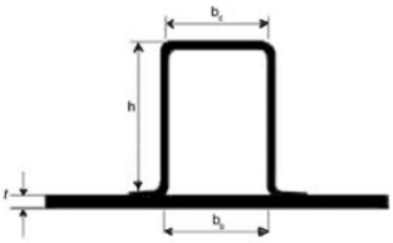
Glass content: g = 0.30
(Chopped strand mat CSM)

Dimensions of former			Plating thickness	Stiffener glass weight	Section modulus
h	b_b	b_c	t	w	SM_{min}
mm	mm	mm	mm	g/m²	cm³
25	25	20	5	600	1,5
			10	600	2,2
			15	600	4,6
40	40	35	5	600	3,6
			10	600	4,4
			15	600	6,3
50	50	45	5	900	8,2
			10	900	9,5
			15	900	12
60	60	50	5	1200	15
			10	1200	17
			15	1200	19
75	75	65	5	1200	23
			10	1200	26
			15	1200	28
100	100	85	5	1800	56
			10	1800	65
			15	1800	69
125	125	105	5	2100	98
			10	2100	112
			15	2100	112
150	150	125	5	2700	173
			10	2700	198
			15	2700	213

Table 7.11 Top hat stiffener and laminate step stiffener

TOP HAT STIFFENERS AND LAMINATE STEP STIFFENER

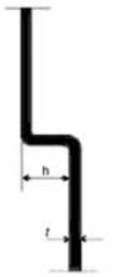
TALL TOP HAT STIFFENER



Glass content: g = 0.30
(Chopped strand mat CSM)

Dimensions of former			Plating thickness	Stiffener glass weight	Section modulus
h mm	b_b mm	b_c mm	t mm	w kg/m²	SM_{min} cm³
100	50	50	5	1,800	41
			10	1,800	48
			15	1,800	53
125	50	50	5	2,100	65
			10	2,100	77
			15	2,100	84
150	50	50	5	2,700	104
			10	2,700	126
			15	2,700	139
150	75	75	5	2,700	126
			10	2,700	150
			15	2,700	163
175	75	75	5	3,000	161
			10	3,000	194
			15	3,000	213
200	75	75	5	3,600	240
			10	3,600	290
			15	3,600	322
200	100	100	5	3,600	277
			10	3,600	331
			15	3,600	364
250	100	100	5	4,200	433
			10	4,200	518
			15	4,200	576

LAMINATE STEP STIFFENER

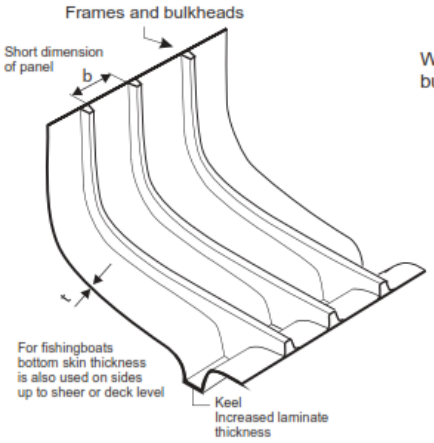


Glass content: g = 0.30
(Chopped strand mat CSM)

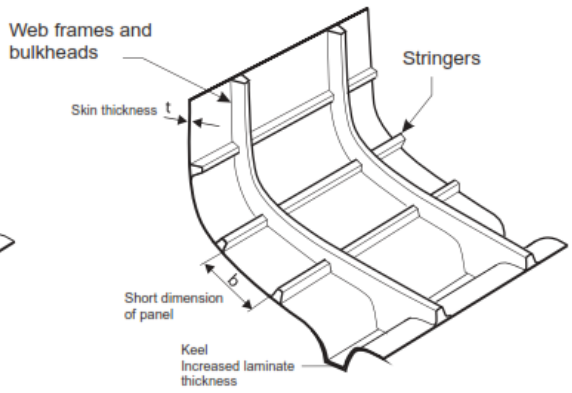
Height of step h mm	Plating thickness t mm	Stiffener glass weight w kg/m²	Section modulus SM cm³
15	5	2,100	1,0
	10	4,300	2,2
	15	6,400	3,6
20	5	2,100	2,9
	10	4,300	3,4
	15	6,400	5,2
30	5	2,100	4,4
	10	4,300	8,0
	15	6,400	11
40	5	2,100	8,2
	10	4,300	14
	15	6,400	20
50	5	2,100	14
	10	4,300	23
	15	6,400	32
60	5	2,100	20
	10	4,300	34
	15	6,400	46

Table 7.12 Design details – Single skin laminate

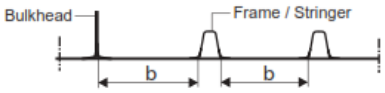
SINGLE SKIN LAMINATE



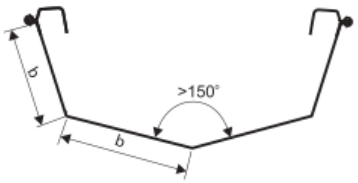
TRANSVERSE STIFFENERS

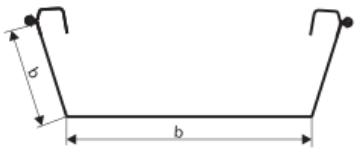


TRANSVERSE AND LONGITUDINAL STIFFENERS

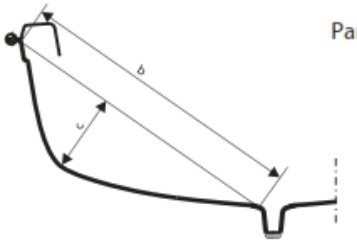


b = shorter dimension of plate panel

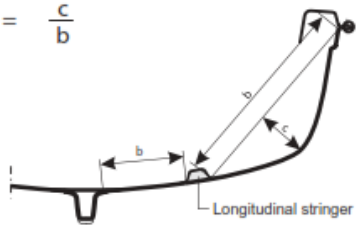




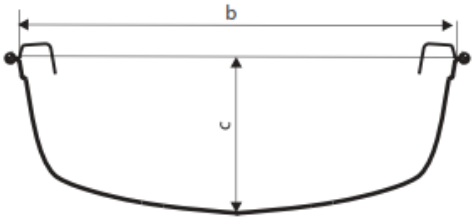
SMALL BOATS WITH HARD CHINES. TRANSVERSE FRAMES WITH GREATER SPACING THAN b



Panel curvature = $\frac{c}{b}$



BOAT WITH CURVED BOTTOM AND KEEL.+ TRANSVERSE FRAMES SPACED MORE THAN b



SMALL BOAT WITHOUT KEEL

Table 7.11 Design details – Stiffeners

<table>
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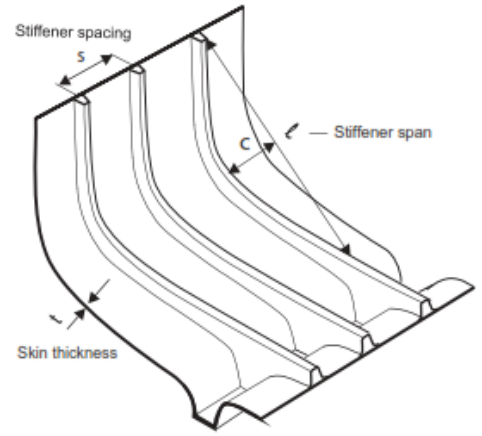
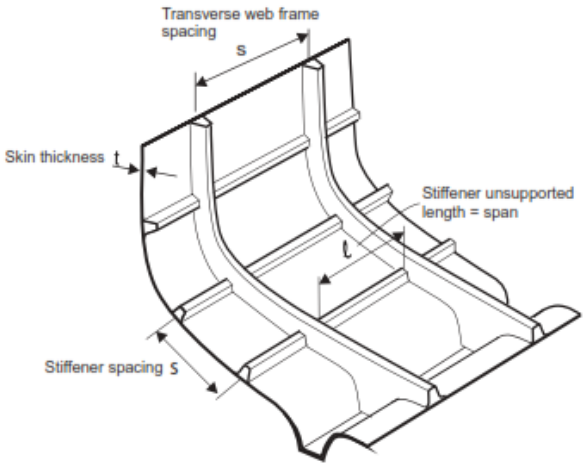


TRANSVERSE STIFFENERS: Frames and bulkheads


TRANSVERSE AND LONGITUDINAL STIFFENERS
PRIMARY STIFFENERS: Web frames and bulkheads
SECONDARY STIFFENERS: Longitudinal stiffeners
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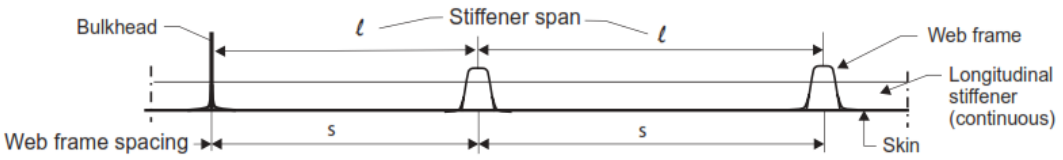

TRANSVERSE WEB FRAMES AND LONGITUDINAL STRINGERS
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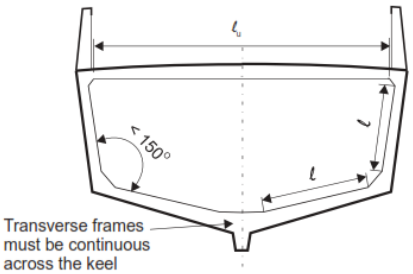
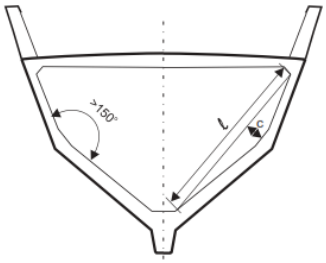


STIFFENER LENGTH ℓ
CHINE ANGLE LESS THAN 150°


STIFFENER LENGTH ℓ
CHINE ANGLE MORE THAN 150°
</td></tr>
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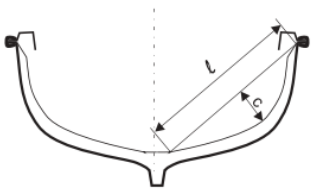
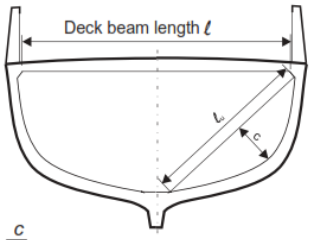


SMALL OPEN BOAT
TRANSVERSE FRAME
Keel and rail are main longitudinal stiffeners
Stiffener curvature = $\frac{c}{\ell}$


DECKED BOAT
TRANSVERSE FRAME
</td></tr>
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C. Watertight Integrity

1. Inlets and discharges

1.1 Sea inlets shall be fitted with valves that have a positive means of closing from a readily accessible position. The valve shall be provided with an indicator, showing whether the valve is open or closed.

1.2 Discharges passing through the hull shall be fitted with an automatic non-return valve with a positive means of closing it from a readily accessible position. The valve shall be provided with an indicator, showing whether the valve is open or closed.

1.3 BKI may accept alternative arrangements, providing that the following requirements are complied with:

1.3.1 Hull penetrations with openings less than 100 mm above the deepest waterline or below the floor on undecked vessels shall be fitted with means of closing.

1.3.2 Discharges between 100 mm above and 350 mm above the deepest waterline may be fitted with a non-return valve, without a means of closing. In the case of wet exhaust systems, the valve may be of a flap type. Refer to Annex C.

1.3.3 Discharges more than 350 mm above the deepest waterline need not be fitted with a valve.

1.4 Inlet and discharge valves not accessible in an emergency shall be fitted with remote means of operation such as by extended spindle or wire pull device.

1.5 Fittings attached to the hull, all valves and all pipes between the shell and the valves shall be of cast steel, bronze or other ductile material. The use of other materials for pipes may be accepted subject to BKI approval.

1.6 Any penetration prone to be damaged by fishing gear, equipment or crew shall be suitably protected.

1.7 Where sea inlet piping systems comprise flexible hoses, such hoses shall be of an approved type and the connections shall be fitted with double, corrosion-resistant hose clips at both ends.

1.8 When operating experience justifies departure from 1.1 to 1.7, BKI may allow alternatives.

2. Drainage of partial decks

Any partial deck either inboard or outboard shall be adequately drained.

3. Securing of heavy items

All heavy items of equipment shall be securely fastened in position to prevent movement when the vessel is at sea.

4. Decked Vessels

4.1 Construction

4.1.1 Bulkheads, closing devices and closures of openings in these bulkheads, as well as methods for their testing, shall be in accordance with the requirements of BKI. Vessels shall be fitted with a collision bulkhead unless BKI deems that this requirement is impracticable, and at least with transverse watertight bulkheads bounding the main machinery space. Such bulkheads shall be extended up to the working deck.

4.1.2 Pipes piercing the collision bulkhead shall be fitted with suitable valves operable from above the working deck and the valves shall be secured at the collision bulkhead inside the forepeak. No door, manhole, ventilation duct or any other opening shall be fitted in the collision bulkhead below the working deck.

4.1.3 The forepeak shall not be used for carrying fuel oil, except where specially approved by BKI.

4.2 Hull integrity

External openings shall be capable of being closed so as to prevent water from entering the vessel. Deck openings, which may be open during fishing operations, shall normally be arranged near the vessel's centreline. However, BKI may approve different arrangements if satisfied that the safety of the vessel will not be impaired.

4.3 Weathertight doors

4.3.1 All access openings in bulkheads of enclosed superstructures and other outer structures, through which water could enter and endanger the vessel, shall be fitted with doors permanently attached to the bulkhead, framed and stiffened so that the whole structure is of equivalent strength to the unpierced structure, and weathertight when closed.

4.3.2 The height above deck of sills in those doorways that give direct access to parts of the deck exposed to the weather and sea shall be at least 150 mm.

4.3.3 Access opening to the engine room shall have a minimum sill height of at least 250 mm in position 1 and 100 mm in position 2.

Notes:

Position 1: upon exposed freeboard and raised quarter deck, and upon exposed superstructure decks situated forward of a point located a quarter of the ship's length from the forward perpendicular

Position 2: upon exposed superstructure decks situated abaft a quarter of the ship's length from the forward perpendicular

4.4 Hatchways

4.4.1 The height above deck of hatchway coamings on exposed parts of the working deck shall be at least 300 mm.

4.4.2 Where operating experience has shown justification and on approval of BKI the height of hatchway coamings, except those which give direct access to machinery spaces, may be reduced from the height as specified in 4.4.1 or the coamings may be omitted entirely, provided that efficient watertight hatch covers other than wood are fitted. Such hatchways shall be kept as small as practicable. The covers shall be permanently attached by hinges or equivalent means and be capable of being rapidly closed or battened down.

4.4.3 The hatchway covers shall have the same strength as the deck. The hatch covers shall be fitted with clamping devices and gaskets or other equivalent arrangements sufficient to ensure weathertightness to the satisfaction of BKI. For guidance on structural strength, reference shall be made as follow:

.1 Plating and planking for hatch covers shall have minimum thickness according to Table 7.12.

.2 The stiffeners listed in Tabel 7.13 may be used for the hatch providing none is longer than 2,0 m and that the maximum spacing of stiffeners is 500 mm.

.2.1 Where heavy loads are to be placed on hatch covers, the stiffeners shall be increased in depth to be double the tabulated depth.

Table 7.12 Minimum thickness of hatch cover

CuNo	Steel [mm]	Aluminium [mm]	Wood [mm]	FRP	
				[mm]	[Est. g/m^2]
10	4,0	5,0	20	5,0	3000
25	4,5	6,0	25	7,0	4200
45	5,0	6,5	30	7,5	4500
80	6,0	8,0	35	8,0	4800
125	6,0	8,0	40	9,0	5400
155	6,0	8,0	40	9,0	5400

Table 7.13 stiffener dimension of hatch cover

Material	Flat bar stiffeners	Angle stiffeners
Steel	50 x 4,5 mm	35 x 35 x 4 mm
Aluminium	64 x 6,5 mm	-
Wood	Beams 45 x 75 mm	-
FRP	As deck beams	-

.2.2 Structure around the perimeter of the hatch shall be sized to be equivalent to or greater than the stiffeners listed in Table 7.13.

4.5 Machinery space openings

External access machinery space openings shall be of sufficient strength and fitted with doors complying with 4.3.3 or hatch covers complying with 4.4.

4.6 Other deck openings

Where it is essential for fishing operations, flush deck covers may be fitted, provided these are capable of being closed watertight. Such devices shall be permanently attached to the adjacent structure. Having regard to the size and disposition of the openings and the design of the closing devices, metal-to-metal closures may be fitted if BKI is satisfied that they are effectively watertight.

4.7 Ventilators

4.7.1 The coamings of ventilators shall be as high as practicable. On the working deck the height above deck of coamings of ventilators shall be not less than 450 mm. When the height of such ventilators may interfere with the fishing operation of the vessel their coaming heights may be reduced to the satisfaction of BKI.

4.7.2 Coamings of ventilators shall be of equivalent strength to the adjacent structure and capable of being closed weathertight by devices permanently attached to the ventilator or adjacent structure. Ventilators shall be arranged as close to the vessel's centreline as possible and, where practicable, shall extend through the top of a deck erection or companion-way.

4.8 Air pipes

4.8.1 Where air pipes to tanks and void spaces below deck extend above the working or superstructure decks, the exposed parts of the pipes shall be of a strength equivalent to the adjacent structures and fitted with appropriate protection, including to prevent damage by fishing or lifting gear. Openings of pipes shall be provided with means of closing, which are permanently attached to the pipe or adjacent structure. Where openings are protected against water trapped on deck, these means of closing may be omitted.

4.8.2 The height of air pipes above deck to the point where water may have access below shall be at least 450 mm on the working deck. When the height of such air pipes may interfere with the fishing operation of the vessel, their heights may be reduced, provided that they are fitted with a non-return arrangement at the air pipe gooseneck.

4.8.3 Provision shall be made to prevent a vacuum from forming in the pipe or tank.

4.8.4 Exposed air pipes, in excess of 25 mm in diameter, serving fuel oil and other oil tanks, shall be fitted with anti-flame net protection or other equivalent devices.

4.9 Sounding devices

4.9.1 Sounding devices shall be fitted to the bilges of those compartments which are not readily accessible at all times during the voyage and to all tanks.

4.9.2 Where sounding pipes are fitted, their upper ends shall extend to a readily accessible position above the working deck and their openings shall be provided with permanently-attached means of closing.

4.9.3 Where sounding pipes are fitted to fuel service tanks, and their upper ends extend to a readily accessible position above the working deck, in order to prevent spillage through the sounding pipes in the event of tanks being overfilled, their openings shall be higher than those of the air pipes from the fuel oil service tanks.

4.9.4 Where it is not practicable to extend sounding pipes of fuel service tanks to a position above the working deck, their opening shall be fitted with automatic self-closing devices.

4.9.5 Fuel tank sounding pipe openings shall not be located in crew accommodation.

4.10 Freeing ports

4.10.1 Care shall always be taken to ensure the quick release of water trapped on deck. If freeing ports are fitted with closing devices, the opening mechanism shall always be easily accessible and never lockable.

4.10.2 When the main deck is prepared for carrying deck load by dividing it with pound boards, or any division capable of trapping water, there shall be slots between them of suitable size to allow easy flow of water to freeing ports.

4.10.3 The size, number and location of freeing ports and scuppers shall be sufficient to drain water overboard from exposed deck. The requirements for the dimensions of freeing ports as follow:

.1 Where the fixed bulwarks, ends or sides of the superstructure, etc. form enclosed wells, means to clear entrapped water are to be provided. Where bulwarks on weather parts of the working deck form wells, the minimum freeing port area (A) in m^2 on each side of the vessel for each well on the working deck shall be determined in relation to the length (l) and height (h) of the bulwark in this well, in accordance with Table 7.14.

Table 7.14 Freeing port area

Height of bulwark (h) in m	Length of well (l) in metres (l need not be taken as greater than 70% of the length of the vessel)								
	4,5	5,0	5,5	6,0	6,5	7,0	7,5	8,0	8,5
0,2	0,03	0,03	0,03	0,04	0,04	0,04	0,05	0,05	0,05
0,3	0,04	0,05	0,05	0,05	0,06	0,06	0,07	0,07	0,08
0,4	0,05	0,06	0,07	0,07	0,08	0,08	0,09	0,10	0,10
0,5	0,07	0,08	0,08	0,09	0,10	0,11	0,11	0,12	0,13
0,6	0,08	0,09	0,10	0,11	0,12	0,13	0,14	0,14	0,15
0,7	0,09	0,11	0,12	0,13	0,14	0,15	0,16	0,17	0,18
0,8	0,11	0,12	0,13	0,14	0,16	0,17	0,18	0,19	0,20
0,9	0,12	0,14	0,15	0,16	0,18	0,19	0,20	0,22	0,23
1,0	0,14	0,15	0,17	0,18	0,20	0,21	0,23	0,24	0,26
1,1	0,15	0,17	0,18	0,20	0,21	0,23	0,25	0,26	0,28
1,2	0,16	0,18	0,20	0,22	0,23	0,25	0,27	0,29	0,31

Note:

For intermediate lengths (l) and heights (h), the value of A shall be obtained by linear interpolation.

.2 The freeing port area according to the Table 7.14 shall be increased when BKI considers that the vessel's sheer is not sufficient to ensure rapid and effective freeing of the deck from water.

.3 Freeing ports shall be so arranged along the length of bulwarks as to provide the most rapid and effective freeing of the deck from water. Lower edges of freeing ports shall be as near as practicable to the deck, the lowest point of the sheer curve and the ends of the well.

.4 Large freeing ports shall be fitted with bars or other suitable protective arrangements to prevent fish, gear, etc., on deck from sliding overboard.

.5 BKI may permit the use of other methods in determining the dimensions of freeing ports[1].

4.11 Working spaces within an enclosed superstructure

Working spaces within an enclosed superstructure shall be arranged considering the following aspect:

- efficient drainage
- openings necessary for fishing operations
- means of escape
- stowage of catch
- headroom
- ventilation

[1] As an alternative, ISO 11812 may be used.

4.12 Tanks for fish in refrigerated seawater (RSW) or chilled seawater (CSW)

4.12.1 If RSW- or CSW-tanks or similar tank systems are used, such tanks shall be provided with a separate permanently-fitted arrangement for the filling and emptying of seawater.

4.12.2 If such tanks are to be used also for other purposes, the tanks shall be arranged with a bilge system and provided with adequate means to avoid ingress of water from the bilge system into the tanks.

D. Anchoring and mooring equipment

1. Anchoring

1.1. Vessels shall be provided with anchoring equipment arranged in such a way that it is possible to anchor efficiently and reliably.

1.2. Vessels shall be equipped with anchoring equipment in accordance with Table 7.15.

Table 7.15 Anchoring equipment

CuNo	Total anchor weight [kg]	Length of anchor rope [m]	Minimum diameter of anchor rope (nylon rope) [mm]	Length of anchor chain [m]	Diameter of anchor chain [mm]
5	6	20	10	5	8
10	9	25	12	5	8
15	11	30	15	6	8
25	16	32	15	6	8
35	19	35	18	8	9,5
45	23	40	18	8	9,5
60	28	45	20	10	9,5
80	32	50	20	10	9,5
100	39	55	25	15	12
155	47	60	25	15	12

1.3. The anchor weight required as indicated in the Table 7.15 may be distributed between two anchors, one of which shall be at least 66 percent of the weight shown.

1.4. Vessels shall be equipped with at least one anchor chain of a length and dimension according to the Table 7.15. The chain shall be provided between the anchor and the anchor rope.

1.5. Vessels shall be equipped with anchor rope(s) of length and dimension according to the Table 7.15.

1.6. Vessels shall be provided with sufficient means to fix the anchor rope to the vessel and protect it against chafing.

1.7. BKI may require increased anchor equipment for vessels fishing in very rough waters and/or may permit reduction in the equipment for vessels operating in sheltered waters.

2. Mooring equipment

2.1 All vessels shall be provided with appropriate mooring equipment, including mooring ropes, bollards and fairleads, arranged in such a way that the vessel can be moored, tow and be towed efficiently.

2.2 Mooring equipment, its mountings, and decks and bulwarks where the equipment (including anchoring equipment) is to be located shall be strongly constructed. Appropriate reinforcements to structure shall be provided where equipment is fastened and, where through bolts are used, washers or backing plates shall be fitted below the nuts.

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Section 8 Stability

A. General

1. General requirements

1.1 No damage stability calculation is required.

1.2 For vessel with fenders along the sides of the hull the fenders may be included when calculating the stability of the vessel subject to agreement with BKI. This applies to fenders that are secured or bonded to the hull such that they will not be dislodged when submerged.

1.3 Permanent heel or trim which may generate danger for accumulation of water on undecked floor is not accepted.

1.4 Person mass to be used in calculations and tests = 82,5 kg

2. Documentation

2.1 The following documentation be submitted for approval (as applicable):

- stability manual
- inclining test or rolling period test
- calculation of metacentric height (GM)
- closing appliances

The following documentation is assumed for information:

- general arrangement
- body/lines plan

2.2 The calculation of metacentri height (GM) shall cover all loading conditions representative for the intended service of the vessel, including drafts, trim and freeboard. The calculation (or a separate appendix/issue) shall also include relevant hydrostatic data, calculation of centres of gravities etc.

2.3 The stability manual shall cover all load conditions representative for the intended service of the vessel, including drafts, trim and freeboard. The manual (or a separate appendix/ issue) shall also include relevant hydrostatic data, calculation of centres of gravities etc. Stability curves shall be made on a free to trim basis. (Cross curves are normally to be prepared on a designed trim basis).

B. Stability

1. Stability criteria for decked vessels

1.1 The following minimum stability criteria shall be met unless BKI is satisfied that operating experience justifies departure therefrom:

1.1.1 The area under the righting lever curve (GZ curve) shall not be less than 0,055 m-rad up to 30° angle of heel and not less than 0,090 m-rad up to 40° or the angle of flooding θf if this angle is less than 40°. Additionally, the area under the righting lever curve (GZ curve) between the angles of heel of 30° and 40° or between 30° and θf, if this angle is less than 40°, shall not be less than 0,030 m-rad. θf is the angle of heel at which openings in the hull, superstructures or deckhouses which cannot rapidly be closed watertight commence to immerse. In applying this criterion, small openings through which progressive flooding cannot take place need not be considered as open;

1.1.2 The righting lever GZ shall be at least 200 mm at an angle of heel equal to or greater than 30°. The righting lever GZ may be reduced but in no case by more than $2(24-L_{OA})$ percent, where L_{OA}, in m, is as defined in Section 1;

1.1.3 The maximum righting lever GZmax shall occur at an angle of heel preferably exceeding 30° but not less than 25°; and

1.1.4 The initial metacentric height GM_0 shall not be less than 350 mm.

1.2 Where ballast is provided to ensure compliance with 1.1, its nature and arrangement shall be to the satisfaction of BKI. Ballast shall be secured in the vessel in such a way that it will not move even if the vessel is inclined to 90°.

2. Alternative stability criteria for decked vessels

For decked vessels for which, by reason of insufficient stability data, 1.1 cannot be applied or where BKI is satisfied that operating experience justifies departure from the stability criteria in 1.1, one of the following criteria shall be used as the criterion.

2.1 Approximate formula for the minimum metacentric height GM_{min}

2.1.1 For decked vessels for which, by reason of insufficient stability data, 1.1 cannot be applied, the following approximate formula for the minimum metacentric height GM_{min}, in m, for all operating conditions shall be used as the criterion:

$$GM_{min} = 0{,}53 + 2B\left[0{,}075 - 0{,}37\left(\frac{f}{B}\right) + 0{,}82\left(\frac{f}{B}\right)^2 - 0{,}014\left(\frac{B}{D}\right) - 0{,}032\left(\frac{l_s}{L_{wl}}\right)\right]$$

where:

L_{wl} in metres, is the length of the vessel on the waterline in maximum load condition;

B, D and f, in metres, are as defined in Section 1; and

l_s is the actual length of enclosed superstructure extending from side to side of the vessel, in metres, as defined in Section 1.

The formula is applicable for vessels having:

1) $\frac{f}{B}$ between 0,02 and 0,20;

2) $\frac{l_s}{L_{wl}}$ smaller than 0,60;

3) $\frac{B}{D}$ between 1,75 and 2,15;

2.1.2 The above formula is not intended as a replacement for the basic criteria given in 1.1, and shall be used only if circumstances are such that cross-curves of stability, KM curve and subsequent GZ curves are not and cannot be made available for judging a particular vessel's stability.

2.1.3 The calculated value of GM_{min} shall be compared with actual GM values of the vessel in all loading conditions. If a rolling test, an inclining experiment based on estimated displacement, or another approximate method of determining the actual GM is used, a safety margin shall be added to the calculated GM_{min}.[1]

2.2 A rolling period test

A rolling period test (see annex B) shall be conducted when the vessel is loaded according to the operating conditions i.e. departure for the fishing grounds with full fuel, stores, ice, fishing gear, etc. The stability is deemed satisfactory if the rolling period (T_r), in seconds, is less than indicated in Table 8.1.

Table 8.1 Maximum rolling periods (T_r) in seconds

H (m)	B (m)														
	1,6	1,8	2,0	2,2	2,4	2,6	2,8	3,0	3,2	3,4	3,6	3,8	4,0	4,2	4,4
0,6	3,2	3,2	3,4												
0,7	3,8	3,5	3,5	3,5											
0,8	4,3	4,0	3,7	3,6	3,6	3,7									
0,9	4,3	4,6	4,3	3,9	3,7	3,7	3,8								
1,0		4,6	4,9	4,5	4,2	4,0	3,8	3,9	4,0						
1,1			4,8	5,1	4,6	4,4	4,2	4,0	4,0	4,1	4,3				
1,2				5,0	5,2	4,8	4,5	4,3	4,2	4,1	4,2	4,3			
1,3					5,1	5,3	5,0	4,7	4,5	4,4	4,2	4,3	4,4		
1,4						5,3	5,5	5,1	4,9	4,7	4,5	4,4	4,4	4,5	4,6
1,5							5,4	5,6	5,3	5,1	4,9	4,7	4,6	4,5	4,6
1,6								5,5	5,7	5,4	5,2	4,9	4,9	4,8	4,7
1,7									5,7	5,9	5,6	5,2	5,2	5,1	5,0
1,8										5,8	6,0	5,5	5,5	5,4	5,2

2.3 Required metacentric height GM_r combined with a rolling period test.

2.3.1 The following approximate formulae for required metacentric height GM_r, in metres, shall be used:

$$GM_r = 0{,}059B\left(\frac{B}{H} - 2{,}20\right) + \left[2{,}085\left(\frac{T}{H}\right)^2 - 2{,}857\,\frac{T}{H} + 0{,}990\right]B$$

B, H and T, in metres, are as defined in Section 1.

2.3.2 A rolling period test (see annex B) shall be conducted when the vessel is loaded according to the operating conditions i.e. departure for the fishing grounds with full fuel, stores, ice, fishing gear, etc. The actual metacentric height GM, in metres, in all operating conditions shall be calculated according to the following formula:

[1] See Annex B.

$$GM = \left(\frac{0,834B}{T_r} \right)^2$$

2.3.3 The stability is deemed satisfactory when the GM is not less than GM_r

2.4 Offset load test

2.4.1 An offset load test shall be conducted when the vessel is loaded according to the operating conditions i.e. departure from the fishing grounds with full catch, 30 percent stores, fuel, etc. A weight equivalent to 25 x L_{OA} x B (kg) shall be distributed along one side of the vessel, where:

L_{OA} and B, in metres, are as defined in Section 1.

2.4.2 The stability is deemed satisfactory when the angle of heel does not exceed 15° and the freeboard to the deck is not less than 75 mm at any point.

3. Stability criteria for undecked vessels

3.1 For undecked vessels, one of the stability criteria in 2.1 to 2.3 shall be used.

3.2 Summary of stability criteria for decked and undecked vessels may be shown in Table 8.2.

Table 8.2 Summary of stability criteria for decked and undecked vessel.

Paragraph		Criteria	Decked vessels	Undecked vessels
1.1	Where sufficient stability data exists	IMO criteria	√	–
2.1	Where insufficient stability data exists (1), (2)	Approx GM formula or	√	√
2.2	Where insufficient stability data exists (1) , (2)	Rolling test option 1 or	√	√
2.3	Where insufficient stability data exists (1) , (2)	GM + rolling test or	√	√
2.4	Where insufficient stability data exists (1) , (2)	Offset load test	√	–

Notes:
1) or where operating experience justifies departure from IMO criteria (for decked vessels).
2) or where operating experience justifies departure from the min. GM criteria (for undecked vessels).

4. Inclining test for decked vessels

4.1 Every decked vessel, for which the stability criteria in 1.1 are used, shall undergo an inclining test upon its completion and the actual displacement and position of the centre of gravity shall be determined for the light ship condition.

4.2 Where alterations are made to a vessel affecting its light ship condition and the position of the centre of gravity, the vessel shall, if considers necessary by BKI, be re-inclined and the stability information revised.

5. Built-in buoyancy for undecked vessels

5.1 Every undecked vessel shall be fitted with buoyancy elements in order to the vessel will stay afloat and on an even keel in order that bailing is possible, without listing if flooded.

5.2 Buoyancy elements may consist of foam (prefabricated or formed in position (in-situ)) or tanks filled with air or foam. Buoyancy elements must be fixed or permanently fitted and protected against mechanical damage and degradation from the environment.

5.3 Drainage shall be arranged for enclosed spaces used for buoyancy element. Such spaces shall normally not be used for storage or other facilities.

5.4 This buoyancy shall be demonstrated by a calculation and/or by a practical test:

5.4.1 A calculation, using one of the following methods:

– Method 1

A) Establish the hull weight (W_H) of the vessel (excluding engine, fittings, equipment, fuel, water, fish, ice, fishing gear, crew and food). This weight can be found by calculation or by using the following approximate formulae:

Hull weight of undecked GRP vessel = approx 60 x CuNo;

B) Establish the weight of engine(s) and engine related equipment (W_E) not included in A.

C) Establish the weight of fittings and equipment (W_F) not included in A.

D) Establish the weight of the load (W_L) that the vessel is designed to carry.

(Note: This weight will include fishing gear and other removable items that will contribute weight to the submerged vessel but not items that will float when the vessel is submerged such as fuel, water, fish, ice and food.

However, if such items are stowed above the deck edge and, thus, above the water when the vessel is submerged, then they shall be included in the load.)

E) Establish the weight of the maximum number of crew (W_{CR}). (Note: A figure of 75 kg per crew is often used although a competent authority may wish to substitute a different figure. Also it is assumed that the crew will be in or on the vessel but submerged only up to the knee.)

F) The weights calculated above need to be converted to submerged weight using the buoyancy factors (K) given in Table 8.3:

Tabel 8.3 The buoyancy factors (K)

Material	Specific gravity, SG	Buoyancy factor, K
Heavy wood	0,80	+0,25
Medium wood	0,65	+0,54
Light wood	0,50	+1,00
Steel	7,85	-0,87
Aluminium	2,65	-0,62
Fibreglass	1,50	-0,33
Lead	11,30	-0,91
Concrete	2,40	-0,58
Engines	–	-0,75
Crew	–	-0,10

Notes:
1. Other materials may be included by use of the following formula:
   Buoyancy factor, K = (1 – SG) / SG.
2. It is very important to use the correct sign (+ or -) with the factor K.

G) Generate a table as shown in Table 8.4.

Table 8.4 Submerged weight

Item	Weight (kg)	Buoyancy factor, K	Submerged weight (kg)
Hull not submerged (10%)	10% W_H	-1	10% W_H x K
Hull submerged (90%)	90% W_H	From table	90% W_H x K
Engine(s) and engine-related equipment	W_E	From table	W_E x K
Hull fittings and equipment	W_F	From table	W_F x K
Load	W_L	From table	W_L x K
Crew load	W_{CR}	-0,1	W_{CR} x -0,1
			Sum submerged weights, WS

H) Calculate the volume of buoyancy required, m^3 = WS / (1000 -DB)

where DB = density of buoyancy material, kg/m^3.

– Method 2

Volume of buoyancy (litres) = hull (kg) + equipment (kg) + motor (kg) + 250M

where:

M = 0,1 L_{OA} B; and

L_{OA} and B, in m, are as defined in Section 1.

For a wooden vessel, the calculations may take into account half the volume of the buoyancy of the wood.

5.4.2 Completing a practical test as follows

The vessel shall be loaded with a simulation of the equipment and motor weights plus 250M (as above) kg and then be flooded to the point of submergence. The vessel shall then bear a weight of 15 kg on the gunwale amidships on one side of the vessel, without capsizing.

Section 9 Machinery Installation

A. General

1. Machinery installations shall be designed, constructed and installed in accordance with good marine engineering practice. Propulsion engine shall be of recognize type adapted for marine use and/or type approved by BKI. Equipment shall be installed, protected and maintained so as not to constitute a danger to persons and the vessel.

2. Access for persons to machinery spaces shall be arranged clear of any moving or heated surfaces and the latter shall be sufficiently insulated. Effective guards shall protect exposed moving parts such as shafts, drive pulleys and belts. Access ladders shall be securely fixed to the vessel's permanent structure and shall be of a metal such as steel, where practicable.

3. Layout and installation of machinery spaces and propulsion machinery shall be designed for safe and efficient operation.

4. Light fittings shall be watertight, where practicable, and designed to facilitate easy inspection and be unaffected by vibration.

5. Ventilation shall be provided either by mechanical fans or natural vents to meet the air requirements of the propulsion machinery and to prevent a build-up of fumes and excessive heat.

6. Floor plates, where fitted, shall be non-slip and securely fastened with accessible fasteners.

7. Piping materials, including plastic piping where allowed to be use, shall be suitable for their intended purpose; when the material to be used is chosen, it shall be ensured that there would be no failure or degradation of the pipe as a result of any reaction with the fluid.

8. Valves, piping and flexible hoses shall be of sound and efficient construction and installation. All piping systems shall be well supported with pipe clips or mounts and protected against vibration and chafing/wear.

9. Where pipework is replaced, alignment of the replacement part shall be as close as possible to the original alignment.

B. Propulsion engine

Propulsion engines and associated stern gear shall be of a design, type and rating to suit the design and size of the vessel, take into account the operating condition and area of operation.

1. Inboard engine

1.1 Inboard engines shall, in general, be diesel-powered. However, in the case of undecked vessels, inboard petrol engines may be fitted, provided appropriate safety requirements are followed.

1.2 Flexibly mounted engines shall be fitted with short flexible connections of an appropriate type, fitted to associated piping and exhaust systems. Flexible shaft couplings shall be suitable for the power to be transmitted, taking into consideration arrangements to cater for thrust, and be of a type that would not create unacceptable torsional vibrations.

2. Outboard engine

Outboard engines shall be securely mounted on a substantial transom; a secondary means of securing the outboard engine to the transom shall be provided, such as a chain. Outboard engines with output of more than 15 kW shall be surrounded by an overboard drained well, large enough to allow the engine to be tilted entirely above the waterline in parked position. Undecked vessels shall have alternative means of propulsion such as oars, paddles or sails.

C. Shaft and propeller

1. The propeller shaft and any intermediate shaft, together with the stern tube, bearings and bushes, shall be properly constructed and operate efficiently. Shaft materials, diameter and eventual free span between bearings shall be suitable for the power being transmitted and according to the manufacturer's requirements. Inboard stern glands shall be accessible for adjustment.

2. As minimum requirement, the shaft diameter shall be:

$$d = k * \sqrt[3]{\frac{p}{r}}$$

Where:

d = shaft diameter in mm

p = maximum continuous rating in kW

r = propeller revolutions per second

k = 30 for carbon steel

= 23 for AISI 316

= 22 for AISI 431

= 21 for AISI 429

= 18 for CuNi K500

D. Engine starting

All propulsion engines, except those engines fitted with hand starting arrangements, shall be provided with a secondary means of starting.

E. Control and instruments

1. The controls shall be properly constructed and operate efficiently. The instrumentation system for the propulsion engine shall, where practicable, show the following parameters:

1) revolutions per minute (RPM);
2) cooling water temperature; and
3) lubricating oil pressure.

2. High water temperature and low lubricating oil pressure alarms shall be fitted, where practicable.

3. Propulsion engines fitted below deck in a machinery space and arranged for remote operation from the wheelhouse or helm position shall be provided with an arrangement on or adjacent to the engine to stop it.

F. Steering arrangement

1. The steering arrangements, including the rudder and associated fittings, shall be of adequate strength and capable of steering the vessel at maximum speed, and shall be so designed and constructed that they are not damaged at maximum astern speed or by manoeuvring during fishing operations.

2. Vessels shall be provided with an alternative means of steering which would operate if the main system fails; one of these alternative means may include a steering oar.

3. Steering gear

3.1 The steering gear shall be designed and installed to ensure safe manoeuvring of the vessel at maximum speed and engine power.

3.2 The steering gear shall be designed and installed so that it may not come into contact with fishing gear, equipment or other obstacles that may hinder the steering.

3.3 Where steering is by remote control, rudder stops shall be fitted.

3.4 Where fitted, a steering console or similar arrangement shall be built and secured to withstand the forces from the gear and the vessel's operator.

3.5 Penetrations in an outboard motor well, such as holes for steering cables, shall be effectively sealed by means of a sleeve or similar device.

3.6 A means of emergency steering shall be possible on all vessels, unless fitted with twin screws.

4. Rudder stock

4.1 If the rudder has a lower bearing point (heel pintle) with the same stiffness as the rudder stock, the diameter of the rudder stock shall not be less than that shown in the table below.

4.2 The diameter of the bolts in a rudder coupling shall not be less than that shown in the table below.

4.3 The stuffing box of the rudder stock housing shall have a height of at least 350 mm above the load waterline and be provided with packing material.

5. Rudder

5.1 Rudders of steel, aluminium and FRP shall have a stock from the rudder coupling down to the pintle (where fitted). In the case of rudders not fitted with a pintle, the diameter may be reduced linearly down from the rudder coupling.

5.2 Steel or aluminium rudders shall have at least two stiffeners across the rudder stock spaced a maximum 600 mm. The thickness of the stiffeners shall not be less than the thickness of the plate in the rudder.

5.3 Plate rudders shall have a thickness not less than that shown in the Table 9.1.

5.4 FRP rudders shall enclose steel stiffeners welded to the rudder stock with maximum spacing of 200 mm. The thickness of the steel reinforcements shall not be less than the thickness of the plate in a steel rudder.

5.5 Wooden rudders shall be made of hardwood and be attached to the rudder stock with steel forks welded to the rudder stock; these shall not be less than the thickness of the plate in a steel rudder.

5.6 Rudders of hardwood shall have a thickness not less than that shown in the Table 9.1

Table 9.1 Rudder stock and Rudder

CuNo	Stock diameter (mm)	Steel plate thickness (mm)	Aluminium plate thickness (mm)	Timber thickness (mm)	Bolt diameter (mm)
10	30	6	8	25	10
15	30	8	10	40	10
20	30	8	10	45	10
25	40	8	10	50	12
30	40	8	10	60	12
60	45	10	12	65	15
80	45	10	12	70	15
100	45	10	12	75	15

G. Pumping and piping systems

1. Fuel oil installations

1.1 Tanks for fuel oil shall be of sound and efficient construction and safe in operation and shall be located remote from heated surfaces and not be situated above hot surfaces and electrical equipment. Tanks and piping shall be arranged to minimize in the event of leakage or rupture the possibility that fuel would come into contact with hot surfaces or electrical components. All fuel tanks shall either be fitted with a level gauge or be able to be sounded manually. Glass contents gauges, where fitted, shall have self-closing valves at the base and be protected by metal rods or slotted covers. Fixed tanks shall be fitted with separate filling and air pipes. A closing valve shall be fitted on the fuel pipeline, as close as possible to the tank, and shall also be closable from outside the engine room. There shall be a drain valve as close as possible to the tank's lowest point.

1.2 Piping systems shall be of sound construction and suitable for the service intended. Flexible connections shall be of an appropriate armoured fire-resistant type, preferably with flange or threaded fastener fittings, and kept as short as practicable. If hose clamps are used, double clamps of an acid-resistant material shall be fitted at each coupling.

1.3 Petrol tanks shall not be integral with the hull structure. An efficient system shall be installed to ensure that petrol does not spill into the hull of the vessel when tanks are being filled. The tanks shall not be placed close to any sources of heat or close to electrical machinery that may cause sparking. Petrol filling systems shall be effectively bonded or earthed.

1.4 Portable petrol tanks for outboard motors shall be secured when in use and arranged in such a way that they can be taken ashore for filling.

2. Cooling water systems

2.1 The piping and fittings are to be of sound construction and efficient in operation; and the following requirements shall be met:

1) Cooling water inlets for main and auxiliary machinery shall be kept to a minimum, noting that, where practicable, there shall be one on either side of the hull, and shall comply with the requirements of sea inlets in Section 7.C.1;
2) Sea inlet trunks or boxes built into the hull structure shall be of such a design that they remain below the waterline at all normal conditions of trim and heel, and shall be fitted with arrangements for the purging of trapped air;
3) An accessible strainer shall be fitted after the sea inlet valve;
4) Where a common sea main supplying a number of services is installed, each branch pipe shall be fitted with an easily accessible isolating valve with open/ closed indication;
5) Where two sea inlets are fitted as recommended in .1) above, an interconnecting pipe shall be fitted between them; the connections shall be inboard of the strainers. The interconnecting pipe shall be fitted with a valve complying with the requirement for sea inlets as set out in Section 7.C.1; and

6) When modifications are made, particular care shall be taken in the selection and installation of appropriate materials, and to comply with the requirements in A.8, A.9 and G.6.1.

3. Bilge pumping systems

3.1 Decked vessels shall have an efficient bilge pumping arrangement fitted and, where practicable, each watertight compartment shall have a bilge suction fitted with a non-return valve and strainer.

3.2 In the event that it is not practicable to have suction pipes to all watertight compartments, BKI may allow means to drain such compartments to the bilge main in the engine room. Each compartment so drained shall be fitted with an easily accessible gate valve at the bulkhead of the compartments, to which a screwed cap can be fitted to the outlet side of the valve (the cap to be attached to the valve by a chain) or with a blank flange. However, draining of any other compartment directly through the fish-hold shall not be allowed.

3.3 Undecked vessels not fitted with a bilge system shall have means of manual bailing such as a bucket, bailer or hand-operated bilge pump.

4. Bilge pumps

4.1 All decked vessels shall be provided with hand bilge pump with minimum capacity of 70 litres/minute.

4.2 Where a deck wash pump is utilized for bilge suction purposes, means shall be provided to prevent flooding of any compartment from the sea inlet via the bilge main and to prevent bilge water from being pumped to deck.

4.3 Flexible connections and hoses, where fitted, shall be soundly constructed and operate efficiently, and shall be readily accessible.

4.4 Where watertight bulkheads are fitted, means shall be provided in the piping system to prevent any leakage via the system from one compartment to another and/or from the sea inlet to a compartment.

4.5 Where practicable, an audible and visible bilge level alarm shall be fitted to indicate leakage of water into the machinery space. Indication shall be at the wheelhouse or control position.

5. Exhaust systems

5.1 Engine exhaust systems of the dry or water-injected type, which discharge through the hull below the deck at the side or stern, shall be provided with means of preventing back-flooding into the hull or engine through the exhaust system. The means may be by system design, valve or non-return device. See Annex D for the recommended practice for exhaust systems.

5.2 The exhaust systems shall be of sound construction and hoses shall be of a suitable material, well-supported, free from defects, and not in contact with combustible materials.

6. Materials for valves and associated piping – seawater systems

6.1 Valves, pipes and fittings serving as sea inlets and discharges attached directly to the hull of the vessel below the loaded waterline shall be of cast steel, bronze or other equivalent, and compatible material. Care shall be taken not to use dissimilar metals when joints are required and particularly when lengths of pipe are replaced.

6.2 The sea inlet valve shall be as close as possible to the hull. Where the sea inlet valve or fitting is connected to the hull by means of a tube or distance piece, the tube or distance piece shall be of a material that is compatible with the hull and valve.

7. Hydraulic systems

7.1 The design and installation of hydraulic piping systems shall ensure the lowest possible risk of leakages, noise and pipe failure. This requirement necessitates as few bends in pipes as possible. To enable noise reduction, expansion pieces shall be fitted on supply lines.

H. Ventilation of the engine room

Where fitted, the separate engine room air intake shall be of a size capable of meeting the specifications of the engine manufacturer, but not less than 10 cm^2/kW. The engine room air intake shall be located on the opposite side of the vessel to the engine air intake. Ventilation ducts shall be provided with means of closing outside the engine room.

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Section 10 Electrical Installation

A. Main source of electrical supply

1. When electrical power constitutes the only means of maintaining auxiliary services essential for the propulsion and safety of the vessel, a main source of electrical power shall be provided.

2. Electricity generating and storage system(s) shall have sufficient capacity in normal operating conditions to ensure the correct operation of all safety and navigation equipment, including navigation and fishing lights.

B. Emergency source of electrical supply

1. If the vessel operates more than 20 nautical miles from a safe haven, it shall be equipped with an emergency accumulator battery bank capable of supplying the emergency lights, the radio communication equipment and the navigation lights for at least three hours.

2. The emergency battery shall receive constant, not selective, charging from an electrical generating system having sufficient capacity to reach the minimum requirements for radio transmissions within a period of 10 hours. The battery shall, where practicable, be located outside the machinery space above deck or as high as possible. It shall be so arranged as to ensure functionality in the event of fire or other causes of failure to the main electrical installations.

3. Where the main engine is arranged for electric starting from a battery and has neither a hand starting facility nor any other mechanical means of starting, such as a spring starter, a second battery bank for emergency starting shall be installed with a capacity of not less than that recommended by the engine manufacturer. The main general electrical services battery bank that supplies other consumers on board could be selected to start the main engine in an emergency provided that it would have sufficient power. If the latter option is selected, there shall be a battery bank dedicated to starting the main engine, a battery bank for supplying general electrical services, plus the emergency battery bank specified in 1.

C. Precautions against shock, fire and other hazards of electrical origin

1. The design and installation of electrical systems shall be such that the risk of fire and the risk of electrical shock to operating personnel are minimized.

2. All electrical cables shall be at least of a flame-retardant type and shall be so installed as not to impair their original flame-retarding properties. BKI may permit the use of special types of cables when

necessary for particular applications, such as radio frequency cables, which do not comply with the foregoing.

3. Except as permitted by BKI in exceptional circumstances, all metal sheaths and armour of cables shall be electrically continuous and shall be earthed.

4. Where the cables are not metal sheathed or armoured and there might be a risk of fire in case of an electrical fault, special precautions shall be taken to the satisfaction of BKI.

5. Cable installations shall be as follows:

5.1 When cables are being selected, particular attention shall be given to environmental factors such as temperature and contact with substances, e.g. polystyrene, that degrade PVC insulation.

5.2 Cables shall not be run below floor plate level or in bilges as the case may be, except where this is necessary for connections to underwater equipment, etc.; such cables shall be run through a protective pipe/shield or conduit.

5.3 Cables running through fish-holds shall be fitted in conduits. Cables shall not be secured directly to fuel or oil storage tanks.

5.4 Where cables are not run through conduits in machinery spaces, cable trays shall be fitted and the cables shall be secured to the trays with suitable clips.

5.5 To the extent practical, all cables from the main switchboard to distribution boxes elsewhere shall also be carried on cable trays and securely fastened with suitable clips.

D. Electrical systems

1. Particular attention shall be given to protection against water ingress and the effects of vibration.

2. All circuits shall be clearly identified on switchboards and distribution boards, including service, protective device rating, current-carrying capacity and voltage values, to the satisfaction of BKI. Differing voltages shall not be included in any one of the distribution boards unless BKI is satisfied that the approved arrangement does not pose a risk to operating or maintenance personnel.

3. All circuits for consumers larger than 5A, except the main supply from the battery to the starter motor and motors for steering-gear systems, shall be fitted with fuses or circuit-breakers to provide protection against overload and short circuit.

4. Piping conveying liquid shall not be fitted above or close to switchboards or other electrical equipment. Where such arrangements are unavoidable, provision shall be made to prevent leakage from damaging the equipment.

5. Taking into consideration the design of the system and the working voltage, BKI may require the installation of a system of earth indicator lamps or means of detecting current leakage.

6. Batteries shall be fitted in enclosed boxes or trays with covers, provided with sufficient ventilation to avoid the risk of explosion and be remote from sources of ignition. Battery boxes shall be sited clear of heat sources and where they are least likely to be flooded. If batteries are sited in accommodation spaces, the boxes shall be sealed from the accommodation and ventilated to open air.

7. Each battery or bank of batteries shall have a spark-proof isolating switch. Systems such as automatic bilge pump or alarm systems shall be connected before the cut-off switch, thus ensuring that such systems will also operate when the vessel is unattended.

8. A means of checking the charge of the battery shall be available.

9. Batteries positioned in the engine compartment shall be so arranged as not to short circuit when the compartment is flooded to the loaded waterline. The batteries shall be securely fastened to avoid movement due to the motion of the vessel.

10. Battery installations of more than 5 kWh, equivalent to 208 Ah at 24 V and 416 Ah at 12 V, shall be placed in a separate compartment with ventilation to open air. The arrangement shall be such that the air circulation is not blocked.

11. Where the main and/or auxiliary engines are fitted with electric motor starters, the batteries connected to the system for starting shall be separate from the batteries used for other services. The starter batteries shall be capable of starting the engine at least six times without recharging.

12. DC systems

12.1 Direct current installations shall be wired as insulated return systems. The hull shall not be used to carry current.

12.2 BKI may approve the following direct current generating and distribution systems, providing these are suitable for the intended purpose:

12 V

24 V

32 V

110 V

12.3 Where suitable earthing systems are fitted, the single-wire system shall be used.

13. AC systems

13.1 BKI may approve alternating current systems of over 220 V, providing that these are suitable for the intended purpose.

13.2 Cables for AC systems shall be kept separate from DC systems and run in separate trays and conduits, unless approved by BKI.

13.3 Switchgear for AC systems shall be fitted in switchboards and panels that are separate from those containing DC systems, unless approved by BKI. Systems and equipment shall be clearly marked.

13.4 Switchgear and sockets shall be so arranged as to prevent the fitting of low voltage equipment and lamps into high-voltage systems.

E. Earthing and bonding

1. A continuous ground conductor shall be installed to facilitate the grounding of non-conducting exposed metal parts of electronic and communication equipment that are required to be earthed. The conductor shall terminate at a point on the main engine or at a copper plate of area not less than 0.2 m^2 fixed to the keel below the light waterline so as to be fully immersed under all conditions of heel. Inside the hull, the earth plate shall be connected to a copper bar or rod of at least 64 mm^2, the length being appropriate to the number of bonding points.

2. Every earthing conductor shall be of copper or other corrosion-resistant material of low electrical resistance and shall be securely installed and protected, where necessary, against damage and against electrolytic corrosion.

3. Exposed permanently-fixed metal parts of electrical machines or equipment that are not intended to be "live", but that are liable under fault conditions to become "live", shall be earthed unless:

3.1 They are supplied at a voltage not exceeding 55 volts direct current or 55 volts, root mean square, between conductors; auto-transformers shall not be used for the purpose of achieving this alternative current voltage; or

3.2 They are supplied at a voltage not exceeding 250 volts by safety isolating transformers supplying one consuming device only; or

3.3 They are constructed taking into account the principle of double insulation.

4. Lightning conductors shall be attached directly to the earth plate.

5. Radar, radio and other navigational equipment that are required to be earthed shall have a separate earthing point and the connection shall be as short as possible.

6. Where a flexible non-conducting coupling is fitted between the engine and the propeller shafting, the coupling shall be bridged by a piece of braided copper conductor.

F. Lighting systems

1. Lighting of normally unattended spaces such as fish rooms and net stores shall be controlled from outside the space.

2. Emergency lighting shall be supplied from an accumulator battery. Such emergency lighting shall be placed at stairways and exits, in machinery spaces, and at control stations. An emergency source of power shall be made available for a signalling lamp if carried.

G. Electric motors

1. Every electric motor shall be provided with a means of starting and stopping, so located as to be easily operated by the person controlling the motor.

2. The circuit supplying the motor shall be fitted with short-circuit and overload protection. In the case of motors in a steering-gear system that are not required to be so protected, an overload alarm shall be provided at the wheelhouse. However, protection against excess current, if provided, shall be set at not less than twice the full load current of the motor or circuit and shall be arranged to cater for the appropriate starting current without tripping.

3. Fans and pumps driven by electric motors are to be fitted with a remote control. The remote control shall be positioned outside the machinery space concerned, for stopping the motors in the event of a fire in the space in which they are located.

H. Lightning conductors

1. Lightning conductors shall be fitted on wooden masts. They shall be of continuous copper tape or copper rope having a cross-section of not less than 75 mm^2 and secured to a copper spike of 12 mm diameter projecting at least 150 mm beyond the top of the mast.

2. The lower end of the conductor is to be attached to the earth plate. All sharp bends must be avoided and only bolted or riveted joints shall be used.

I. Equivalency

Electrical installations that do not comply with the requirements of this Section may be accepted, provided that they are unavoidable, that there are justifiable reasons precluding compliance and that the electrical installations are deemed by BKI to be equivalent to the requirements specified in this Section.

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Section 11 Fire Safety and Life Saving Appliances

A. Structure

1. Fire-retardant materials shall be used in any part of the vessel where the risk of fire is increased due to proximity of heat sources (e.g. intumescing paint, fire retarding resin on interior surface of FRP laminates in engine space).

2. Manholes or other openings to fuel oil tanks shall not be positioned in the accommodation.

3. Openings for ventilation of the engine space shall be equipped with closing appliances readily operable from the outside of the engine space.

4. Tank spaces separated from engine spaces need not follow the requirements in 1., but shall be ventilated to the outside of the vessel.

B. Fire fighting appliances

1. The vessels shall be provided with fire extinguisher(s) of a type and size approved by BKI. Such extinguishers shall be sited near the machinery space. The minimum requirements are to be according to Table 11.1.

Table 11.1 Minimum requirement of fire fighting appliances

Type of vessel	Undecked		Decked	
Propulsion	Outboard	Inboard	Outboard	Inboard
Fire extinguisher	0	1 [a)]	1	2
Fire bucket	1 [b)]	1 [b)]	1 [b)]	1 [c)]

a) BKI may, after consultation with fishermen's representatives and owners' representatives, exempt the vessels from this requirement.
b) Not required where two or more extinguishers are carried.
c) Not required where three or more extinguishers are carried.

2. Fire fighting appliances shall be maintained in the manner as specified by the manufacturer and to the satisfaction of BKI.

3. Type of fire fighting appliances for machinery spaces

3.1 Where appropriate, a sufficient number of automatic dispersion-type fire extinguishers or fire extinguishers deemed appropriate by BKI shall be placed in the machinery spaces, taking into account the volume of the space and arrangement of the machinery.

3.2 When the automatic dispersion-type fire extinguishers or extinguishing equipment are provided in accordance with 3.1, one of the extinguishers required for decked vessel with inboard engine may be dispensed.

C. Miscellaneous items

1. BKI shall ensure that materials used as deck coverings and for fittings do not have low spontaneous combustion temperatures or have explosive qualities when exposed to abnormal heat sources. This requirement would not exclude the use of wood, FRP or other similar materials.

2. All reasonable measures shall be taken to minimize the emission of harmful vapours in the event of fire.

3. In the event of a fire in a space containing machinery, it shall be possible to stop the machinery from a location outside the machinery space.

D. Life saving appliances

1. Life jacket and safety personal flotation device

1.1 A lifejacket of an approved type or a personal flotation device accepted by BKI shall be carried for every person on board.

1.2 Lifejackets shall comply with the provisions of BKI recommendations for testing lifejackets.

1.3 BKI shall determine whether lifejackets or personal flotation devices or a combination of both shall be carried on board.

2. Life buoy

2.1 Decked vessels of 7 m or more in LOA shall be provided with at least one lifebuoy which shall be attached to a buoyant line of not less than 18 m in length.

2.2 All lifebuoys shall be so placed as to be readily accessible, shall always be capable of being rapidly deployed and shall not be permanently secured in any way.

3. Distress signals

3.1 Every vessel shall be provided with means of making effective distress signals by day and by night. For this purpose, two handheld flares shall be carried on board.

3.2 Distress signals shall be of an approved type. They shall be correctly stored in a dry place and be so placed as to be readily accessible, and their position shall be clearly indicated.

4. Miscellaneous

4.1 The following additional safety equipment shall be carried on all vessels:

- A whistle;
- a mirror; and
- a torch

4.2 Handrails or similar means, e.g. a capsize rope, shall be fitted to the vessel to allow persons to hold on to the vessel in the event of a capsize. The rope shall be 1.5

times the length of the vessel and fitted with a snap shackle, or equivalent, at each end, with attachment at each end of the vessel on deck.

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Section 12 Protection of the Crew

A. General Protective Measure

1. The surfaces of decks and of flooring in working spaces on board, such as machinery spaces, galleys, fish-handling and deck equipment operating areas, and deck areas at the foot and head of ladders shall be designed and treated to minimize the possibility of personnel slipping.

2. A means shall be provided on every vessel to allow a person to climb on board from the water. On single-handed vessels, the means of reboarding shall be accessible by a person in the water.

3. Decks shall have a toe-rail of minimum 25 mm height at the outboard edge or gunwale.

B. Deck Openings and Doors

1. Hinged and sliding covers of hatchways, manholes, doors and other openings shall be prevented from swinging or accidental closure.

2. In general, external hatches and doors shall be closed when the vessel is at sea. All openings occasionally required to be kept open during fishing and which may lead to flooding shall be closed immediately if such danger of filling occurs, with subsequent loss of buoyancy and stability.

C. Bulwarks, Rails and Guards

1. On decked vessels, efficient bulwarks or guard rails shall be fitted to all exposed parts of the working deck and on superstructures and deck erections. Part of the railing may be dismountable. Where a fixed bulwark is less than 750 mm, guardrails shall be fitted up to 750 mm, but where this would interfere with the fishing operations of the vessel, alternative arrangements may be accepted.

2. On undecked vessels, the height of the gunwales shall be sufficient to minimize the risk of persons falling overboard.

3. The distance between vertical stanchions of railing shall normally not be more than 1500 mm. The vertical distance between bars in rails shall normally not exceed 230 mm from deck level and 250 mm elsewhere. Rails and bulwarks shall be free from sharp edges and corners and shall be of adequate strength.

4. Satisfactory means in the form of guard rails or lifelines shall be provided for the protection of the crew in getting to and from their quarters, machinery spaces and other working spaces. Storm rails shall be fitted on the outside of all deckhouses and casings.

5. Where equipment is normally incorporated in the structure of a bulwark or rail within the minimum height prescribed for the bulwark, or mounted between stanchions of a guard rail, provision shall be made to protect the area when the equipment is not in place.

5. Where part of a bulwark or guard rail has to be removed for the purpose of the fishing operation, protection for the crew shall be provided at the opening.

D. Deck Machinery, Tackle and Lifting Gear

1. All powered winches and hauling equipment for fishing gear shall be fitted with emergency stop safety devices. The emergency stop shall be provided at the winch and at other appropriate places in the deck area, as well as in the wheelhouse. Special attention shall be given in the case of deck machinery that is belt driven from a power source below deck level.

2. Controls of winches, line and net hauling equipment shall be so placed that winch operators have ample room for their unimpeded operation and have as unobstructed a view as possible of the working area. Control handles shall be provided, where necessary, with a suitable locking device in the stop/neutral position to prevent accidental movements or displacement or unauthorized use.

3. Moving parts of machinery, winches, line and net haulers shall be adequately guarded.

E. Lighting in Working Spaces and Areas

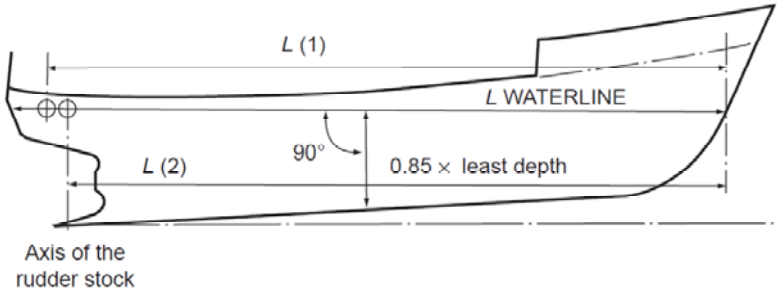
1. All passageways, working spaces and working areas on board the vessel shall be well-lit. The quality and intensity of the lighting shall be sufficient to ensure that work can be carried out with full regard to health and safety.

2. Fish-holds shall be provided with lighting ensuring adequate lighting in all conditions, both for orientation and during work in the hold.

3. The lighting shall not interfere with the keeping of a proper lookout.

Annex A Illustration of terms used in the definitions

A. Illustration



L (1) is 0.96 OF THE TOTAL LENGTH ON A WATERLINE AT 85 PERCENT OF LEAST DEPTH

L (2) is LENGTH ON A WATERLINE AT 85 PERCENT OF LEAST DEPTH BETWEEN THE STEM AND THE AXIS OF THE RUDDER STOCK

Fig A.1 Length (L)

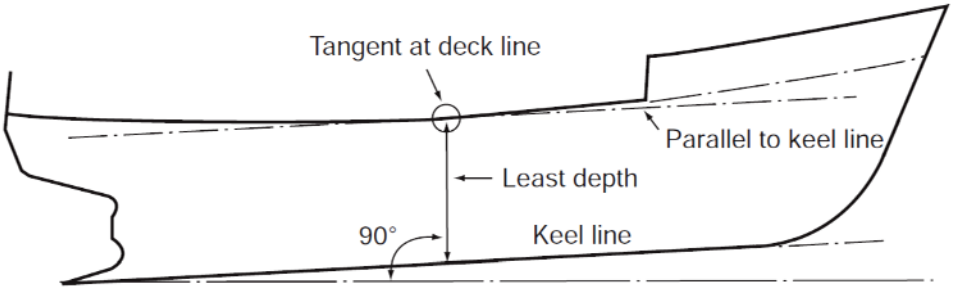


Fig A.2 Least depth

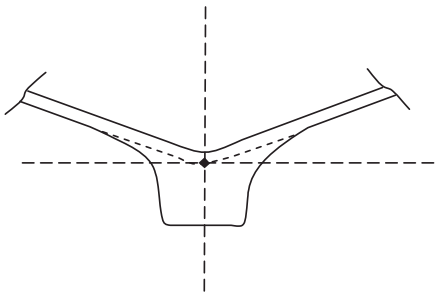


Fig A.3 Keel line

Annex A Illustration of terms used in the definitions A

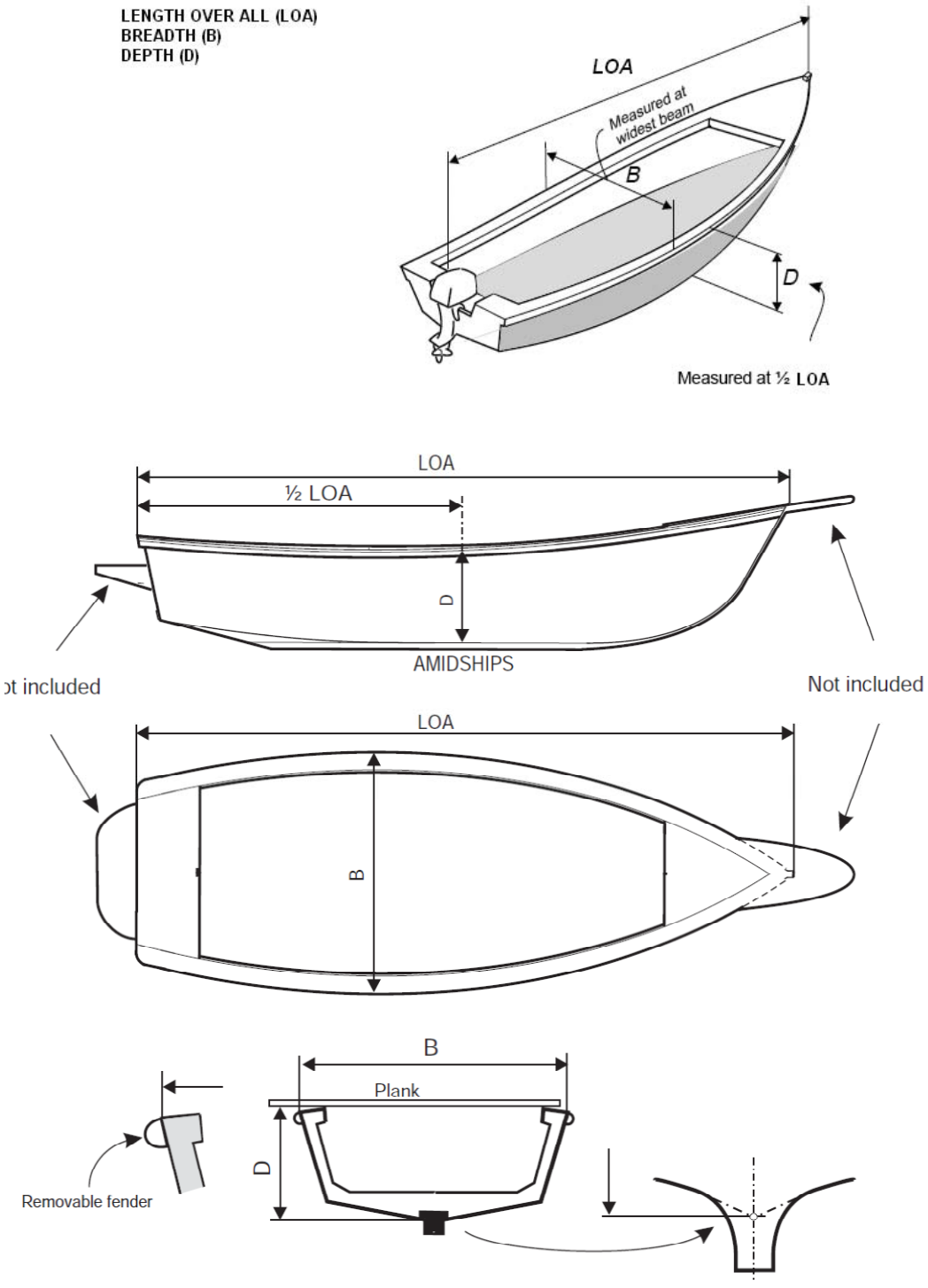


Fig A.4 Undecked vessel measurements

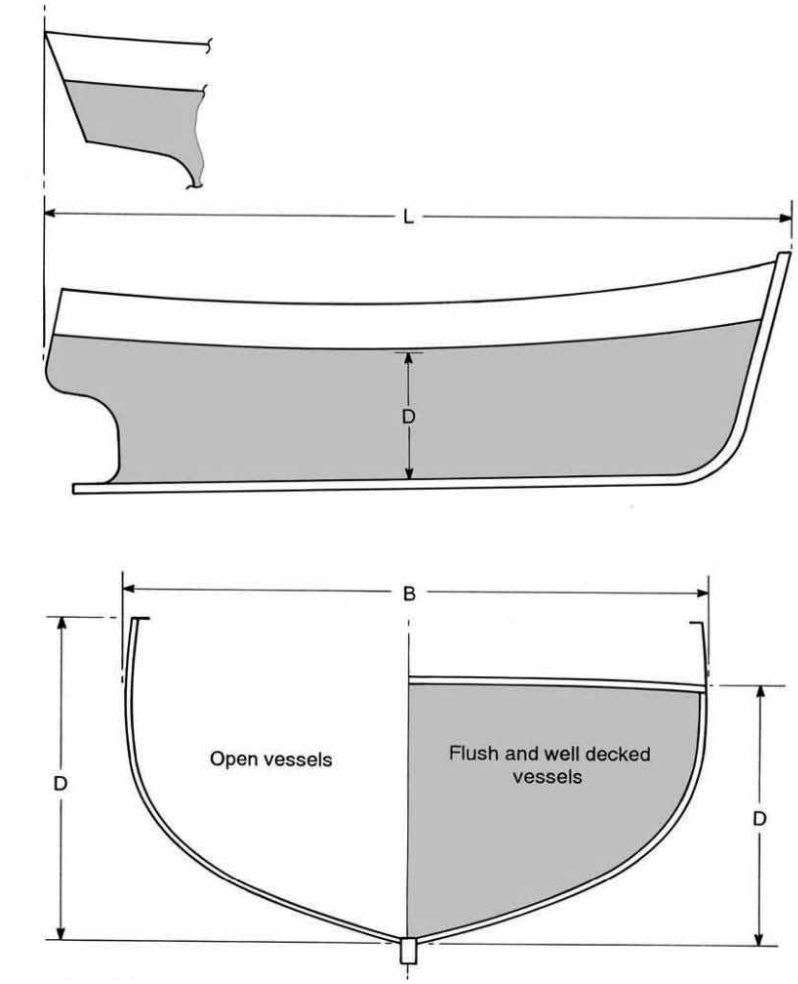


Fig A.5 Cubic numeral

Annex A Illustration of terms used in the definitions

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Annex B An approximate determination of stability by means of a rolling period test

A. General

1. As a supplement to the approved stability information, the initial stability can be approximately determined by means of a rolling period test.

2. Vessels with a high initial stability are “stiff” and have a short rolling period. In contrast, vessels with a low initial stability are “tender” and have a long rolling period.

3. The following guidance describes a rolling period test which can be performed at any time by the crew of a small vessel.

B. Test procedure

1. The test should be conducted in smooth water with the mooring lines slack and the vessel “breasted off” to avoid making any contact during the rolling test. Care should be taken to ensure that there is a reasonable clearance of water under the keel and the sides of the vessel.

2. The vessel is made to roll. This can, for example, be done by the crew running together from one side of the vessel to the other. As soon as this forced rolling has commenced, the crew should stop and place themselves amidships and the vessel should be allowed to roll freely and naturally.

3. The timing and counting of the oscillations should only begin when it is judged that the vessel is rolling freely and naturally and only as much as it is necessary to accurately time and count these oscillations (approximately 2°–6° to each side).

4. With the vessel at the extreme end of the roll to one side (say port) and the vessel about to move toward the upright, one complete oscillation will have been made when the vessel has moved right across to the other extreme side (i.e. starboard) and returned to the original starting point and is about to commence the next roll.

5. By means of a chronometer, the time should be taken for not less than four of the complete oscillations. The counting of these oscillations should begin when the vessel is at the extreme end of a roll.

6. After allowing the roll to completely fade away, this operation should be repeated at least twice more. When the total time for the total number of oscillations is known, the time for one complete oscillation, say T seconds, can be calculated.

C. Determination of whether the initial stability is sufficient

1. If the calculated value of T, in seconds, is less than the breadth of the vessel, in m, it is likely that the initial stability will be sufficient, provided that the vessel carries full fuel, stores, ice, fishing gear, etc., when the test is made.

2. The rolling period (T) usually increases and the vessel becomes tenderer as the weight of fuel, stores, ice, fishing gear, etc., decreases. As a consequence, the initial stability will also decrease. If the rolling period test is conducted under such circumstances, it is recommended that, for the estimate of the initial stability to be considered satisfactory, the calculated value of T, in seconds, should not be more than 1.2 times the breath of the vessel, in metres.

D. Limitations to the use of this method

This method may not be applicable to vessels with a hull shape that dampens the rolling; for example, vessels with large bilge keels or vessels of an unconventional design, such as high-speed vessels.

Annex C Recommended Practice for Exhaust Systems

A. General

1. All materials used in exhaust systems should be corrosion-resistant and metal parts should not be used in combination in such a way that corrosion will occur.

2. Exhaust pipes should be securely mounted so that mechanical wear and vibration are avoided, and such that there is no weight on the engine manifold.

3. Exhaust pipes may require flexible connections (bellows) where engines are prone to vibration or where engines are flexibly mounted.

4. Exhaust outlets that discharge through the hull below the deck should be provided with means of preventing back flooding into the hull or engine. Back flooding may be prevented by the system design described below or by a flap, a valve or a nonreturn device.

5. Exhaust pipes and silencers of every engine should be adequately cooled or lagged to protect the persons on board the vessel.

6. Oil and fuel pipes should be kept as clear as practicable from exhaust pipes and turbochargers.

7. Where multiple engines are installed, each engine should have a separate exhaust system.

B. Dry exhaust systems

1. The exhaust system and piping should be leak-proof to prevent the passage of toxic fumes into accommodation spaces.

2. There should be at least a 100 mm clearance between piping and FRP materials.

3. The diameter of exhaust pipes should be sized in accordance with the engine manufacturer's recommendations or should be at least the same size as the engine manifold.

4. Typical installation sketches and notes are given in Fig. C.1.

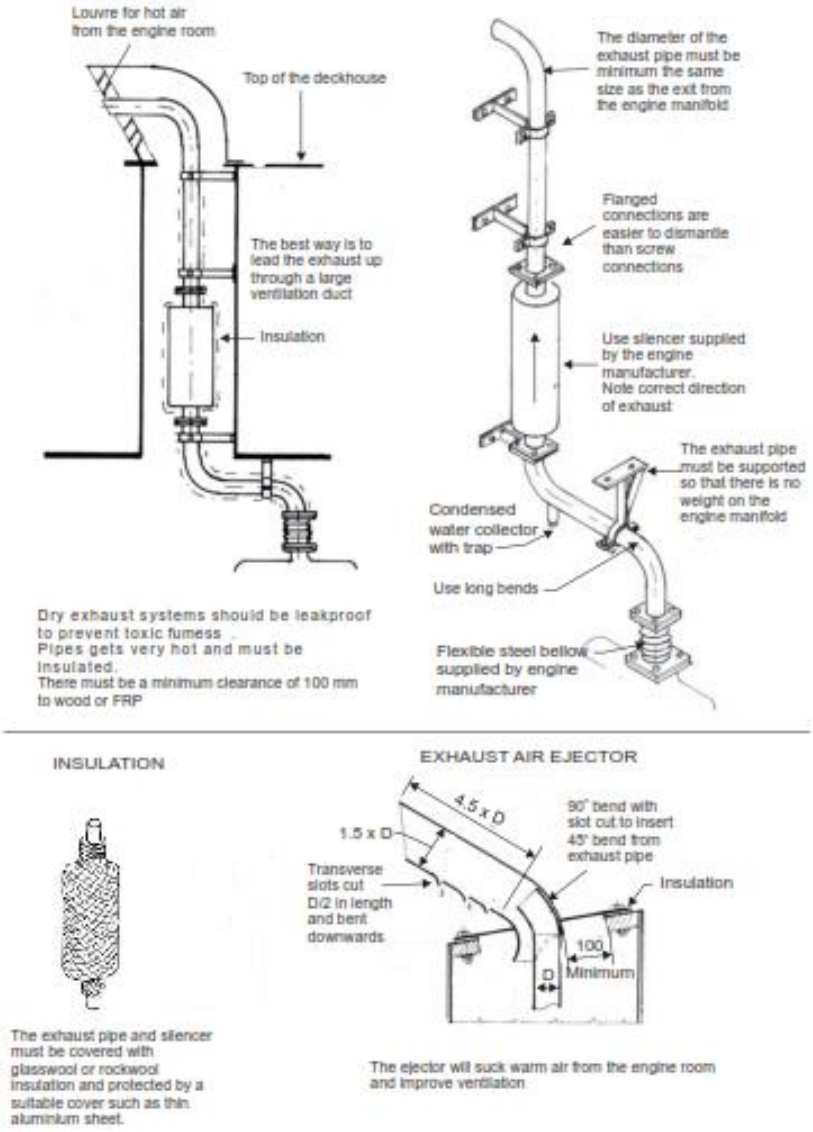


Fig. C.1 Dry exhaust systems

C. Water-injected (wet) exhaust systems

1. The most important factor in the design and installation of wet exhaust systems is the prevention of entry of water into the engine. Prevention may be achieved by the installation of a waterlock chamber in the exhaust line and by the correct positioning of components in relation to the load waterline.

2. The diameter of exhaust pipes should be sized in accordance with the engine manufacturer's recommendations.

3. There are two main types of wet exhaust systems: those with the engine manifold above the load waterline and those with the engine manifold below the load waterline. Typical installation sketches and notes for these types are given in Figs. D.2 to D.4.

4. Exhaust pipes should always be drawn up so that a part is at least 350 mm above the load waterline with a slope downwards to the outlet.

5. Exhaust outlets should be at least 100 mm above the load waterline or connected to a fixed pipeline which is drawn up to at least 100 mm above the load waterline.

6. The volume of the waterlock chamber should be sufficient to hold all the water in the pipes on either side of it; this will ensure that water does not fill up the waterlock and re-enter the engine.

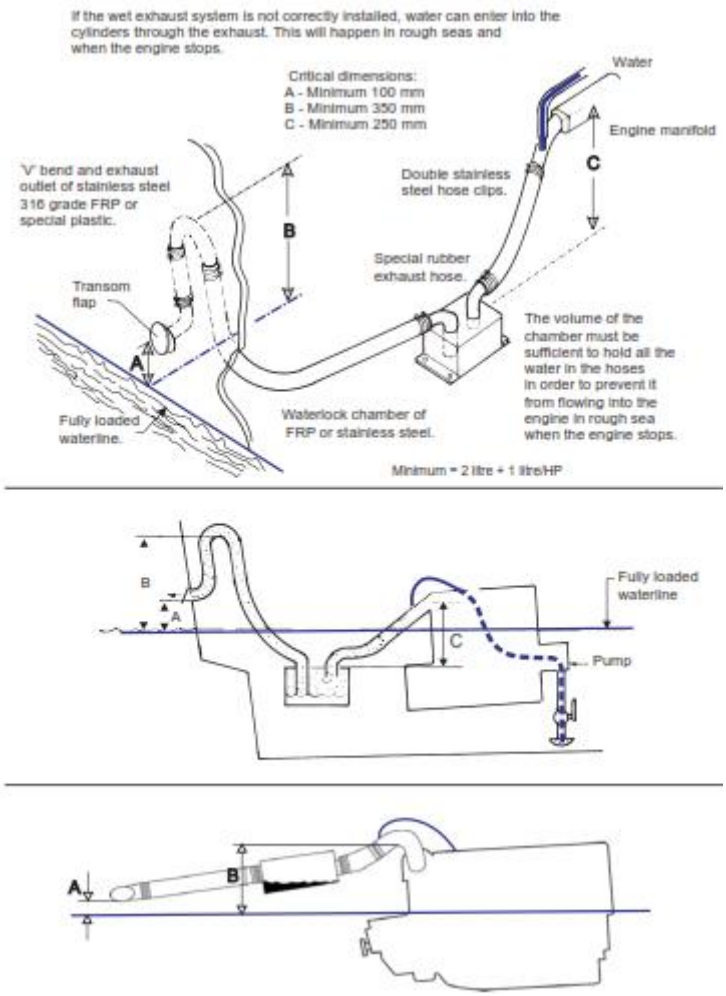


Fig. C.2 Wet exhaust system-engine manifold above loaded waterline

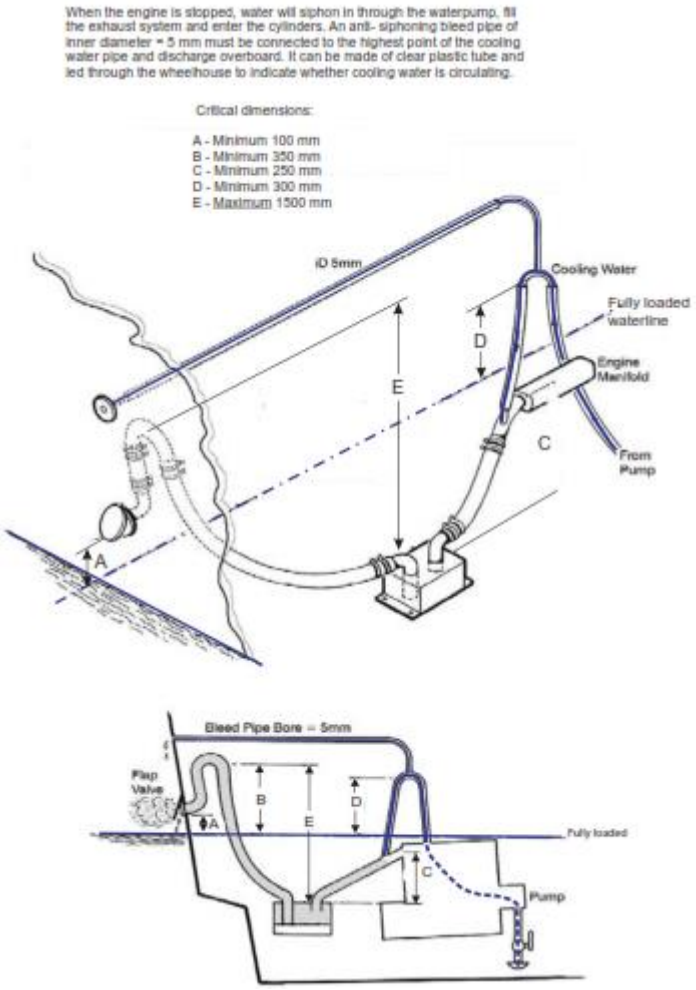
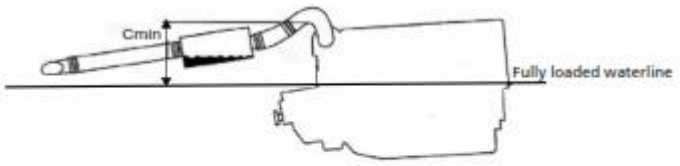


Fig. C.3 Wet exhaust system-engine manifold below loaded waterline



An in-line system is not recommended when height (Cmin) exhaust-elbow waterline is less than 350 mm.

Fig. C.4 Wet exhaust system